

Document

## Energy Strategy Report

Project

### Highgate Newtown Residential and Community Centre Redevelopment

Client

### London Borough of Camden

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| D5          | P1       | 30-10-2018   | Draft for comment                                   |                |
| D5          | P2       | 09-11-2018   | With updated calculations                           |                |
| D5          | P3       | 29-01-2019   | Update for revised scheme                           |                |
| D5          | P4       | 14-02-2020   | Updated to revised mechanical system including ASHP |                |
| D5          | P5       | 27-02-2020   | Updated to incorporate PM comments                  |                |

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## APPROVALS

This document requires the following approvals:

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|---------------|----------|
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## 1.0 EXECUTIVE SUMMARY

This Energy Strategy has been prepared by McBains Ltd for the revised scheme at Highgate Newtown Community Centre in support of the Section 73 Application. The scheme comprises 39 new private dwellings, 2 houses within the refurbished Gospel Hall, and a new community centre. This document supersedes the previous Energy Strategy Report P3 (January 2019).

The Energy Assessment has been updated to incorporate the re-design of the mechanical system which consists in a centralised heat pump system providing heating and domestic hot water to the entire development. This new design solution is being proposed in the form of ASHP, in place of the original CHP system. This was a requirement from the London Borough of Camden to allow for the use of a low carbon technology reducing the carbon footprint of the development and to be in line with the Draft New London Plan (that should be published in March 2020).

In support to incorporating the low carbon technologies, Camden's Sustainability department has confirmed that the assessment should be carried out using SAP 10 carbon factors, in line with the new draft London Plan.

This report has been prepared as part of a series of documents to support the application, in conjunction with which it should be read, and addresses requirements related to energy use and carbon dioxide emissions reduction in accordance with local and national policy. The main policy and guidance context of the responses includes:

- London Borough of Camden - Local Plan (July 2017)
- The London Plan - Minor Alterations to the London Plan (MALP) (March 2016)
- Draft New London Plan (March 2020)

The reduction in regulated carbon dioxide emissions of the proposed site-wide scheme has been estimated as 42% under SAP 10 across the residential and commercial elements from a Part L 2013 compliant baseline by maximising the contribution at each step of the energy hierarchy. This is split down as table 1 below. Having minimised energy demand, a centralised ASHP and a PV array of 24.8 kWp is proposed.

This document sets out how the expected energy demands of the proposed development have been analysed and forms the site-wide energy strategy in accordance with the London Plan's Energy Hierarchy. A summary of key outcomes is provided below:

**Be Lean:** Energy demand has been minimised through a highly efficient building envelope and systems in terms of U-values and air-tightness, inverter driven pumps, reduced thermal bridges, the inclusion of high efficiency lighting throughout coupled with PIR sensors, occupancy detectors and dimmers. High efficiency heat recovery in the mechanical ventilation system will also be specified. The challenging Target Fabric Energy Efficiency criterion introduced in Part L1A 2013 is complied with across the residential elements of the development.

The overall contribution of lean measures across the site is a 4% savings in carbon dioxide emissions.

The proposed energy efficiency measures to deliver the above performance are summarised below:

- Construction of highly insulated fabric and low air tightness.
- Heat recovery on MVHR (with summer bypass)
- Provision of lamps/luminaires with high efficacy and efficient lighting controls.
- Provision of efficient air source heat pumps (ASHP) systems in non-residential areas
- Provision of PV panels on available roof space.

**Be Clean:** The new proposed design solution does not include a connection to a District Heating Network nor the installation of an on-site CHP system, and so no carbon reduction is available in this part of the Energy Hierarchy.

**Be Green:** To further reduce the carbon dioxide emissions of the proposed development, an assessment of potential low and zero carbon technologies has been undertaken. The new proposal would be to use an ASHP providing heating and domestic hot water, as well as installing a PV array (24.8kWp) to contribute towards the electrical load of the development.

The overall contribution of green measures across the site is a further 38% reduction in carbon dioxide emissions.

The development is expected to achieve regulated CO<sub>2</sub> reductions of an estimated 42% compared under SAP 10 as shown below.

**Table 1:** Site-wide CO<sub>2</sub> Emissions after each stage of the Energy Hierarchy:

| Carbon dioxide emissions from proposed measures (tonnes CO <sub>2</sub> /annum) | Regulated | Unregulated |
|---------------------------------------------------------------------------------|-----------|-------------|
| Baseline: Part L 2013 compliance                                                | 60        | 34          |
| After Be Lean measures                                                          | 58        | 34          |
| After Be Clean measures                                                         | 58        | 34          |
| After Be Green measures                                                         | 35        | 34          |

**Table 2:** Combined Regulated CO<sub>2</sub> savings from each stage of the Energy Hierarchy

| Regulated carbon dioxide emissions savings from proposed measures | (tnCO <sub>2</sub> /annum) | (%) |
|-------------------------------------------------------------------|----------------------------|-----|
| Savings from Be Lean measures                                     | 2                          | 4%  |
| Savings from Be Clean measures                                    | 0                          | 0%  |
| Savings from Be Green measures                                    | 23                         | 38% |
| Cumulative on-site savings                                        | 25                         | 42% |

**Table 3:** Buildings A-D - Residential CO<sub>2</sub> Emissions after each stage of the Energy Hierarchy

| Carbon dioxide emissions from proposed measures (tonnes CO <sub>2</sub> /annum) | Regulated | Unregulated |
|---------------------------------------------------------------------------------|-----------|-------------|
| Baseline: Part L 2013 compliance                                                | 40        | 23          |
| After Be Lean measures                                                          | 38        | 23          |
| After Be Clean measures                                                         | 38        | 23          |
| After Be Green measures                                                         | 22        | 23          |

**Table 4:** Buildings A-D - Residential Regulated CO<sub>2</sub> savings from each stage of the Energy Hierarchy

| Regulated carbon dioxide emissions savings from proposed measures | (tnCO <sub>2</sub> /annum) | (%) |
|-------------------------------------------------------------------|----------------------------|-----|
| Savings from Be Lean measures                                     | 2                          | 6%  |
| Savings from Be Clean measures                                    | 0                          | 0%  |
| Savings from Be Green measures                                    | 15                         | 39% |
| Cumulative on-site savings                                        | 18                         | 45% |

**Table 5:** Building B - Commercial Spaces CO<sub>2</sub> Emissions after each stage of the Energy Hierarchy

| Carbon dioxide emissions from proposed measures (tonnes CO <sub>2</sub> /annum) | Regulated | Unregulated |
|---------------------------------------------------------------------------------|-----------|-------------|
| Baseline: Part L 2013 compliance                                                | 20        | 11          |
| After Be Lean measures                                                          | 20        | 11          |
| After Be Clean measures                                                         | 20        | 11          |
| After Be Green measures                                                         | 13        | 11          |

**Table 6:** Building B - Commercial Spaces Regulated CO<sub>2</sub> savings from each stage of the Energy Hierarchy

| Regulated carbon dioxide emissions savings from proposed measures | (tnCO <sub>2</sub> /annum) | (%) |
|-------------------------------------------------------------------|----------------------------|-----|
| Savings from Be Lean measures                                     | 0                          | 0%  |
| Savings from Be Clean measures                                    | 0                          | 0%  |
| Savings from Be Green measures                                    | 7                          | 36% |
| Cumulative on-site savings                                        | 7                          | 37% |

The residential apartments are expected to achieve regulated CO<sub>2</sub> reductions of an estimated 45% compared using the SAP 10 carbon factors. To achieve the “zero - carbon homes” objective, the amount of CO<sub>2</sub> in that needs to be offset is 22 tonnes per year.

The above tables exclude the savings to the residential refurb (Gospel Hall).

In the Gospel Hall refurbished property, by improving U Values to walls and windows and installing high efficiency boilers provides a reduction in CO<sub>2</sub> emissions of 34.8% is achieved against its current emissions.

### **1.1 Carbon Off Set Payment Residential Buildings A-D**

The overall predicted reduction in CO<sub>2</sub> emissions from the Baseline development model (which is Part L 2013 compliant) for Buildings A-D is approximately 45% which represents an annual saving of approximately 18 tonnes of CO<sub>2</sub>. To enable the domestic elements to meet their zero carbon reduction targets a one off carbon offset payment of approximately £39,670 will be required in line with the London Plan Policy. This figure is based on a shortfall of approximately 22 tonnes CO<sub>2</sub> per year for a period of 30 years at a rate of £60 / tonne of CO<sub>2</sub>.

These calculations are based on SAP 10 carbon factor values.



## 2.0 INTRODUCTION

The Proposed Development is situated in the London Borough of Camden and it consists in the redevelopment of the Highgate Newtown Community Centre, 25 Bertram Street, London, N19 5DQ. The site is located off Bertram Street and Winscombe Street in a predominantly residential area of Highgate, with the nearest London Underground stations being Archway (1km to the north-east) and Tufnell Park (1km to the south-east). It is currently occupied by Highgate Newtown Community Centre (HNCC) and Fresh Youth Academy, was identified through Camden Council's Community Investment Programme as being in significant need for investment.

The proposals are for the comprehensive redevelopment of the site to provide new a community centre and associated facilities for both the HNCC and FYA and the provision of 39 residential units. The site location is shown in the figure below.





### 3.0 POLICY REQUIREMENT

The Proposed Development in Old Kent Road has addressed relevant policies and regulations at national, regional and local level as part of this Energy Statement. The relevant policies to this scheme in terms of energy strategy are summarised below:

#### National level

|                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p><b>Building Regulations Part L</b></p> <p>To meet the requirements of the Energy Performance of Buildings Directive 2002/91/EC and 2010/31/EU of the European Parliament and Council on energy efficiency of buildings, the UK government introduced Approved Document L1A (ADL1A) in residential dwellings and Approved Document L2A (ADL2A) in non-domestic buildings.</p> <p>The implementation of Part L1 2013 in April 2014 required meeting the minimum target fabric energy efficiency (TFEE) and targeting emission rates (TER). The implementation of Part L2 2013 in April 2014 required meeting the minimum target emission rates (TER). The documents set minimum standards for the building fabric thermal performance that must be met to minimise energy demand, among other criteria such as limit on solar gain.</p> |
|  | <p><b>National Planning Policy Framework</b></p> <p>The National Planning Policy Framework (NPPF) was introduced in 2012 and has superseded all Planning Policy Statements (PPS) and Planning Policy Guidance (PPG) documents, with the exception of PPS10 (Waste). The NPPF sets out the Government's strategy on the delivery of sustainable development through the planning system in a more simplified approach.</p>                                                                                                                                                                                                                                                                                                                                                                                                                |

### Regional and Local levels

The local policies reviewed include the following

- London Plan - (March 2016)
- New Draft London Plan (it should be published in March 2020)
- GLA Revised Sustainable Design & Construction SPG (April 2014)
- GLA guidance on preparing energy assessments (April 2015)
- London Borough of Camden - Camden Local Plan (2017)

### **The London Plan (March 2016)**

The London Plan sets out the overall strategic plan for London's development, providing an integrated economic, environmental, transport and social framework for the development of London over the next 20-25 years. The London Plan sets the strategic planning structure for all major developments in London. Some energy related key policies stated in the plan are summarised below.



### **Policy 5.2 Minimising carbon dioxide emissions:**

5.2A - Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

- Be lean: use less energy
- Be clean: supply energy efficiently
- Be green: use renewable energy

5.2B - The Mayor will work with boroughs and developers to ensure that major developments meet required CO<sub>2</sub> reduction of 35% against building regulations 2013 target emission rate.

5.2C - Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.

5.6C - Potential opportunities to meet the priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

### **Policy 5.7 Renewable energy:**

5.7B - Within the framework of the energy hierarchy, major development proposals should provide a reduction in expected carbon dioxide emissions using on-site renewable energy generation, where feasible.

### **Policy 5.9 Overheating and cooling:**

5.9B - Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

- minimise internal heat generation through energy efficient design
- reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
- manage the heat within the building through exposed internal thermal mass and high ceilings
- passive ventilation

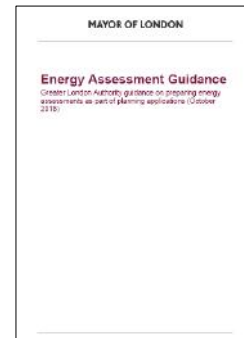
- mechanical ventilation
- active cooling systems (ensuring they are the lowest carbon options).

5.9C - Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible

### GLA Guidance on Planning Energy Assessment (April 2016)

Although primarily aimed at strategic planning applications, London Boroughs are encouraged to apply this strategy for energy assessments related to non-referable applications and adapt it for relevant scales of development.

This guidance note provides further detail on how to prepare an energy assessment to accompany strategic planning applications as set out in London Plan Policy 5.2. The purpose of an energy assessment is to demonstrate that climate change mitigation measures comply with London Plan energy policies, including the energy hierarchy. It also ensures energy remains an integral part of the development's design and evolution.



Policy 5.2 of the London Plan states that from 2013 to 2016 energy assessments should be produced to meet a target of 40 per cent carbon reduction beyond Part L 2010 of the Building Regulations. This requirement has been applied to Stage 1 applications received by the Mayor since 1 October 2013. This reduction in CO<sub>2</sub> emissions affected the percentage reduction necessary above the Part L 2013 regulations to meet the Mayor's targets in the London Plan.

As outlined in the Sustainable, Design and Construction SPG, since 6 April 2014, up until 30 Sept 2016, the Mayor has applied a 35% carbon reduction target beyond Part L 2013 of the Building Regulations - this is deemed to be broadly equivalent to the 40% target beyond Part L 2010 of the Building Regulations, as specified in Policy 5.2 of the London Plan for 2013-2016. The 35% target is a flat percentage reduction across both residential and non-domestic buildings.

After 1 Oct 2016 "Zero carbon" homes will be the target for major development where residential elements of the application achieves at least 35% CO<sub>2</sub> reduction in regulated emissions beyond Part L1A 2013. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be off-set through cash in lieu contribution to the relevant borough to secure the delivery of carbon dioxide savings elsewhere (in line with policy 5.2E).

Grid electricity has significantly decarbonised since the last update of Part L in April 2014 and in July 2018 the Government published updated carbon emissions factors (SAP 10) demonstrating this. The impact of these new emissions factors is significant in that technologies generating on-site electricity (such as gas-engine CHP and solar PV) will not achieve the carbon savings they have to date.

From January 2019 planning applications are encouraged to use the SAP 10 emissions factors in referable applications when estimating CO<sub>2</sub> emission performance against London Plan policies.

## 4.0 METHODOLOGY

### 4.1 The Accredited Software

In order to determine the baseline consumption and improvements in the private residential dwellings, a series of Standard Assessment Procedure (SAP) assessments were carried out. A representative sample of 22 dwellings (more than 50% of the total number of residential units) was selected to show a range of compliance strategies and potential improvements. For this exercise the Stroma FSAP 2012 Calculator Version 1.0.4.16 was used, which is a government accredited software package (checked by BRE on behalf of DECC, CLG, SBS and DFPNI).

In order to develop the Simplified Building Energy Model (SBEM) for the non-domestic elements of the development, for this calculation Tas v9.4.4 has been used. This is a Dynamic Simulation Modeller which gives a highly accurate representation of the building energy use, calculating the building demand, consumption and CO<sub>2</sub> emissions for every hour of the year. This version of the software has been accredited by the CLG for Part L2a & production of EPC certificates for all levels of buildings.

### 4.2 SAP 10 Carbon Emission Factors

From January 2019, to be in line with the draft new London Plan, applicants are encouraged to use the updated SAP 10 emission factors. The Energy Assessment is undertaken using the SAP 10 carbon factors, as confirmed by the Camden's Sustainability department.

### 4.3 The Approach

Once the Part L 2013 calculations had been set up according to the information from the rest of the design team, the energy hierarchy was applied as described in London Plan Policy 5.2 Minimising carbon dioxide emissions;

- Be lean: Use less energy
- Be clean: Supply energy efficiently
- Be green: Use renewable energy

The Baseline: The Building/Dwelling Emission Rate (BER/DER) of the development and the Target Emission Rates (TER) of the corresponding notional buildings were calculated using SBEM and SAP in accordance with Building Regulations Part L 2013. For the residential element of the development, SAP calculations were undertaken in order to establish an overall figure for the Dwelling Emission Rate (DER) across the residential element of the development. Similarly, full SBEM simulations were carried out for the community centre to estimate the associated energy demand and regulated carbon dioxide emissions.

The Energy Hierarchy: Once the baselines were determined, the energy hierarchy was applied to maximise the reduction of carbon dioxide emissions; energy efficiency measures first, followed by an assessment of the options for meeting the remaining energy demand efficiently and finally an assessment of the options to further reduce carbon dioxide emissions from renewable energy generated onsite.

## 5.0 THE BASELINE

To assess the performance of the residential element of the development, the following parameters summarised in Table 3 were applied to the representative sample dwellings.

**Table 3: NEW RESIDENTIAL - Fabric and services parameters**

| Element or system                                             | Units                | Highgate Newtown             | Notional building<br>(Part L1A 2013) | Limiting Values<br>(Part 1a 2013) |
|---------------------------------------------------------------|----------------------|------------------------------|--------------------------------------|-----------------------------------|
| <b>FABRIC PERFORMANCE</b>                                     |                      |                              |                                      |                                   |
| Ground Floor - U value                                        | W/m <sup>2</sup> K   | 0.11                         | 0.13                                 | 0.25                              |
| External Walls - U value                                      | W/m <sup>2</sup> K   | Block A 0.15<br>Block D 0.18 | 0.18                                 | 0.3                               |
| Party walls - U value                                         | W/m <sup>2</sup> K   | 0                            | 0                                    | 0.2                               |
| Roof - U value                                                | W/m <sup>2</sup> K   | Block A 0.11<br>Block D 0.13 | 0.13                                 | 0.25                              |
| Windows, rooflights, glazed doors                             |                      |                              |                                      |                                   |
| U value                                                       | W/m <sup>2</sup> K   | 1.4                          | 1.4                                  | 2                                 |
| g value                                                       |                      | 0.37<br>Flats                | 0.63                                 | -                                 |
| frame factor                                                  |                      | varies                       |                                      |                                   |
| External Doors                                                |                      | 1.4                          | 1                                    |                                   |
| Air tightness                                                 | m <sup>3</sup> /hr/m | 3                            | 5                                    | 10                                |
| Thermal bridging (y factor)                                   |                      | Accredited Construction      |                                      |                                   |
| <b>BUILDING SERVICES</b>                                      |                      |                              |                                      |                                   |
| ASHP SCOP                                                     | -                    | 3.7                          |                                      |                                   |
| Fraction of heating load                                      | %                    | 46%                          |                                      |                                   |
| Boiler efficiency                                             | %                    | 93.9                         | 89.5                                 |                                   |
| Fraction of heating load                                      | %                    | 54                           |                                      |                                   |
| Energy efficient lighting                                     | %                    | 100                          | 100                                  | 100                               |
| Mechanical ventilation & heat recovery:<br>Specific Fan Power | W / L / s            | SFP = 0.53 /<br>94%          |                                      |                                   |
| Mechanical cooling SEER                                       |                      | None                         |                                      |                                   |

**Table 3: EXISTING BUILDING RESIDENTIAL - Fabric and services parameters**

| Element or system                                                          | Units                             | Existing Building<br>(Part L1B 2013) | Improved<br>U Values |
|----------------------------------------------------------------------------|-----------------------------------|--------------------------------------|----------------------|
| <b>FABRIC PERFORMANCE</b>                                                  |                                   |                                      |                      |
| Ground Floor - U value                                                     | W/m <sup>2</sup> K                | 0.6                                  | 0.6                  |
| External Walls - U value                                                   | W/m <sup>2</sup> K                | 2.2                                  | 1.8                  |
| Party walls - U value                                                      | W/m <sup>2</sup> K                | 0                                    | 0                    |
| Roof - U value                                                             | W/m <sup>2</sup> K                | 2.5                                  | 0.18                 |
| Windows, rooflights, glazed doors                                          |                                   |                                      |                      |
| U value                                                                    | W/m <sup>2</sup> K                | 5.6                                  | 1.4                  |
| g value                                                                    |                                   |                                      | 0.44 - 0.558         |
| Air tightness                                                              | m <sup>3</sup> /hr/m <sup>2</sup> | 15                                   | 10                   |
| <b>BUILDING SERVICES</b>                                                   |                                   |                                      |                      |
| Boiler efficiency                                                          | %                                 | n/a                                  | 91%)                 |
| Energy efficient lighting                                                  | %                                 | n/a                                  | 100                  |
| Mechanical ventilation & heat recovery:<br>Specific Fan Power (SFP) / heat | W / L / s                         | n/a                                  | SFP = 0.53 /<br>94%  |
| Mechanical cooling SEER                                                    |                                   | None                                 | None                 |

Table 4: NON DOMESTIC - Fabric and services parameters

| Element or system                                   | Units                             | Highgate<br>Newtown                           | Notional<br>building<br>(Part L2A 2013) | Limiting Values<br>(Part 1a 2013) |
|-----------------------------------------------------|-----------------------------------|-----------------------------------------------|-----------------------------------------|-----------------------------------|
| <b>FABRIC PERFORMANCE</b>                           |                                   |                                               |                                         |                                   |
| External Walls - U value                            | W/m <sup>2</sup> K                | 0.22                                          | 0.26                                    | 0.35                              |
| Ground Floor - U value                              | W/m <sup>2</sup> K                | 0.11                                          | 0.22                                    | 0.25                              |
| Ground Floor Hall - U value                         | W/m <sup>2</sup> K                | 0.18                                          | 0.22                                    | 0.25                              |
| Roof - U value                                      | W/m <sup>2</sup> K                | 0.14                                          | 0.22                                    | 0.25                              |
| Roof Hall - U value                                 | W/m <sup>2</sup> K                | 0.18                                          | 0.22                                    | 0.25                              |
| Windows, rooflights, glazed doors                   |                                   |                                               |                                         |                                   |
| U value                                             | W/m <sup>2</sup> K                | 1.5                                           | 1.4                                     | 2.2                               |
| g value                                             |                                   | 0.32                                          | 0.63                                    | -                                 |
| frame factor                                        |                                   | 0.8                                           |                                         |                                   |
| External Doors (entrance)                           |                                   | 1.5                                           |                                         |                                   |
| Air tightness                                       | m <sup>3</sup> /hr/m <sup>2</sup> | 3                                             | 3                                       | 10                                |
| <b>BUILDING SERVICES</b>                            |                                   |                                               |                                         |                                   |
| ASHP SCOP                                           | -                                 | 3.7                                           |                                         |                                   |
| Fraction of heating load                            | %                                 | 46%                                           |                                         |                                   |
| Boiler efficiency                                   | %                                 | 93.9                                          | 91                                      |                                   |
| Fraction of heating load                            | %                                 | 54                                            |                                         |                                   |
| Lighting (lm/W)                                     | %                                 | 100                                           | 60                                      | 60                                |
| Mechanical ventilation & heat recovery:             |                                   |                                               |                                         |                                   |
| Specific Fan Power (SFP) / heat recovery efficiency | W / L / s                         | varies<br>(refer to mechanical specification) |                                         |                                   |
| Mechanical cooling SEER                             |                                   |                                               | 5.44                                    |                                   |

### 5.1 Percentage of Glazed Area of the Façade

The percentage of glazing to the façade of each building is detailed as below:

|                                       |       |
|---------------------------------------|-------|
| Building A New Build Residential      | 29.5% |
| Building B New Build Community Centre | 15.4% |
| Building C Existing Building          | 17.3% |
| Building D New Build Residential      | 24%   |



## 6.0 IMPROVEMENTS FROM REDUCING ENERGY DEMAND ('BE LEAN')

Reducing carbon emissions from the total energy needs (heating, cooling and power) of the development is one of the fundamental aims of any development adopting the principles of sustainable design in order to mitigate the effects of climate change and help conserve fossil fuel resources.

The first step in the energy hierarchy is to use passive design and energy efficiency measures to reduce the energy demand of the building. From preliminary calculations, it is estimated that a regulated carbon dioxide emissions reduction of 6% over Part L 2013 across the development as a whole through lean measures alone can be achieved. It is worth noting that the challenging Target Fabric Energy Efficiency criterion has been achieved in all of the sample dwellings and on a block basis this criterion is passed.

### A. Building Fabric Improvements and Overheating

The glazed areas in the residential element of the scheme are a key component. The proportion of glazing to façade area was assessed with careful consideration of beneficial heat gain, winter heat losses, daylight and aesthetic appeal of the building. Windows with a U-value of 1.40 W/m<sup>2</sup>K are proposed. This will help to minimise excessive heat loss in winter and solar gain in the summer, reducing the associated heating load in winter and the risk of overheating in summer. Furthermore, external wall U-values of 0.15 - 0.22 W/m<sup>2</sup>K have been selected for the new residential & commercial buildings.

### B. Air Tightness Improvements

An improvement upon the minimum requirements of the Part L 2013 will be targeted with 3m<sup>3</sup>/m<sup>2</sup>hour at 50 Pa pressure. The Design Team and Contractor will incorporate suitable construction details into the design and adopt best practice construction practices in order to achieve these figures.

### C. Thermal Bridging

Thermal bridging will be carefully considered to improve upon the minimum default  $\psi$  value of 0.15. Thermal bridges at all window junctions (sills, jambs and lintels) will be designed with Accredited Construction Details to ensure that heat transferred through to the building is reduced. Particular attention will also be paid to the balconies, which are one of the highest risk areas to cause thermal bridging due to construction methods and detailing.

### D. Luminaires and Controls

Low energy lighting has become an essential feature of building design. Advances in lamp and ballast design have led to higher efficiency luminaires with control measures having become standard in most new developments in order to respond to changes to standards such as Part L of the Building Regulations and sustainability assessment methods such as BREEAM and the Code for Sustainable Homes.

Lighting controls can consist of simple presence detection which when combined with daylight control can switch luminaires on/off automatically or regulate the lighting levels in accordance with the outside conditions. These systems are proposed for use in conjunction with each other for the most energy efficient installation. Daylight control is intended for use to control external lighting.

Energy efficient light fittings will be provided throughout the development to reduce the electrical load. Daylight sensors and timers will be installed to all external lighting (not including security lighting). High efficiency lamps will be installed in communal areas managed by the landlord. These will be controlled by a combination of infrared occupancy control.

**E. Ventilation**

Due to the high performance of the building fabric and the development, relying solely on natural ventilation for the residential dwellings is not considered an appropriate strategy and a balanced mechanical ventilation strategy with mechanical extract is proposed. This will ensure minimum fresh air requirements, moisture and odour removal from the kitchen and toilet areas and allow for a boost / purge facility to increase the volume of air flow controlled. In order to optimise the energy performance of the system, each unit will incorporate heat recovery.

For the community centre, a natural ventilation strategy is proposed. Given that the building is on multiple floors and based around a central atrium with large open spaces, the opportunity exists to adopt this operational strategy.

**F. Comfort Cooling**

The controlled ventilation strategies and high performance fabric within both the residential dwellings and community centre assume that comfort cooling will not be required. Likewise, both buildings will be provided with openable windows, and a summertime boost function on the MVHR (mechanical ventilation unit) will allow the occupants choice as to how to regulate the internal comfort within the apartment blocks.

It should be noted that no internal blinds are assumed for all dwellings.

The table below demonstrates how the development has addressed the issue of cooling in line with Cooling Hierarchy as included within Policy 5.2 of the Minor Alterations to the London Plan (MALP) (March 2016).

| Cooling hierarchy                                                                                                                                         | Proposed Development                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1 minimise internal heat generation through energy efficient design</b>                                                                                | Selection of high performance glazing units with U values and g- values that exceed Part L 2013 requirements.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>2 reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls</b> | In terms of external shading, window reveals and a significant quantum of logias (recessed balconies) substantially reduce excessive solar gains.<br><br>Areas of green roofs are also being considered in combination with the roof mounted PV arrays.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| <b>3 manage the heat within the building through exposed internal thermal mass and high ceilings</b>                                                      | An ample floor -ceiling height of 2.5m is provided. A night-time cooling strategy via openable windows or rooflights is proposed to allow the structure of the buildings to cool down Community Centre only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>4 passive ventilation</b>                                                                                                                              | Openable windows are provided to all dwellings and the community centre allow users control over their environment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>5 mechanical ventilation</b>                                                                                                                           | Mechanical ventilation with heat recovery is to be installed in all dwellings, with a summertime boost function.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>6 active cooling systems (ensuring they are the lowest carbon options).</b>                                                                            | <p>A in depth overheating analysis has been undertaken for both the community centre and the residential buildings which has highlighted the following issues</p> <p>Residential - TM59<br/>There are a number of south facing bedrooms and living rooms currently failing the TM59 assessment. Currently the analysis has been carried out excluding blinds and the analysis will be run using blinds to confirm any overheating areas.</p> <p>A review is ongoing on how these issues can be mitigated and resolved, trying to avoid any cooling being installed.</p> <p>Commercial - TM52<br/>The community centre currently passes the TM52 analysis as detailed in the results shown in appendix D.</p> <p>During the stage 4 design the scheme, looking at window openings and louvre openings.</p> <p>The results of the TM52 and TM59 thermal models can be seen in Appendix D.</p> |

## 7.0 IMPROVEMENT FROM SUPPLYING ENERGY EFFICIENTLY ('BE CLEAN')

### 7.1 District Heating Network

In accordance with GLA Energy Assessment Guidance (2018) and draft London Plan Policy SI3, the energy systems for the site have been determined in accordance with the following hierarchy:

1. Connection to existing low carbon heat distribution networks
2. Use zero emission or local secondary heat sources (in conjunction with heat pump if required)
3. Use low-emission combined heat and power (CHP)
4. Use ultra low NOx gas boilers

Although not indicated on the London Heat Map below, existing heating networks exist in close proximity and are under London Borough of Camden's ownership. These are Highgate Newtown and Brookfield. However, it is our understanding that these networks are both refurbishments and the respective plant rooms do not include sufficient capacity to extend the networks to service the Highgate Newtown Community Centre.

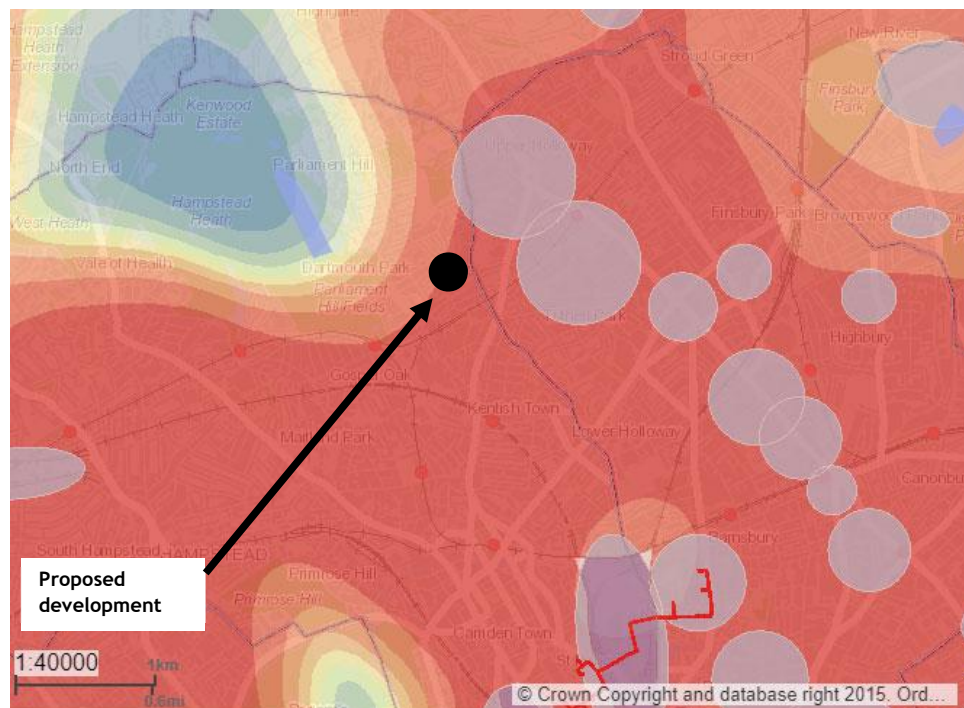


**Figure 1:** London Heat Map showing heat loads and district heating networks in the vicinity of the proposed development.

- Heat mapping decentralised energy potential
- Potential District Heating Networks
- Rivers, lakes or sea
- Existing District Heating Networks

### 7.2 Combined Heat and Power (CHP)

Connecting to a District Heating Network was the first option assessed. As no suitable heat network currently exists, nor plans confirmed in terms of future network routes, the next solution that was assessed was to install a Combined Heat and Power (CHP) unit.

The inclusion of a centralised CHP plant was developed and proposed within the previous energy assessment. However, as described in the Executive Summary, the energy strategy has been amended at this stage to be in line with the new draft London Plan which encourage the use of heat pumps and low-emissions technologies. For that reason the heating strategy for all the building has been reviewed and the CHP system not included.

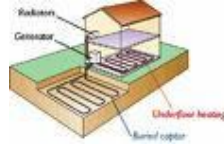
As such no benefit in terms of carbon dioxide reduction are offered in this part of the Energy Hierarchy.

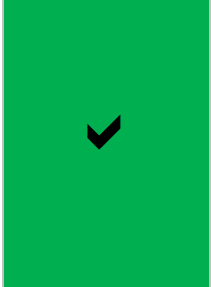
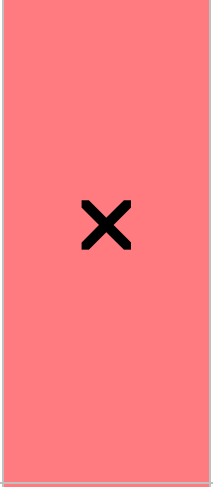
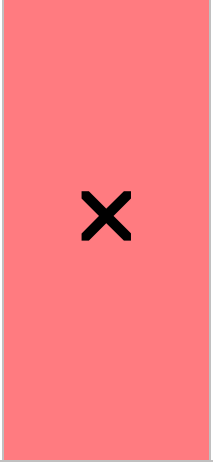
## 8.0 IMPROVEMENT FROM INTRODUCING RENEWABLE ENERGY TECHNOLOGIES ('BE GREEN')

### 8.1 Initial feasibility

A renewable and low carbon technology feasibility study has been carried out to investigate the contribution that on-site generation from renewable energy technologies could make to further reduce the carbon dioxide emissions in the proposed development. The following technologies have been assessed in terms of their technical feasibility and potential CO<sub>2</sub> emissions savings:

- Solar thermal water heating;
- Photovoltaics;
- Biomass heating;
- Building mounted and stand-alone wind turbines;
- Ground source heat pumps (GSHP); and
- Air source heat pumps (ASHP).

| Technology                                                                                                             | Feasibility                                                                         | Comments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Ground Source Heat Pumps</b><br> |  | <p>Ground source heat pumps extract heat from the ground and convert it to low grade heat for space heating and hot water. A ground source heat pump requires a large ground array, which would not fit on this site. Also, the cost of installing bore holes or slinky installations can still be prohibitively expensive.</p> <p>Heat Pumps typically meet a proportion of the heating and cooling loads and can be incorporated into the piles of a building structure. However, optimum performance is yielded when both heating and cooling are provided as this ensures that over the long term, the temperature of the ground remains relatively constant over a typical year.</p> <p>Mechanical cooling is not proposed for any of the dwellings and for a few spaces in building B, so a long-term temperature regime, and therefore optimal performance of a heat pump system could not be guaranteed. The technology is therefore discounted.</p> |
| <b>Air Source Heat Pumps</b><br>    |  | <p>Air source heat pumps extract heat from the air and convert it to low grade heat for space heating. These will produce low-grade heat which can then be boosted by the gas boilers to provide higher grade heat to the site-wide heat loop. This combination offers the best efficiency given the constraints of the site.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

| Technology                                                                                                           | Feasibility                                                                         | Comments                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Photovoltaics</b><br>            |    | <p>The proposed development has a large area of flat or south facing roof and thus with the appropriate mounting systems can be very favourable for the installation of Photovoltaic panels. Photovoltaic cells would contribute to a proportion of the electrical load of the scheme and also benefit from the Feed in Tariff.</p>                                                                                     |
| <b>Solar Hot Water Systems</b><br> |   | <p>The hot water load is substantial in any residential scheme. In this case this has been addressed at the second step of the energy hierarchy through the Combined Heat and Power plant; therefore, the solar thermal technology would not make a further contribution to the carbon dioxide emissions reduction and will not be considered further.</p>                                                              |
| <b>Biomass Heating</b><br>        |  | <p>A communal biomass boiler would be unsuitable for the development due to its central London location and the associated implications of fuel deliveries. Furthermore, given the restricted space between buildings and regular pedestrian movements related to the Community Centre, fuel deliveries from large vehicles would be deemed to pose a significant safety risk. This will not be further considered.</p> |



| Technology                                                                                                      | Feasibility | Comments                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Wind (roof mounted)</b><br> | X           | <p>Roof mounted wind turbines are not recommended for this site due to noise, flicker and vibration implications on the residential/non-domestic areas. Numerous inner city wind turbine trials have shown that such turbines' energy yields are significantly lower than manufacturers' estimations. This will not be further considered.</p> |
| <b>Wind (standalone)</b><br>  | X           | <p>Small-scale (10m mast), standalone turbines are not suitable for this development due to lack of space on the site and relatively low wind speeds that would be achieved in this very urban environment. This will not be further considered.</p>                                                                                           |

## 8.2 Preferred Options for Renewables

As the proposed development will not include structural piles, a ground source heat pump system is not proposed. Air Source Heat Pumps have been considered the ideal technology to serve this site. The ASHP system will supply both heating and domestic hot water to all the buildings. External units could be located on the top roof area. Where higher flow temperatures are required for DHW production this will be met with ultra-low NOx gas boilers.

Space is available at roof level to install a PV array, then this renewable technology has been proposed. A 99 panel PV array is installed which will equate to 24.8 kWp, with active area of approximately 160m<sup>2</sup>. Please refer to Appendix A for an indicative PV layout.

Indicative details of the PV panels are listed below:

| Solar PV Information Required                 |                                                                                                                                                                                                                                      | Units             |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Model                                         | Sanyo HIT-H250E01                                                                                                                                                                                                                    |                   |
| Efficiency                                    | 18                                                                                                                                                                                                                                   | %                 |
| Number of PV panels                           | 99                                                                                                                                                                                                                                   |                   |
| Area of PV panels                             | 160                                                                                                                                                                                                                                  | m <sup>2</sup>    |
| Total Capacity (Installed Power)              | 24.75                                                                                                                                                                                                                                | kWp               |
| Total Energy Output                           | 17,325                                                                                                                                                                                                                               | kWh/year          |
| CO <sub>2</sub> Offset                        | 8.9                                                                                                                                                                                                                                  | kgCO <sub>2</sub> |
| Emissions Reductions                          | 17.1                                                                                                                                                                                                                                 | %                 |
| Additionally, FiT information can be provided | It should be noted that on 19th July 2018 the Department of Business Energy and Industrial Strategy (BEIS) published a consultation in which they state their intention to close the FIT scheme to new applicants from 1 April 2019. |                   |

## APPENDIX A - PROPOSED PV LAYOUT

## Proposed PV Layout



## APPENDIX B1 - SAP OUTPUTS FOR SAMPLE UNITS “LEAN”

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-0-01                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be Lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 84 B                                                                    | DER           | 16.14   | TER            | 16.84      |
| Environmental                      | 88 B                                                                    | % DER<TER     | 4.16    |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.97                                                                    | DFEE          | 43.85   | TFEE           | 47.91      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 8.48    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Ground-floor flat, total floor area 74 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 16.84 kgCO<sub>2</sub>/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 16.14 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)47.9 kWh/m<sup>2</sup>/yr

Dwelling Fabric Energy Efficiency (DFEE)43.8 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | 0.11 (max. 0.25) | 0.11 (max. 0.70) | OK |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.34 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day

Permitted by DBSCG 0.32 Fail

Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls: No cylinderstat

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

Continuous supply and extract system

|                     |      |    |
|---------------------|------|----|
| Specific fan power: | 0.53 |    |
| Maximum             | 1.5  | OK |
| MVHR efficiency:    | 94%  |    |
| Minimum:            | 70%  | OK |

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail

Based on:

|                            |                                                                          |
|----------------------------|--------------------------------------------------------------------------|
| Overshading:               | Average                                                                  |
| Windows facing North East: | 3.35 m <sup>2</sup> , No overhang                                        |
| Windows facing West:       | 15.10 m <sup>2</sup> , Overhang width less than twice window, ratio 1.00 |
| Air change rate:           | 0.50 ach                                                                 |
| Blinds/curtains:           | None                                                                     |

#### 10 Key features

|                    |                                      |
|--------------------|--------------------------------------|
| Party wall U-value | 0.00 W/m <sup>2</sup> K              |
| Floor U-value      | 0.11 W/m <sup>2</sup> K              |
| Air permeability   | 3.0 m <sup>3</sup> /m <sup>2</sup> h |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 74.0000 (1b)              | x 2.5400 (2b)                   | = 187.9600 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 187.9600 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 2                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2631                       | 0.2599 | 0.2567    | 0.2408 | 0.2376 | 0.2216 | 0.2216                      | 0.2184      | 0.2280 | 0.2376 | 0.2439 | 0.2503 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W03 (Uw = 1.25)                                                |                         |                            | 8.4000                    | 1.1905                        | 10.0000      |                                | (27)                                                 |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                | (26a)                                                |
| W01 (Uw = 1.40)                                                |                         |                            | 10.0500                   | 1.3258                        | 13.3239      |                                | (27)                                                 |
| Heat Loss Floor 1                                              |                         |                            | 74.0000                   | 0.1100                        | 8.1400       | 110.0000                       | 8140.0000 (28a)                                      |
| External Wall 1                                                | 49.5300                 | 20.5500                    | 28.9800                   | 0.1500                        | 4.3470       | 140.0000                       | 4057.2000 (29a)                                      |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 123.5300                  |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      | 38.7509                       |              |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 42.5000                   | 0.0000                        | 0.0000       | 140.0000                       | 5950.0000 (32)                                       |
| Party Ceilings                                                 |                         |                            | 74.0000                   |                               |              | 80.0000                        | 5920.0000 (32b)                                      |
| Internal Wall                                                  |                         |                            | 132.0000                  |                               |              | 9.0000                         | 1188.0000 (32c)                                      |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 25255.2000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 341.2865 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 7.7649 (36)                                          |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 46.5158 (37)                           |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 16.3169 | 16.1192 | 15.9215 | 14.9330 | 14.7352 | 13.7467 | 13.7467 | 13.5490 | 14.1421 | 14.7352 | 15.1307 | 15.5261 (38) |
| Heat transfer coeff       | 62.8327 | 62.6350 | 62.4373 | 61.4487 | 61.2510 | 60.2625 | 60.2625 | 60.0647 | 60.6579 | 61.2510 | 61.6464 | 62.0418 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 61.3993 (39) |
| HLP                       | 0.8491  | 0.8464  | 0.8437  | 0.8304  | 0.8277  | 0.8144  | 0.8144  | 0.8117  | 0.8197  | 0.8277  | 0.8331  | 0.8384 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.8297 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |              |             |             |             |             |             |             |             |             |              |                   |
|------------------------------------------|--------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------------|
| Assumed occupancy                        |              |              |             |             |             |             |             |             |             |             |              | 2.3392 (42)       |
| Average daily hot water use (litres/day) |              |              |             |             |             |             |             |             |             |             |              | 94.4799 (43)      |
| Daily hot water use                      | Jan 103.9278 | Feb 100.1486 | Mar 96.3694 | Apr 92.5903 | May 88.8111 | Jun 85.0319 | Jul 85.0319 | Aug 88.8111 | Sep 92.5903 | Oct 96.3694 | Nov 100.1486 | Dec 103.9278 (44) |
| Energy conte                             | 154.1220     | 134.7961     | 139.0975    | 121.2685    | 116.3601    | 100.4099    | 93.0445     | 106.7699    | 108.0451    | 125.9162    | 137.4473     | 149.2589 (45)     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                     |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------------|
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = | 1486.5360 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |          |                     |                |
|                                                                 | 23.1183  | 20.2194  | 20.8646  | 18.1903  | 17.4540  | 15.0615  | 13.9567  | 16.0155  | 16.2068  | 18.8874  | 20.6171  | 22.3888             | (46)           |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |                     |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 2.0000              | (47)           |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 0.7400              | (48)           |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 1.0000              | (49)           |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7400              | (55)           |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |                     |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400             | (56)           |
| If cylinder contains dedicated storage                          |          |          |          |          |          |          |          |          |          |          |          |                     |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400             | (57)           |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624             | (59)           |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |                     |                |
|                                                                 | 200.3244 | 176.5273 | 185.2999 | 165.9805 | 162.5625 | 145.1219 | 139.2469 | 152.9723 | 152.7571 | 172.1186 | 182.1593 | 195.4613            | (62)           |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | (63)           |
| Solar input (sum of months) = Sum (63)m =                       |          |          |          |          |          |          |          |          |          |          |          | 0.0000              | (63)           |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |                     |                |
|                                                                 | 200.3244 | 176.5273 | 185.2999 | 165.9805 | 162.5625 | 145.1219 | 139.2469 | 152.9723 | 152.7571 | 172.1186 | 182.1593 | 195.4613            | (64)           |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |                     |                |
|                                                                 | 88.2075  | 78.2047  | 83.2118  | 76.0914  | 75.6516  | 69.1559  | 67.8992  | 72.4629  | 71.6946  | 78.8290  | 81.4708  | 86.5905             | (65)           |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |          |      |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|                                                                                     | 18.4049  | 16.3471  | 13.2943  | 10.0647  | 7.5235   | 6.3516   | 6.8632   | 8.9210   | 11.9737  | 15.2034  | 17.7446  | 18.9165  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |          |      |
|                                                                                     | 206.4473 | 208.5895 | 203.1911 | 191.6984 | 177.1909 | 163.5559 | 154.4469 | 152.3047 | 157.7031 | 169.1958 | 183.7033 | 197.3383 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |          |      |
|                                                                                     | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | (69) |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |          |      |
|                                                                                     | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |          |      |
|                                                                                     | 118.5584 | 116.3760 | 111.8439 | 105.6825 | 101.6823 | 96.0498  | 91.2624  | 97.3964  | 99.5758  | 105.9530 | 113.1539 | 116.3851 | (72) |
| Total internal gains                                                                |          |          |          |          |          |          |          |          |          |          |          |          |      |
|                                                                                     | 401.4985 | 399.4005 | 386.4172 | 365.5335 | 344.4846 | 324.0453 | 310.6604 | 316.7100 | 327.3406 | 348.4402 | 372.6898 | 390.7277 | (73) |

#### 6. Solar gains

|             |          |            |          |             |          |               |          |             |          |          |          |          |      |
|-------------|----------|------------|----------|-------------|----------|---------------|----------|-------------|----------|----------|----------|----------|------|
| [Jan]       |          |            |          |             |          |               |          |             |          |          |          |          |      |
|             | Area     | Solar flux |          | g           |          | FF            |          | Access      |          | Gains    |          |          |      |
|             | m2       | Table 6a   |          | or Table 6b |          | Specific data |          | or Table 6c |          | factor   |          |          |      |
|             |          | W/m2       |          |             |          |               |          |             |          | Table 6d |          |          |      |
| West        | 8.4000   | 19.6403    |          | 0.3700      |          | 0.8900        |          | 0.7700      |          | 37.6488  |          | (80)     |      |
| Northeast   | 3.3500   | 11.2829    |          | 0.3700      |          | 0.6500        |          | 0.7700      |          | 6.2996   |          | (75)     |      |
| West        | 6.7000   | 19.6403    |          | 0.3700      |          | 0.6500        |          | 0.7700      |          | 21.9316  |          | (80)     |      |
| Solar gains | 65.8801  | 129.3751   | 215.0477 | 317.8816    | 394.0780 | 405.5728      | 385.2214 | 327.7574    | 251.3909 | 153.9696 | 82.2164  | 54.1407  | (83) |
| Total gains | 467.3786 | 528.7756   | 601.4648 | 683.4151    | 738.5626 | 729.6182      | 695.8818 | 644.4673    | 578.7315 | 502.4097 | 454.9061 | 444.8684 | (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-----------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |          |          |          |          |          |          |          |          |          |          |          | 21.0000  | (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |          |          |          |          |          |          |          |          |          |          |          |          |      |
|                                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| tau                                                                         | 111.6510 | 112.0034 | 112.3581 | 114.1657 | 114.5342 | 116.4130 | 116.4130 | 116.7962 | 115.6541 | 114.5342 | 113.7995 | 113.0742 |      |
| alpha                                                                       | 8.4434   | 8.4669   | 8.4905   | 8.6110   | 8.6356   | 8.7609   | 8.7609   | 8.7864   | 8.7103   | 8.6356   | 8.5866   | 8.5383   |      |
| util living area                                                            | 0.9994   | 0.9980   | 0.9894   | 0.9295   | 0.7509   | 0.5277   | 0.3810   | 0.4286   | 0.7108   | 0.9697   | 0.9980   | 0.9996   | (86) |
| MIT                                                                         | 20.4011  | 20.5053  | 20.6806  | 20.8883  | 20.9845  | 20.9993  | 21.0000  | 20.9999  | 20.9926  | 20.8454  | 20.5846  | 20.3843  | (87) |
| Th 2                                                                        | 20.2110  | 20.2133  | 20.2156  | 20.2271  | 20.2294  | 20.2409  | 20.2409  | 20.2432  | 20.2363  | 20.2294  | 20.2248  | 20.2202  | (88) |
| util rest of house                                                          | 0.9991   | 0.9971   | 0.9846   | 0.9040   | 0.6966   | 0.4656   | 0.3153   | 0.3582   | 0.6382   | 0.9529   | 0.9969   | 0.9994   | (89) |
| MIT 2                                                                       | 19.4084  | 19.5623  | 19.8173  | 20.1089  | 20.2173  | 20.2406  | 20.2409  | 20.2432  | 20.2319  | 20.0615  | 19.6878  | 19.3913  | (90) |
| Living area fraction                                                        |          |          |          |          |          |          |          |          |          |          |          |          |      |
| MIT                                                                         | 19.7465  | 19.8835  | 20.1113  | 20.3743  | 20.4786  | 20.4989  | 20.4994  | 20.5009  | 20.4910  | 20.3284  | 19.9932  | 19.7295  | (91) |
| Temperature adjustment                                                      |          |          |          |          |          |          |          |          |          |          |          | 0.0000   |      |
| adjusted MIT                                                                | 19.7465  | 19.8835  | 20.1113  | 20.3743  | 20.4786  | 20.4989  | 20.4994  | 20.5009  | 20.4910  | 20.3284  | 19.9932  | 19.7295  | (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |              |              |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|--------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec          |              |
|                      | 0.9989   | 0.9966   | 0.9839   | 0.9094   | 0.7146   | 0.4868   | 0.3377   | 0.3822   | 0.6630   | 0.9554   | 0.9964   | 0.9993       | (94)         |
| Useful gains         | 466.8713 | 526.9741 | 591.7614 | 621.4787 | 527.7985 | 355.1496 | 234.9753 | 246.2859 | 383.6778 | 480.0272 | 453.2838 | 444.5418     | (95)         |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000       | (96)         |
| Heat loss rate W     |          |          |          |          |          |          |          |          |          |          |          |              |              |
|                      | 970.5422 | 938.4895 | 849.8532 | 705.0808 | 537.6959 | 355.4848 | 234.9869 | 246.3184 | 387.6619 | 595.8773 | 794.8176 | 963.4774     | (97)         |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000       | (97a)        |
| Space heating kWh    |          |          |          |          |          |          |          |          |          |          |          |              |              |
|                      | 374.7312 | 276.5384 | 192.0203 | 60.1936  | 7.3637   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 86.1925  | 245.9044 | 386.0881     | (98)         |
| Space heating        |          |          |          |          |          |          |          |          |          |          |          | 1629.0321    | (98)         |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | (98) / (4) = | 22.0139 (99) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

-----  
8c. Space cooling requirement  
-----

Not applicable

-----  
9b. Energy requirements  
-----

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1629.0321 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 1791.9353 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2030.5320 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 2233.5852 (310a) |
| Electricity used for heat distribution                                                  | 40.2552 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 151.9187 (330a)  |
| Total electricity for the above, kWh/year                                               | 151.9187 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 325.0367 (332)   |
| Total delivered energy for all uses                                                     | 4502.4758 (338)  |

-----  
12b. Carbon dioxide emissions - Community heating scheme  
-----

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 4287.0292          | 0.2160                        | 925.9983 (367)           |
| Electrical energy for heat distribution                                                    | 40.2552            | 0.5190                        | 20.8925 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 946.8908 (373)           |
| Space and water heating                                                                    |                    |                               | 946.8908 (376)           |
| Pumps and fans                                                                             | 151.9187           | 0.5190                        | 78.8458 (378)            |
| Energy for lighting                                                                        | 325.0367           | 0.5190                        | 168.6941 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1194.4306 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 16.1400 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 16.1400 ZC1 |
| Total Floor Area                                                                | TFA | 74.0000     |
| Assumed number of occupants                                                     | N   | 2.3392      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 16.5319 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.3668 ZC3  |
| Total CO2 emissions                                                             |     | 35.0387 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 35.0387 ZC8 |

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 74.0000 (1b)              | x 2.5400 (2b)                   | = 187.9600 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 187.9600 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | =               | 0 * 40 = 0.0000 (6a)    |
| Number of open flues                                                      | 0               | +                    | 0                           | =               | 0 * 20 = 0.0000 (6b)    |
| Number of intermittent fans                                               |                 |                      |                             |                 | 3 * 10 = 30.0000 (7a)   |
| Number of passive vents                                                   |                 |                      |                             |                 | 0 * 10 = 0.0000 (7b)    |
| Number of flueless gas fires                                              |                 |                      |                             |                 | 0 * 40 = 0.0000 (7c)    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 30.0000 / (5) = | 0.1596 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.4096 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 2 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.8500 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3482 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4439 | 0.4352 | 0.4265 | 0.3830 | 0.3743 | 0.3308 | 0.3308 | 0.3221 | 0.3482 | 0.3743 | 0.3917 | 0.4091 (22b) |
|                 | 0.5985 | 0.5947 | 0.5910 | 0.5733 | 0.5700 | 0.5547 | 0.5547 | 0.5519 | 0.5606 | 0.5700 | 0.5767 | 0.5837 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------------|------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|------|
| TER Semi-glazed door                                                |                |                | 2.1000               | 1.2000           | 2.5200         |                   |                | (26a)          |                |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                | 16.4100              | 1.3258           | 21.7557        |                   |                | (27)           |                |                |                |                |      |
| Heat Loss Floor 1                                                   |                |                | 74.0000              | 0.1300           | 9.6200         |                   |                | (28a)          |                |                |                |                |      |
| External Wall 1                                                     | 49.5300        | 18.5100        | 31.0200              | 0.1800           | 5.5836         |                   |                | (29a)          |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 123.5300             |                  |                |                   |                | (31)           |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26)...(30) + (32) = |                  | 39.4793        |                   |                | (33)           |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                      |                  |                |                   | 250.0000       | (35)           |                |                |                |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                      |                  |                |                   | 5.5349         | (36)           |                |                |                |                |      |
| Total fabric heat loss                                              |                |                |                      |                  |                | (33) + (36) =     | 45.0142        | (37)           |                |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                      |                  |                |                   |                |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>37.1249 | Feb<br>36.8875 | Mar<br>36.6549       | Apr<br>35.5623   | May<br>35.3579 | Jun<br>34.4063    | Jul<br>34.4063 | Aug<br>34.2301 | Sep<br>34.7729 | Oct<br>35.3579 | Nov<br>35.7715 | Dec<br>36.2038 | (38) |
| Heat transfer coeff                                                 | 82.1390        | 81.9017        | 81.6691              | 80.5765          | 80.3721        | 79.4205           | 79.4205        | 79.2443        | 79.7870        | 80.3721        | 80.7856        | 81.2180        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                      |                  |                |                   |                |                |                |                |                | 80.5755        | (39) |
| HLP                                                                 | Jan<br>1.1100  | Feb<br>1.1068  | Mar<br>1.1036        | Apr<br>1.0889    | May<br>1.0861  | Jun<br>1.0732     | Jul<br>1.0732  | Aug<br>1.0709  | Sep<br>1.0782  | Oct<br>1.0861  | Nov<br>1.0917  | Dec<br>1.0975  | (40) |
| HLP (average)                                                       |                |                |                      |                  |                |                   |                |                |                |                |                | 1.0889         | (40) |
| Days in month                                                       | 31             | 28             | 31                   | 30               | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |          |          |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|----------|----------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |          |          |                    |          | 2.3392 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |          |          |                    |          | 89.7559 (43)   |
| Daily hot water use                                         | 98.7314  | 95.1412  | 91.5510  | 87.9607  | 84.3705  | 80.7803 | 80.7803 | 84.3705  | 87.9607  | 91.5510            | 95.1412  | 98.7314 (44)   |
| Energy conte                                                | 146.4159 | 128.0563 | 132.1426 | 115.2051 | 110.5421 | 95.3894 | 88.3923 | 101.4314 | 102.6429 | 119.6204           | 130.5750 | 141.7960 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |          | 1412.2092 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 21.9624  | 19.2084  | 19.8214  | 17.2808  | 16.5813  | 14.3084 | 13.2588 | 15.2147  | 15.3964  | 17.9431            | 19.5862  | 21.2694 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |          |          |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |          |          |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |          |          |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |          |          |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |          |          |                    |          | 0.1290 (55)    |
| Total storage loss                                          |          |          |          |          |          |         |         |          |          |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 173.6760 | 152.6783 | 159.4027 | 141.5859 | 137.8022 | 121.7702 | 115.6524 | 128.6916 | 129.0236 | 146.8805 | 156.9558 | 169.0561 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 173.6760 | 152.6783 | 159.4027 | 141.5859 | 137.8022 | 121.7702 | 115.6524 | 128.6916 | 129.0236 | 146.8805 | 156.9558 | 169.0561 (64) |
|                                                                 | 70.4914  | 62.2764  | 65.7455  | 59.4103  | 58.5633  | 52.8216  | 51.1986  | 55.5341  | 55.2334  | 61.5819  | 64.5208  | 68.9553 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 18.4071  | 16.3490  | 13.2959  | 10.0659  | 7.5244   | 6.3524   | 6.8640   | 8.9221   | 11.9752  | 15.2052  | 17.7467  | 18.9187  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 206.4473 | 208.5895 | 203.1911 | 191.6984 | 177.1909 | 163.5559 | 154.4469 | 152.3047 | 157.7031 | 169.1958 | 183.7033 | 197.3383 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | (71) |
| Water heating gains (Table 5)                                                       | 94.7465  | 92.6732  | 88.3676  | 82.5143  | 78.7142  | 73.3633  | 68.8153  | 74.6426  | 76.7130  | 82.7713  | 89.6122  | 92.6818  | (72) |
| Total internal gains                                                                | 380.6888 | 378.6997 | 365.9426 | 345.3665 | 324.5174 | 304.3596 | 291.2141 | 296.9572 | 307.4792 | 328.2603 | 352.1502 | 370.0267 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|
| Northeast   |          |          |          |          | 2.9800     | 11.2829                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 10.2757       |
| West        |          |          |          |          | 13.4300    | 19.6403                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 80.6112 (75)  |
|             |          |          |          |          |            |                                |                                   |                                    |          |          |                              |               |
| Solar gains | 90.8868  | 178.6090 | 297.3819 | 440.6420 | 547.3670   | 563.8571                       | 535.3462                          | 454.7292                           | 347.9580 | 212.6770 | 113.4421                     | 74.6823 (83)  |
| Total gains | 471.5756 | 557.3086 | 663.3245 | 786.0085 | 871.8843   | 868.2167                       | 826.5602                          | 751.6864                           | 655.4372 | 540.9373 | 465.5923                     | 444.7090 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 62.5633 | 62.7446 | 62.9233 | 63.7765 | 63.9387 | 64.7048 | 64.7048 | 64.8487 | 64.4076 | 63.9387 | 63.6114 | 63.2728 |              |
| alpha                                                                       | 5.1709  | 5.1830  | 5.1949  | 5.2518  | 5.2626  | 5.3137  | 5.3137  | 5.3232  | 5.2938  | 5.2626  | 5.2408  | 5.2182  |              |
| util living area                                                            | 0.9974  | 0.9933  | 0.9777  | 0.9155  | 0.7694  | 0.5708  | 0.4202  | 0.4796  | 0.7598  | 0.9618  | 0.9942  | 0.9981  | (86)         |
| MIT                                                                         | 19.8476 | 20.0214 | 20.3144 | 20.6722 | 20.9016 | 20.9837 | 20.9973 | 20.9948 | 20.9325 | 20.5947 | 20.1533 | 19.8203 | (87)         |
| Th 2                                                                        | 19.9927 | 19.9953 | 19.9979 | 20.0099 | 20.0122 | 20.0227 | 20.0227 | 20.0247 | 20.0187 | 20.0122 | 20.0076 | 20.0028 | (88)         |
| util rest of house                                                          | 0.9965  | 0.9911  | 0.9703  | 0.8893  | 0.7119  | 0.4899  | 0.3283  | 0.3807  | 0.6798  | 0.9444  | 0.9919  | 0.9974  | (89)         |
| MIT 2                                                                       | 18.4590 | 18.7138 | 19.1378 | 19.6412 | 19.9230 | 20.0128 | 20.0218 | 20.0227 | 19.9685 | 19.5503 | 18.9161 | 18.4265 | (90)         |
| Living area fraction                                                        | 18.9319 | 19.1591 | 19.5385 | 19.9923 | 20.2563 | 20.3434 | 20.3540 | 20.3537 | 20.2967 | 19.9060 | 19.3375 | 18.9012 | (92)         |
| Temperature adjustment                                                      | 18.9319 | 19.1591 | 19.5385 | 19.9923 | 20.2563 | 20.3434 | 20.3540 | 20.3537 | 20.2967 | 19.9060 | 19.3375 | 18.9012 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |          |          |           |       |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 469.2973  | 550.9451  | 640.7266  | 698.5949 | 633.8343 | 448.9376 | 297.2982 | 311.5720 | 461.5349 | 509.6110 | 460.7879 | 443.0931  | (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Heat loss rate W     | 1201.8494 | 1167.8433 | 1064.8433 | 893.7774 | 687.6842 | 456.1431 | 298.1449 | 313.3112 | 494.4197 | 747.9389 | 988.6105 | 1193.9990 | (97)  |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating kWh    | 545.0187  | 414.5556  | 315.5428  | 140.5314 | 40.0644  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 177.3160 | 380.0323 | 558.6740  | (98)  |
| Space heating        |           |           |           |          |          |          |          |          |          |          |          | 2571.7350 | (98)  |
| Space heating per m2 |           |           |           |          |          |          |          |          |          |          |          | 34.7532   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2750.5188 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 545.0187 | 414.5556 | 315.5428 | 140.5314 | 40.0644  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 177.3160 | 380.0323 | 558.6740  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 582.9077 | 443.3749 | 337.4789 | 150.3010 | 42.8496  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 189.6428 | 406.4516 | 597.5123  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 173.6760 | 152.6783 | 159.4027 | 141.5859 | 137.8022 | 121.7702 | 115.6524 | 128.6916 | 129.0236 | 146.8805 | 156.9558 | 169.0561  | (64)            |
| Efficiency of water heater (217)m                                     | 87.6596  | 87.3476  | 86.6027  | 84.7939  | 81.9834  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.3171  | 87.0869  | 87.7662   | (216)           |
| Fuel for water heating, kWh/month                                     | 198.1255 | 174.7940 | 184.0621 | 166.9764 | 168.0856 | 152.5942 | 144.9279 | 161.2677 | 161.6838 | 172.1583 | 180.2289 | 192.6210  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2057.5253 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2750.5188 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 325.0756  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5208.1196 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2750.5188          | 0.2160                        | 594.1121 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2057.5253          | 0.2160                        | 444.4255 (264)           |
| Space and water heating                                                                           |                    |                               | 1038.5375 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 325.0756           | 0.5190                        | 168.7142 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1246.1767 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 14.0343 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.2799 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5260 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (14.0343 * 1.00) + 2.2799 + 0.5260, rounded to 2 d.p. |                    |                               | 16.8400 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-0-02                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 83 B                                                                    | DER           | 17.02   | TER            | 17.58      |
| Environmental                      | 88 B                                                                    | % DER<TER     | 3.18    |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.01                                                                    | DFEE          | 47.48   | TFEE           | 51.31      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 7.46    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Ground-floor flat, total floor area 74 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 17.58 kgCO<sub>2</sub>/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 17.02 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)51.3 kWh/m<sup>2</sup>/yr

Dwelling Fabric Energy Efficiency (DFEE)47.5 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | 0.11 (max. 0.25) | 0.11 (max. 0.70) | OK |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day

Permitted by DBSCG 0.32 Fail

Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls: No cylinderstat

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

Continuous supply and extract system

|                     |      |    |
|---------------------|------|----|
| Specific fan power: | 0.53 |    |
| Maximum             | 1.5  | OK |
| MVHR efficiency:    | 94%  |    |
| Minimum:            | 70%  | OK |

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail

Based on:

|                            |                                                                          |
|----------------------------|--------------------------------------------------------------------------|
| Overshading:               | Average                                                                  |
| Windows facing North East: | 3.35 m <sup>2</sup> , No overhang                                        |
| Windows facing North West: | 15.10 m <sup>2</sup> , Overhang width less than twice window, ratio 1.00 |
| Air change rate:           | 0.50 ach                                                                 |
| Blinds/curtains:           | None                                                                     |

#### 10 Key features

|                    |                                      |
|--------------------|--------------------------------------|
| Party wall U-value | 0.00 W/m <sup>2</sup> K              |
| Floor U-value      | 0.11 W/m <sup>2</sup> K              |
| Air permeability   | 3.0 m <sup>3</sup> /m <sup>2</sup> h |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 74.0000 (1b)              | x 2.5400 (2b)                   | = 187.9600 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 187.9600 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 2                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2631                       | 0.2599 | 0.2567    | 0.2408 | 0.2376 | 0.2216 | 0.2216                      | 0.2184      | 0.2280 | 0.2376 | 0.2439 | 0.2503 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364      |                                | (27)                                                 |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                | (26a)                                                |
| W01 (Uw = 1.40)                                                |                         |                            | 10.0500                   | 1.3258                        | 13.3239      |                                | (27)                                                 |
| Heat Loss Floor 1                                              |                         |                            | 74.0000                   | 0.1100                        | 8.1400       | 110.0000                       | 8140.0000 (28a)                                      |
| External Wall 1                                                | 49.5300                 | 20.5500                    | 28.9800                   | 0.1500                        | 4.3470       | 140.0000                       | 4057.2000 (29a)                                      |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 123.5300                  |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      | 39.8872                       |              |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 42.5000                   | 0.0000                        | 0.0000       | 140.0000                       | 5950.0000 (32)                                       |
| Party Ceilings                                                 |                         |                            | 74.0000                   |                               |              | 80.0000                        | 5920.0000 (32b)                                      |
| Internal Wall                                                  |                         |                            | 132.0000                  |                               |              | 9.0000                         | 1188.0000 (32c)                                      |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 25255.2000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 341.2865 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 7.7649 (36)                                          |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 47.6521 (37)                           |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 16.3169 | 16.1192 | 15.9215 | 14.9330 | 14.7352 | 13.7467 | 13.7467 | 13.5490 | 14.1421 | 14.7352 | 15.1307 | 15.5261 (38) |
| Heat transfer coeff       | 63.9691 | 63.7713 | 63.5736 | 62.5851 | 62.3874 | 61.3988 | 61.3988 | 61.2011 | 61.7942 | 62.3874 | 62.7828 | 63.1782 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 62.5357 (39) |
| HLP                       | 0.8644  | 0.8618  | 0.8591  | 0.8457  | 0.8431  | 0.8297  | 0.8297  | 0.8270  | 0.8351  | 0.8431  | 0.8484  | 0.8538 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.8451 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |              |             |             |             |             |             |             |             |             |              |                   |
|------------------------------------------|--------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------------|
| Assumed occupancy                        |              |              |             |             |             |             |             |             |             |             |              | 2.3392 (42)       |
| Average daily hot water use (litres/day) |              |              |             |             |             |             |             |             |             |             |              | 94.4799 (43)      |
| Daily hot water use                      | Jan 103.9278 | Feb 100.1486 | Mar 96.3694 | Apr 92.5903 | May 88.8111 | Jun 85.0319 | Jul 85.0319 | Aug 88.8111 | Sep 92.5903 | Oct 96.3694 | Nov 100.1486 | Dec 103.9278 (44) |
| Energy conte                             | 154.1220     | 134.7961     | 139.0975    | 121.2685    | 116.3601    | 100.4099    | 93.0445     | 106.7699    | 108.0451    | 125.9162    | 137.4473     | 149.2589 (45)     |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                                    |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------------------------------|
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = 1486.5360 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |          |                                    |
| 23.1183                                                         | 20.2194  | 20.8646  | 18.1903  | 17.4540  | 15.0615  | 13.9567  | 16.0155  | 16.2068  | 18.8874  | 20.6171  | 22.3888  | (46)                               |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |                                    |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)                        |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)                        |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)                        |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)                        |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |                                    |
| 22.9400                                                         | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | (56)                               |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |                                    |
| 22.9400                                                         | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | (57)                               |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | (59)                               |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |                                    |
| 200.3244                                                        | 176.5273 | 185.2999 | 165.9805 | 162.5625 | 145.1219 | 139.2469 | 152.9723 | 152.7571 | 172.1186 | 182.1593 | 195.4613 | (62)                               |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (63)                               |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)                        |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |                                    |
| 200.3244                                                        | 176.5273 | 185.2999 | 165.9805 | 162.5625 | 145.1219 | 139.2469 | 152.9723 | 152.7571 | 172.1186 | 182.1593 | 195.4613 | (64)                               |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |                                    |
| 88.2075                                                         | 78.2047  | 83.2118  | 76.0914  | 75.6516  | 69.1559  | 67.8992  | 72.4629  | 71.6946  | 78.8290  | 81.4708  | 86.5905  | (65)                               |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |      |
| (66)m                                                                               | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |      |
| 18.4049                                                                             | 16.3471  | 13.2943  | 10.0647  | 7.5235   | 6.3516   | 6.8632   | 8.9210   | 11.9737  | 15.2034  | 17.7446  | 18.9165  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |      |
| 206.4473                                                                            | 208.5895 | 203.1911 | 191.6984 | 177.1909 | 163.5559 | 154.4469 | 152.3047 | 157.7031 | 169.1958 | 183.7033 | 197.3383 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |      |
| 34.6960                                                                             | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | (69) |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |      |
| -93.5678                                                                            | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |      |
| 118.5584                                                                            | 116.3760 | 111.8439 | 105.6825 | 101.6823 | 96.0498  | 91.2624  | 97.3964  | 99.5758  | 105.9530 | 113.1539 | 116.3851 | (72) |
| Total internal gains                                                                | 401.4985 | 399.4005 | 386.4172 | 365.5335 | 344.4846 | 324.0453 | 310.6604 | 316.7100 | 327.3406 | 348.4402 | 372.6898 | (73) |

#### 6. Solar gains

|             |          |            |          |               |               |          |          |          |          |          |          |               |
|-------------|----------|------------|----------|---------------|---------------|----------|----------|----------|----------|----------|----------|---------------|
| [Jan]       |          |            |          |               |               |          |          |          |          |          |          |               |
|             | Area     | Solar flux | g        | Specific data | FF            | Access   | Gains    |          |          |          |          |               |
|             | m2       | Table 6a   | W/m2     | or Table 6b   | Specific data | factor   | W        |          |          |          |          |               |
|             |          |            |          |               | or Table 6c   | Table 6d |          |          |          |          |          |               |
| Northwest   | 8.4000   | 11.2829    | 0.3700   | 0.8900        | 0.7700        | 21.6285  | (81)     |          |          |          |          |               |
| Northeast   | 3.3500   | 11.2829    | 0.3700   | 0.6500        | 0.7700        | 6.2996   | (75)     |          |          |          |          |               |
| Northwest   | 6.7000   | 11.2829    | 0.3700   | 0.6500        | 0.7700        | 12.5993  | (81)     |          |          |          |          |               |
| Solar gains | 40.5274  | 82.4947    | 148.6293 | 244.0919      | 328.1075      | 349.7973 | 327.2282 | 260.8701 | 181.1071 | 100.8151 | 50.9940  | 33.0967 (83)  |
| Total gains | 442.0260 | 481.8952   | 535.0465 | 609.6254      | 672.5921      | 673.8426 | 637.8886 | 577.5801 | 508.4477 | 449.2553 | 423.6837 | 423.8245 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |          |          |          |          |          |          |          |          |          |          |          |              |
|-----------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |          |          |          |          |          |          |          |          |          |          |          | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |          |          |          |          |          |          |          |          |          |          |          |              |
| Jan                                                                         | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |              |
| tau                                                                         | 109.6676 | 110.0076 | 110.3497 | 112.0927 | 112.4480 | 114.2584 | 114.2584 | 114.6276 | 113.5273 | 112.4480 | 111.7398 | 111.0404     |
| alpha                                                                       | 8.3112   | 8.3338   | 8.3566   | 8.4728   | 8.4965   | 8.6172   | 8.6172   | 8.6418   | 8.5685   | 8.4965   | 8.4493   | 8.4027       |
| util living area                                                            | 0.9996   | 0.9990   | 0.9955   | 0.9644   | 0.8179   | 0.5808   | 0.4234   | 0.4869   | 0.8018   | 0.9860   | 0.9989   | 0.9997 (86)  |
| MIT                                                                         | 20.3571  | 20.4402  | 20.6003  | 20.8257  | 20.9690  | 20.9984  | 20.9999  | 20.9997  | 20.9807  | 20.7881  | 20.5376  | 20.3445 (87) |
| Th 2                                                                        | 20.1978  | 20.2001  | 20.2024  | 20.2139  | 20.2162  | 20.2277  | 20.2277  | 20.2300  | 20.2231  | 20.2162  | 20.2116  | 20.2070 (88) |
| util rest of house                                                          | 0.9994   | 0.9986   | 0.9934   | 0.9484   | 0.7649   | 0.5120   | 0.3491   | 0.4057   | 0.7281   | 0.9770   | 0.9982   | 0.9996 (89)  |
| MIT 2                                                                       | 19.3332  | 19.4565  | 19.6915  | 20.0180  | 20.1908  | 20.2268  | 20.2276  | 20.2299  | 20.2107  | 19.9734  | 19.6085  | 19.3223 (90) |
| Living area fraction                                                        |          |          |          |          |          |          |          |          |          |          |          |              |
| MIT                                                                         | 19.6819  | 19.7915  | 20.0010  | 20.2931  | 20.4558  | 20.4896  | 20.4906  | 20.4920  | 20.4729  | 20.2508  | 19.9249  | 19.6704 (92) |
| Temperature adjustment                                                      |          |          |          |          |          |          |          |          |          |          |          | 0.0000       |
| adjusted MIT                                                                | 19.6819  | 19.7915  | 20.0010  | 20.2931  | 20.4558  | 20.4896  | 20.4906  | 20.4920  | 20.4729  | 20.2508  | 19.9249  | 19.6704 (93) |

#### 8. Space heating requirement

|                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec          |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|-------|
| Utilisation          | 0.9993   | 0.9983   | 0.9927   | 0.9503   | 0.7819   | 0.5355   | 0.3744   | 0.4334   | 0.7531   | 0.9775   | 0.9979   | 0.9995       | (94)  |
| Useful gains         | 441.7110 | 481.0617 | 531.1170 | 579.3158 | 525.9146 | 360.8266 | 238.8479 | 250.3330 | 382.9203 | 439.1543 | 422.7975 | 423.6100     | (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000       | (96)  |
| Heat loss rate W     | 983.9667 | 949.6509 | 858.3071 | 713.0376 | 546.2501 | 361.6134 | 238.8795 | 250.4367 | 393.8102 | 602.0897 | 805.1840 | 977.3933     | (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000       | (97a) |
| Space heating kWh    | 403.4383 | 314.8919 | 243.4295 | 96.2797  | 15.1296  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 121.2239 | 275.3183 | 412.0147     | (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |          |          | 1881.7258    | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 25.4287      | (99)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | (98) / (4) = |       |

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8c. Space cooling requirement  
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Not applicable

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9b. Energy requirements  
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|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 1881.7258 | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 2069.8984 | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 2030.5320 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 2233.5852 | (310a) |
| Electricity used for heat distribution                                                  | 43.0348   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |           |        |
| mechanical ventilation fans (SFP = 0.6625)                                              | 151.9187  | (330a) |
| Total electricity for the above, kWh/year                                               | 151.9187  | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 325.0367  | (332)  |
| Total delivered energy for all uses                                                     | 4780.4390 | (338)  |

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12b. Carbon dioxide emissions - Community heating scheme  
-----

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 4583.0496          | 0.2160                        | 989.9387 (367)           |
| Electrical energy for heat distribution                                                    | 43.0348            | 0.5190                        | 22.3351 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 1012.2738 (373)          |
| Space and water heating                                                                    |                    |                               | 1012.2738 (376)          |
| Pumps and fans                                                                             | 151.9187           | 0.5190                        | 78.8458 (378)            |
| Energy for lighting                                                                        | 325.0367           | 0.5190                        | 168.6941 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1259.8136 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 17.0200 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |         |     |
|---------------------------------------------------------------------------------|-----|---------|-----|
| DER                                                                             |     | 17.0200 | ZC1 |
| Total Floor Area                                                                | TFA | 74.0000 |     |
| Assumed number of occupants                                                     | N   | 2.3392  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |     | 16.5319 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.3668  | ZC3 |
| Total CO2 emissions                                                             |     | 35.9187 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |     | 35.9187 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 74.0000 (1b)              | x 2.5400 (2b)                   | = 187.9600 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 187.9600 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | =               | 0 * 40 = 0.0000 (6a)    |
| Number of open flues                                                      | 0               | +                    | 0                           | =               | 0 * 20 = 0.0000 (6b)    |
| Number of intermittent fans                                               |                 |                      |                             |                 | 3 * 10 = 30.0000 (7a)   |
| Number of passive vents                                                   |                 |                      |                             |                 | 0 * 10 = 0.0000 (7b)    |
| Number of flueless gas fires                                              |                 |                      |                             |                 | 0 * 40 = 0.0000 (7c)    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 30.0000 / (5) = | 0.1596 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.4096 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 2 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.8500 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3482 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4439 | 0.4352 | 0.4265 | 0.3830 | 0.3743 | 0.3308 | 0.3308 | 0.3221 | 0.3482 | 0.3743 | 0.3917 | 0.4091 (22b) |
|                 | 0.5985 | 0.5947 | 0.5910 | 0.5733 | 0.5700 | 0.5547 | 0.5547 | 0.5519 | 0.5606 | 0.5700 | 0.5767 | 0.5837 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------------|------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|------|
| TER Semi-glazed door                                                |                |                | 2.1000               | 1.2000           | 2.5200         |                   |                | (26a)          |                |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                | 16.4100              | 1.3258           | 21.7557        |                   |                | (27)           |                |                |                |                |      |
| Heat Loss Floor 1                                                   |                |                | 74.0000              | 0.1300           | 9.6200         |                   |                | (28a)          |                |                |                |                |      |
| External Wall 1                                                     | 49.5300        | 18.5100        | 31.0200              | 0.1800           | 5.5836         |                   |                | (29a)          |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 123.5300             |                  |                |                   |                | (31)           |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26)...(30) + (32) = |                  | 39.4793        |                   |                | (33)           |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                      |                  |                |                   | 250.0000       | (35)           |                |                |                |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                      |                  |                |                   | 5.5349         | (36)           |                |                |                |                |      |
| Total fabric heat loss                                              |                |                |                      |                  |                | (33) + (36) =     | 45.0142        | (37)           |                |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                      |                  |                |                   |                |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>37.1249 | Feb<br>36.8875 | Mar<br>36.6549       | Apr<br>35.5623   | May<br>35.3579 | Jun<br>34.4063    | Jul<br>34.4063 | Aug<br>34.2301 | Sep<br>34.7729 | Oct<br>35.3579 | Nov<br>35.7715 | Dec<br>36.2038 | (38) |
| Heat transfer coeff                                                 | 82.1390        | 81.9017        | 81.6691              | 80.5765          | 80.3721        | 79.4205           | 79.4205        | 79.2443        | 79.7870        | 80.3721        | 80.7856        | 81.2180        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                      |                  |                |                   |                |                |                |                |                | 80.5755        | (39) |
| HLP                                                                 | Jan<br>1.1100  | Feb<br>1.1068  | Mar<br>1.1036        | Apr<br>1.0889    | May<br>1.0861  | Jun<br>1.0732     | Jul<br>1.0732  | Aug<br>1.0709  | Sep<br>1.0782  | Oct<br>1.0861  | Nov<br>1.0917  | Dec<br>1.0975  | (40) |
| HLP (average)                                                       |                |                |                      |                  |                |                   |                |                |                |                |                | 1.0889         | (40) |
| Days in month                                                       | 31             | 28             | 31                   | 30               | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |          |          |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|----------|----------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |          |          |                    |          | 2.3392 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |          |          |                    |          | 89.7559 (43)   |
| Daily hot water use                                         | 98.7314  | 95.1412  | 91.5510  | 87.9607  | 84.3705  | 80.7803 | 80.7803 | 84.3705  | 87.9607  | 91.5510            | 95.1412  | 98.7314 (44)   |
| Energy conte                                                | 146.4159 | 128.0563 | 132.1426 | 115.2051 | 110.5421 | 95.3894 | 88.3923 | 101.4314 | 102.6429 | 119.6204           | 130.5750 | 141.7960 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |          | 1412.2092 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 21.9624  | 19.2084  | 19.8214  | 17.2808  | 16.5813  | 14.3084 | 13.2588 | 15.2147  | 15.3964  | 17.9431            | 19.5862  | 21.2694 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |          |          |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |          |          |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |          |          |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |          |          |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |          |          |                    |          | 0.1290 (55)    |
| Total storage loss                                          |          |          |          |          |          |         |         |          |          |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 173.6760 | 152.6783 | 159.4027 | 141.5859 | 137.8022 | 121.7702 | 115.6524 | 128.6916 | 129.0236 | 146.8805 | 156.9558 | 169.0561 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 173.6760 | 152.6783 | 159.4027 | 141.5859 | 137.8022 | 121.7702 | 115.6524 | 128.6916 | 129.0236 | 146.8805 | 156.9558 | 169.0561 (64) |
|                                                                 | 70.4914  | 62.2764  | 65.7455  | 59.4103  | 58.5633  | 52.8216  | 51.1986  | 55.5341  | 55.2334  | 61.5819  | 64.5208  | 68.9553 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 18.4071  | 16.3490  | 13.2959  | 10.0659  | 7.5244   | 6.3524   | 6.8640   | 8.9221   | 11.9752  | 15.2052  | 17.7467  | 18.9187  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 206.4473 | 208.5895 | 203.1911 | 191.6984 | 177.1909 | 163.5559 | 154.4469 | 152.3047 | 157.7031 | 169.1958 | 183.7033 | 197.3383 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | (71) |
| Water heating gains (Table 5)                                                       | 94.7465  | 92.6732  | 88.3676  | 82.5143  | 78.7142  | 73.3633  | 68.8153  | 74.6426  | 76.7130  | 82.7713  | 89.6122  | 92.6818  | (72) |
| Total internal gains                                                                | 380.6888 | 378.6997 | 365.9426 | 345.3665 | 324.5174 | 304.3596 | 291.2141 | 296.9572 | 307.4792 | 328.2603 | 352.1502 | 370.0267 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area     | Solar flux | g           |          | FF          | Access   |          | Gains        |               |
|-------------|----------|----------|----------|----------|------------|-------------|----------|-------------|----------|----------|--------------|---------------|
|             |          |          |          | m2       | Table 6a   | or Table 6b |          | or Table 6c | factor   |          | W            |               |
|             |          |          |          |          | W/m2       |             |          |             | Table 6d |          |              |               |
| Northeast   |          |          |          | 2.9800   | 11.2829    | 0.6300      |          | 0.7000      | 0.7700   |          | 10.2757 (75) |               |
| Northwest   |          |          |          | 13.4300  | 11.2829    | 0.6300      |          | 0.7000      | 0.7700   |          | 46.3095 (81) |               |
|             |          |          |          |          |            |             |          |             |          |          |              |               |
| Solar gains | 56.5852  | 115.1808 | 207.5191 | 340.8060 | 458.1102   | 488.3939    | 456.8825 | 364.2320    | 252.8653 | 140.7600 | 71.1988      | 46.2103 (83)  |
| Total gains | 437.2740 | 493.8804 | 573.4617 | 686.1725 | 782.6275   | 792.7535    | 748.0966 | 661.1892    | 560.3445 | 469.0203 | 423.3490     | 416.2370 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 62.5633 | 62.7446 | 62.9233 | 63.7765 | 63.9387 | 64.7048 | 64.7048 | 64.8487 | 64.4076 | 63.9387 | 63.6114 | 63.2728 |              |
| alpha                                                                       | 5.1709  | 5.1830  | 5.1949  | 5.2518  | 5.2626  | 5.3137  | 5.3137  | 5.3232  | 5.2938  | 5.2626  | 5.2408  | 5.2182  |              |
| util living area                                                            | 0.9982  | 0.9961  | 0.9879  | 0.9473  | 0.8204  | 0.6181  | 0.4627  | 0.5407  | 0.8336  | 0.9784  | 0.9962  | 0.9986  | (86)         |
| MIT                                                                         | 19.8043 | 19.9426 | 20.2094 | 20.5830 | 20.8647 | 20.9764 | 20.9958 | 20.9909 | 20.8927 | 20.5160 | 20.1006 | 19.7842 | (87)         |
| Th 2                                                                        | 19.9927 | 19.9953 | 19.9979 | 20.0099 | 20.0122 | 20.0227 | 20.0227 | 20.0247 | 20.0187 | 20.0122 | 20.0076 | 20.0028 | (88)         |
| util rest of house                                                          | 0.9975  | 0.9948  | 0.9836  | 0.9287  | 0.7672  | 0.5334  | 0.3623  | 0.4315  | 0.7615  | 0.9677  | 0.9947  | 0.9981  | (89)         |
| MIT 2                                                                       | 18.3959 | 18.5995 | 18.9888 | 19.5250 | 19.8850 | 20.0079 | 20.0212 | 20.0211 | 19.9329 | 19.4431 | 18.8397 | 18.3738 | (90)         |
| Living area fraction                                                        | 18.8755 | 19.0568 | 19.4044 | 19.8853 | 20.2186 | 20.3378 | 20.3531 | 20.3513 | 20.2598 | 19.8084 | 19.2691 | 18.8541 | (92)         |
| Temperature adjustment                                                      | 18.8755 | 19.0568 | 19.4044 | 19.8853 | 20.2186 | 20.3378 | 20.3531 | 20.3513 | 20.2598 | 19.8084 | 19.2691 | 18.8541 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |          |          |           |       |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 435.7521  | 490.4623  | 562.1247  | 635.3230 | 609.9123 | 445.1543 | 296.7198 | 310.0100 | 437.7826 | 452.4935 | 420.4194 | 415.1094  | (94)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Heat loss rate W     | 1197.2172 | 1159.4695 | 1053.8945 | 885.1574 | 684.6607 | 455.6950 | 298.0731 | 313.1211 | 491.4692 | 740.0999 | 983.0863 | 1190.1742 | (97)  |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating kWh    | 566.5300  | 449.5729  | 365.8767  | 179.8808 | 55.6127  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 213.9792 | 405.1201 | 576.6482  | (98)  |
| Space heating        |           |           |           |          |          |          |          |          |          |          |          | 2813.2207 | (98)  |
| Space heating per m2 |           |           |           |          |          |          |          |          |          |          |          | 38.0165   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 3008.7922 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 566.5300 | 449.5729 | 365.8767 | 179.8808 | 55.6127  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 213.9792 | 405.1201 | 576.6482  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 605.9145 | 480.8266 | 391.3120 | 192.3859 | 59.4789  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 228.8547 | 433.2835 | 616.7360  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 173.6760 | 152.6783 | 159.4027 | 141.5859 | 137.8022 | 121.7702 | 115.6524 | 128.6916 | 129.0236 | 146.8805 | 156.9558 | 169.0561  | (64)            |
| Efficiency of water heater (217)m                                     | 87.7397  | 87.5248  | 86.9615  | 85.4535  | 82.6083  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.8164  | 87.2338  | 87.8301   | (217)           |
| Fuel for water heating, kWh/month                                     | 197.9447 | 174.4400 | 183.3026 | 165.6878 | 166.8140 | 152.5942 | 144.9279 | 161.2677 | 161.6838 | 171.1566 | 179.9255 | 192.4807  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2052.2254 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3008.7922 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 325.0756  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5461.0931 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 3008.7922          | 0.2160                        | 649.8991 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2052.2254          | 0.2160                        | 443.2807 (264)           |
| Space and water heating                                                                           |                    |                               | 1093.1798 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 325.0756           | 0.5190                        | 168.7142 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1300.8190 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 14.7727 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.2799 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5260 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (14.7727 * 1.00) + 2.2799 + 0.5260, rounded to 2 d.p. |                    |                               | 17.5800 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-0-06                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 85 B                                                                    | DER           | 14.65   | TER            | 15.30      |
| Environmental                      | 88 B                                                                    | % DER<TER     | 4.27    |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.19                                                                    | DFEE          | 43.30   | TFEE           | 47.30      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 8.45    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Ground-floor flat, total floor area 102 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 15.30 kgCO<sub>2</sub>/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 14.65 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)47.3 kWh/m<sup>2</sup>/yr

Dwelling Fabric Energy Efficiency (DFEE)43.3 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | 0.11 (max. 0.25) | 0.11 (max. 0.70) | OK |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day

Permitted by DBSCG 0.32 Fail

Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls: No cylinderstat

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

Continuous supply and extract system

|                     |      |    |
|---------------------|------|----|
| Specific fan power: | 0.53 |    |
| Maximum             | 1.5  | OK |
| MVHR efficiency:    | 94%  |    |
| Minimum:            | 70%  | OK |

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail

Based on:

|                            |                                    |
|----------------------------|------------------------------------|
| Overshading:               | Average                            |
| Windows facing East:       | 7.61 m <sup>2</sup> , No overhang  |
| Windows facing South West: | 15.08 m <sup>2</sup> , No overhang |
| Air change rate:           | 0.50 ach                           |
| Blinds/curtains:           | None                               |

#### 10 Key features

|                    |                                      |
|--------------------|--------------------------------------|
| Party wall U-value | 0.00 W/m <sup>2</sup> K              |
| Floor U-value      | 0.11 W/m <sup>2</sup> K              |
| Air permeability   | 3.0 m <sup>3</sup> /m <sup>2</sup> h |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 102.0000 (1b)             | x 2.5400 (2b)                   | = 259.0800 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 102.0000                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 259.0800 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |        |             |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |        |             |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)   |             |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 1                           | (19)   |             |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.9250 | (20)        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1388 | (21)        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1769                       | 0.1734 | 0.1700    | 0.1526 | 0.1492 | 0.1318 | 0.1318                      | 0.1283 | 0.1388      | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2774                       | 0.2739 | 0.2705    | 0.2531 | 0.2497 | 0.2323 | 0.2323                      | 0.2288 | 0.2393      | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W08 (Uw = 1.40)                                                |                         |                            | 11.2800                   | 1.3258                        | 14.9545      |                                | (27)                                                 |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                | (26a)                                                |
| W11 (Uw = 1.40)                                                |                         |                            | 11.4100                   | 1.3258                        | 15.1269      |                                | (27)                                                 |
| Heat Loss Floor 1                                              |                         |                            | 102.0000                  | 0.1100                        | 11.2200      | 110.0000                       | 11220.0000 (28a)                                     |
| External Wall 1                                                | 71.1000                 | 22.6900                    | 48.4100                   | 0.1500                        | 7.2615       | 140.0000                       | 6777.4000 (29a)                                      |
| Corridor wall                                                  | 3.8000                  | 2.1000                     | 1.7000                    | 0.1409                        | 0.2395       | 110.0000                       | 187.0000 (29a)                                       |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 176.9000                  |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 51.7425      |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 45.7000                   | 0.0000                        | 0.0000       | 140.0000                       | 6398.0000 (32)                                       |
| Party Ceilings                                                 |                         |                            | 102.0000                  |                               |              | 80.0000                        | 8160.0000 (32b)                                      |
| Internal Wall                                                  |                         |                            | 166.0000                  |                               |              | 9.0000                         | 1494.0000 (32c)                                      |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 34236.4000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 335.6510 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 11.3039 (36)                                         |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 63.0464 (37)                           |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 23.7172 | 23.4207 | 23.1241 | 21.6413 | 21.3447 | 19.8619 | 19.8619 | 19.5653 | 20.4550 | 21.3447 | 21.9378 | 22.5310 (38) |
| Heat transfer coeff       | 86.7636 | 86.4671 | 86.1705 | 84.6877 | 84.3911 | 82.9083 | 82.9083 | 82.6117 | 83.5014 | 84.3911 | 84.9842 | 85.5774 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 84.6135 (39) |
| HLP                       | 0.8506  | 0.8477  | 0.8448  | 0.8303  | 0.8274  | 0.8128  | 0.8128  | 0.8099  | 0.8186  | 0.8274  | 0.8332  | 0.8390 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.8295 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |          |         |         |         |         |          |          |          |               |
|------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|----------|---------------|
| Assumed occupancy                        |          |          |          |          |         |         |         |         |          |          |          | 2.7573 (42)   |
| Average daily hot water use (litres/day) |          |          |          |          |         |         |         |         |          |          |          | 104.9321 (43) |
| Jan                                      | 115.4253 | 111.2280 | 107.0308 | 102.8335 | 98.6362 | 94.4389 | 94.4389 | 98.6362 | 102.8335 | 107.0308 | 111.2280 | 115.4253 (44) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Energy content (annual)                                         | 171.1724 | 149.7085 | 154.4858 | 134.6844 | 129.2329 | 111.5182 | 103.3380 | 118.5819 | 119.9981 | 139.8462 | 152.6531 | 165.7714 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          | 25.6759  | 22.4563  | 23.1729  | 20.2027  | 19.3849  | 16.7277  | 15.5007  | 17.7873  | 17.9997  | 20.9769  | 22.8980  | 24.8657 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)    |
| Total storage loss                                              | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month | 217.3748 | 191.4397 | 200.6882 | 179.3964 | 175.4353 | 156.2302 | 149.5404 | 164.7843 | 164.7101 | 186.0486 | 197.3651 | 211.9738 (62)  |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)    |
| Output from w/h                                                 | 217.3748 | 191.4397 | 200.6882 | 179.3964 | 175.4353 | 156.2302 | 149.5404 | 164.7843 | 164.7101 | 186.0486 | 197.3651 | 211.9738 (64)  |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |          |          |          |          |          |          |          | 2194.9869 (64) |
| Heat gains from water heating, kWh/month                        | 93.8768  | 83.1630  | 88.3284  | 80.5522  | 79.9319  | 72.8494  | 71.3218  | 76.3904  | 75.6690  | 83.4608  | 86.5267  | 92.0809 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 23.1365   | 20.5496   | 16.7121   | 12.6521   | 9.4576    | 7.9845    | 8.6275    | 11.2144   | 15.0520   | 19.1119   | 22.3064   | 23.7795 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 259.5211  | 262.2141  | 255.4278  | 240.9805  | 222.7434  | 205.6032  | 194.1524  | 191.4594  | 198.2457  | 212.6930  | 230.9300  | 248.0703 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864 (69)   |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 (71) |
| Water heating gains (Table 5)                                                       | 126.1784  | 123.7545  | 118.7210  | 111.8780  | 107.4353  | 101.1797  | 95.8626   | 102.6753  | 105.0958  | 112.1785  | 120.1760  | 123.7646 (72)  |
| Total internal gains                                                                | 473.1953  | 470.8775  | 455.2201  | 429.8699  | 403.9956  | 379.1267  | 363.0019  | 369.7083  | 382.7527  | 408.3426  | 437.7718  | 459.9738 (73)  |

#### 6. Solar gains

| [Jan]       |            |          |          |          |                                |          |                                   |          |                                    |          |                              |          |              |  |
|-------------|------------|----------|----------|----------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|--------------|--|
|             | Area<br>m2 |          |          |          | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W   |  |
| Southwest   | 11.2800    |          |          |          | 36.7938                        |          | 0.3700                            |          | 0.8900                             |          | 0.7700                       |          | 94.7129 (79) |  |
| East        | 7.6100     |          |          |          | 19.6403                        |          | 0.3700                            |          | 0.6800                             |          | 0.7700                       |          | 26.0601 (76) |  |
| Southwest   | 3.8000     |          |          |          | 36.7938                        |          | 0.3700                            |          | 0.6800                             |          | 0.7700                       |          | 24.3782 (79) |  |
| Solar gains | 145.1512   | 253.8353 | 361.5120 | 466.3500 | 535.2631                       | 536.0306 | 514.9372                          | 463.5048 | 398.1787                           | 284.6903 | 175.1376                     | 123.3477 | (83)         |  |
| Total gains | 618.3465   | 724.7128 | 816.7322 | 896.2200 | 939.2587                       | 915.1573 | 877.9391                          | 833.2131 | 780.9315                           | 693.0330 | 612.9094                     | 583.3215 | (84)         |  |

#### 7. Mean internal temperature (heating season)

|                                                                             |          |          |          |          |          |          |          |          |          |          |          |              |
|-----------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |          |          |          |          |          |          |          |          |          |          |          | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec          |
| tau                                                                         | 109.6094 | 109.9854 | 110.3639 | 112.2963 | 112.6909 | 114.7064 | 114.7064 | 115.1182 | 113.8916 | 112.6909 | 111.9044 | 111.1288     |
| alpha                                                                       | 8.3073   | 8.3324   | 8.3576   | 8.4864   | 8.5127   | 8.6471   | 8.6471   | 8.6745   | 8.5928   | 8.5127   | 8.4603   | 8.4086       |
| util living area                                                            | 0.9995   | 0.9979   | 0.9899   | 0.9441   | 0.7992   | 0.5776   | 0.4154   | 0.4558   | 0.7228   | 0.9685   | 0.9981   | 0.9997 (86)  |
| MIT                                                                         | 20.3710  | 20.4934  | 20.6659  | 20.8644  | 20.9741  | 20.9985  | 20.9999  | 20.9998  | 20.9911  | 20.8432  | 20.5677  | 20.3520 (87) |
| Th 2                                                                        | 20.2097  | 20.2122  | 20.2147  | 20.2272  | 20.2297  | 20.2422  | 20.2422  | 20.2447  | 20.2372  | 20.2297  | 20.2247  | 20.2197 (88) |
| util rest of house                                                          | 0.9993   | 0.9970   | 0.9855   | 0.9223   | 0.7462   | 0.5104   | 0.3439   | 0.3811   | 0.6501   | 0.9514   | 0.9971   | 0.9996 (89)  |
| MIT 2                                                                       | 19.3643  | 19.5450  | 19.7964  | 20.0797  | 20.2086  | 20.2415  | 20.2422  | 20.2447  | 20.2319  | 20.0591  | 19.6642  | 19.3446 (90) |
| Living area fraction                                                        | 19.7364  | 19.8956  | 20.1177  | 20.3697  | 20.4915  | 20.5213  | 20.5223  | 20.5238  | 20.5125  | 20.3489  | 19.9981  | 19.7169 (92) |
| MIT                                                                         | 19.7364  | 19.8956  | 20.1177  | 20.3697  | 20.4915  | 20.5213  | 20.5223  | 20.5238  | 20.5125  | 20.3489  | 19.9981  | 19.7169 (93) |
| Temperature adjustment                                                      |          |          |          |          |          |          |          |          |          |          |          | 0.0000       |
| adjusted MIT                                                                | 19.7364  | 19.8956  | 20.1177  | 20.3697  | 20.4915  | 20.5213  | 20.5223  | 20.5238  | 20.5125  | 20.3489  | 19.9981  | 19.7169 (93) |

#### 8. Space heating requirement

|                   | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec            |
|-------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Utilisation       | 0.9991    | 0.9965    | 0.9848    | 0.9269   | 0.7650   | 0.5353   | 0.3704   | 0.4088   | 0.6770   | 0.9545   | 0.9968    | 0.9994 (94)    |
| Useful gains      | 617.8042  | 722.1926  | 804.3025  | 830.6661 | 718.5060 | 489.8757 | 325.1500 | 340.5879 | 528.6959 | 661.5021 | 610.9256  | 582.9973 (95)  |
| Ext temp.         | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000 (96)    |
| Heat loss rate W  | 1339.3169 | 1296.6215 | 1173.4481 | 971.3416 | 741.9246 | 490.9211 | 325.1882 | 340.6739 | 535.4507 | 822.7185 | 1096.1374 | 1327.8995 (97) |
| Month fracti      | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000 (97a)   |
| Space heating kWh | 536.8054  | 386.0162  | 274.6443  | 101.2863 | 17.4234  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 119.9450 | 349.3525  | 554.2073 (98)  |
| Space heating     |           |           |           |          |          |          |          |          |          |          |           | 2339.6805 (98) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 22.9380 (99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 2339.6805 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 2573.6485 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2194.9869 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 2414.4855 (310a) |
| Electricity used for heat distribution                                                  | 49.8813 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 209.4014 (330a)  |
| Total electricity for the above, kWh/year                                               | 209.4014 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 408.5977 (332)   |
| Total delivered energy for all uses                                                     | 5606.1332 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 5312.1769          | 0.2160                        | 1147.4302 (367)          |
| Electrical energy for heat distribution                                                    | 49.8813            | 0.5190                        | 25.8884 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 1173.3186 (373)          |
| Space and water heating                                                                    |                    |                               | 1173.3186 (376)          |
| Pumps and fans                                                                             | 209.4014           | 0.5190                        | 108.6793 (378)           |
| Energy for lighting                                                                        | 408.5977           | 0.5190                        | 212.0622 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1494.0602 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 14.6500 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 14.6500 ZC1 |
| Total Floor Area                                                                | TFA | 102.0000    |
| Assumed number of occupants                                                     | N   | 2.7573      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 15.0771 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 1.8154 ZC3  |
| Total CO2 emissions                                                             |     | 31.5426 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 31.5426 ZC8 |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 102.0000 (1b)             | x 2.5400 (2b)                   | = 259.0800 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 102.0000                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 259.0800 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | 0                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | 0                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 4 * 10 =        | 40.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 40.0000 / (5) = | 0.1544 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.4044 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 1 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.9250 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3741 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4769 | 0.4676 | 0.4582 | 0.4115 | 0.4021 | 0.3554 | 0.3554 | 0.3460 | 0.3741 | 0.4021 | 0.4208 | 0.4395 (22b) |
| Effective ac    | 0.6137 | 0.6093 | 0.6050 | 0.5847 | 0.5808 | 0.5631 | 0.5631 | 0.5599 | 0.5700 | 0.5808 | 0.5885 | 0.5966 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 22.6900                   | 1.3258                        | 30.0814      |                                | (27)          |
| Heat Loss Floor 1                                              |                         |                            | 102.0000                  | 0.1300                        | 13.2600      |                                | (28a)         |
| External Wall 1                                                | 71.1000                 | 22.6900                    | 48.4100                   | 0.1800                        | 8.7138       |                                | (29a)         |
| Corridor wall                                                  | 3.8000                  | 2.1000                     | 1.7000                    | 0.1800                        | 0.3060       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 176.9000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 54.8812      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 8.9914 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 63.8726 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| (38)m                     | 52.4718  | 52.0942  | 51.7241  | 49.9858  | 49.6605  | 48.1465  | 48.1465  | 47.8661  | 48.7297  | 49.6605  | 50.3185  | 51.0064 (38)  |
| Heat transfer coeff       | 116.3445 | 115.9669 | 115.5968 | 113.8584 | 113.5332 | 112.0191 | 112.0191 | 111.7387 | 112.6023 | 113.5332 | 114.1911 | 114.8790 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 113.8569 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.1406 | 1.1369 | 1.1333 | 1.1163 | 1.1131 | 1.0982 | 1.0982 | 1.0955 | 1.1039 | 1.1131 | 1.1195 | 1.1263 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.1162 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |          |         |          |          |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |          |         |          |          |                    |          | 2.7573 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |          |         |          |          |                    |          | 99.6855 (43)   |
| Daily hot water use                                         | 109.6541 | 105.6666 | 101.6792 | 97.6918  | 93.7044  | 89.7170  | 89.7170 | 93.7044  | 97.6918  | 101.6792           | 105.6666 | 109.6541 (44)  |
| Energy conte                                                | 162.6138 | 142.2231 | 146.7615 | 127.9502 | 122.7713 | 105.9423 | 98.1711 | 112.6528 | 113.9982 | 132.8539           | 145.0204 | 157.4828 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |          |         |          |          | Total = Sum(45)m = |          | 1568.4413 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 24.3921  | 21.3335  | 22.0142  | 19.1925  | 18.4157  | 15.8913  | 14.7257 | 16.8979  | 17.0997  | 19.9281            | 21.7531  | 23.6224 (46)   |
| Water storage loss:                                         |          |          |          |          |          |          |         |          |          |                    |          |                |
| Store volume                                                |          |          |          |          |          |          |         |          |          |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |          |         |          |          |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |          |         |          |          |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |          |         |          |          |                    |          | 0.1290 (55)    |

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### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 189.8740 | 166.8451 | 174.0216 | 154.3310 | 150.0314 | 132.3231 | 125.4312 | 139.9129 | 140.3790 | 160.1140 | 171.4012 | 184.7429 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 189.8740 | 166.8451 | 174.0216 | 154.3310 | 150.0314 | 132.3231 | 125.4312 | 139.9129 | 140.3790 | 160.1140 | 171.4012 | 184.7429 (64) |
| Heat gains from water heating, kWh/month                        | 75.8772  | 66.9868  | 70.6063  | 63.6481  | 62.6296  | 56.3304  | 54.4500  | 59.2652  | 59.0090  | 65.9820  | 69.3239  | 74.1711 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 23.1376   | 20.5506   | 16.7129   | 12.6527   | 9.4581    | 7.9849    | 8.6280    | 11.2149   | 15.0527   | 19.1128   | 22.3075   | 23.7806 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 259.5211  | 262.2141  | 255.4278  | 240.9805  | 222.7434  | 205.6032  | 194.1524  | 191.4594  | 198.2457  | 212.6930  | 230.9300  | 248.0703 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864 (69)   |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 (71) |
| Water heating gains (Table 5)                                                       | 101.9855  | 99.6828   | 94.9009   | 88.4001   | 84.1795   | 78.2367   | 73.1855   | 79.6575   | 81.9570   | 88.6855   | 96.2832   | 99.6924 (72)   |
| Total internal gains                                                                | 452.0034  | 449.8067  | 434.4009  | 409.3926  | 383.7403  | 359.1840  | 343.3251  | 349.6911  | 362.6146  | 387.8506  | 416.8800  | 438.9026 (73)  |

#### 6. Solar gains

| [Jan]       |          |          |          |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W    |          |               |
|-------------|----------|----------|----------|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|---------------|----------|---------------|
| East        |          |          |          |           | 7.6100     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       | 45.6777 (76)  |          |               |
| Southwest   |          |          |          |           | 15.0800    | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       | 169.5697 (79) |          |               |
| -----       |          |          |          |           |            |                                |                                   |                                    |                              |               |          |               |
| Solar gains | 215.2473 | 378.1951 | 542.3586 | 704.2933  | 811.4994   | 813.7609                       | 781.3036                          | 701.2876                           | 599.0693                     | 425.2571      | 260.0601 | 182.6794 (83) |
| Total gains | 667.2508 | 828.0018 | 976.7595 | 1113.6859 | 1195.2397  | 1172.9450                      | 1124.6288                         | 1050.9786                          | 961.6839                     | 813.1077      | 676.9401 | 621.5820 (84) |
| -----       |          |          |          |           |            |                                |                                   |                                    |                              |               |          |               |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 60.8824 | 61.0807 | 61.2762 | 62.2118 | 62.3900 | 63.2333 | 63.2333 | 63.3919 | 62.9058                   | 62.3900 | 62.0305 | 61.6591      |
| alpha                                                                       | 5.0588  | 5.0720  | 5.0851  | 5.1475  | 5.1593  | 5.2156  | 5.2156  | 5.2261  | 5.1937                    | 5.1593  | 5.1354  | 5.1106       |
| util living area                                                            | 0.9971  | 0.9909  | 0.9722  | 0.9121  | 0.7816  | 0.5921  | 0.4349  | 0.4830  | 0.7380                    | 0.9495  | 0.9928  | 0.9979 (86)  |
| MIT                                                                         | 19.8216 | 20.0341 | 20.3290 | 20.6648 | 20.8873 | 20.9791 | 20.9965 | 20.9941 | 20.9376                   | 20.6211 | 20.1526 | 19.7889 (87) |
| Th 2                                                                        | 19.9678 | 19.9708 | 19.9737 | 19.9876 | 19.9902 | 20.0023 | 20.0023 | 20.0045 | 19.9976                   | 19.9902 | 19.9849 | 19.9794 (88) |
| util rest of house                                                          | 0.9961  | 0.9880  | 0.9631  | 0.8850  | 0.7241  | 0.5079  | 0.3381  | 0.3817  | 0.6558                    | 0.9277  | 0.9899  | 0.9972 (89)  |
| MIT 2                                                                       | 18.4032 | 18.7141 | 19.1394 | 19.6119 | 19.8874 | 19.9894 | 20.0011 | 20.0023 | 19.9522                   | 19.5669 | 18.8984 | 18.3638 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3696 (91)  |
| MIT                                                                         | 18.9274 | 19.2020 | 19.5791 | 20.0011 | 20.2570 | 20.3552 | 20.3690 | 20.3689 | 20.3164                   | 19.9565 | 19.3619 | 18.8905 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.9274 | 19.2020 | 19.5791 | 20.0011 | 20.2570 | 20.3552 | 20.3690 | 20.3689 | 20.3164                   | 19.9565 | 19.3619 | 18.8905 (93) |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |              |           |                |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|--------------|-----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov       | Dec            |
| Useful gains         | 0.9947    | 0.9850    | 0.9587    | 0.8854    | 0.7404   | 0.5385   | 0.3740   | 0.4193   | 0.6836   | 0.9268       | 0.9875    | 0.9962 (94)    |
| Ext temp.            | 663.6814  | 815.5886  | 936.4452  | 986.0461  | 884.9269 | 631.5766 | 420.6028 | 440.6414 | 657.4375 | 753.6179     | 668.4721  | 619.1937 (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000    | 4.2000 (96)    |
| Month fracti         | 1701.8192 | 1658.5530 | 1511.8966 | 1263.9509 | 971.5007 | 644.6966 | 422.1983 | 443.4760 | 699.9799 | 1062.2786    | 1400.2047 | 1687.6324 (97) |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000    | 1.0000 (97a)   |
| Space heating        | 772.3745  | 566.4721  | 428.1358  | 200.0915  | 64.4109  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 229.6436     | 526.8474  | 794.9184 (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          | (98) / (4) = |           | 35.1264 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 3831.9723 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 772.3745 | 566.4721 | 428.1358 | 200.0915 | 64.4109  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 229.6436 | 526.8474 | 794.9184  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 826.0690 | 605.8525 | 457.8993 | 214.0016 | 68.8887  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 245.6081 | 563.4732 | 850.1801  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 189.8740 | 166.8451 | 174.0216 | 154.3310 | 150.0314 | 132.3231 | 125.4312 | 139.9129 | 140.3790 | 160.1140 | 171.4012 | 184.7429  | (64)            |
| Efficiency of water heater (217)m                                     | 88.1673  | 87.8208  | 87.1239  | 85.5075  | 82.7383  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.7753  | 87.6162  | 88.2681   | (217)           |
| Fuel for water heating, kWh/month                                     | 215.3565 | 189.9836 | 199.7403 | 180.4882 | 181.3326 | 165.8184 | 157.1820 | 175.3295 | 175.9135 | 186.6669 | 195.6274 | 209.2975  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2232.7364 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3831.9723 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 408.6169  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 6548.3256 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 3831.9723          | 0.2160                        | 827.7060 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2232.7364          | 0.2160                        | 482.2711 (264)           |
| Space and water heating                                                                           |                    |                               | 1309.9771 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 408.6169           | 0.5190                        | 212.0722 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1560.9743 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.8429 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.0791 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.3816 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.8429 * 1.00) + 2.0791 + 0.3816, rounded to 2 d.p. |                    |                               | 15.3000 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-1-01                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be Lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 83 B                                                                    | DER           | 17.26   | TER            | 17.69      |
| Environmental                      | 89 B                                                                    | % DER<TER     | 2.44    |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.79                                                                    | DFEE          | 42.59   | TFEE           | 44.47      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 4.23    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 55 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 17.69 kgCO<sub>2</sub>/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 17.26 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)44.5 kWh/m<sup>2</sup>/yr

Dwelling Fabric Energy Efficiency (DFEE)42.6 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.14 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.38 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day

Permitted by DBSCG 0.32 Fail

Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls: No cylinderstat

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

Continuous supply and extract system

|                     |      |    |
|---------------------|------|----|
| Specific fan power: | 0.53 |    |
| Maximum             | 1.5  | OK |
| MVHR efficiency:    | 94%  |    |
| Minimum:            | 70%  | OK |

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail

Based on:

|                            |                                   |
|----------------------------|-----------------------------------|
| Overshading:               | Average                           |
| Windows facing North:      | 8.40 m <sup>2</sup> , No overhang |
| Windows facing North East: | 1.64 m <sup>2</sup> , No overhang |
| Windows facing South East: | 7.61 m <sup>2</sup> , No overhang |
| Air change rate:           | 0.50 ach                          |
| Blinds/curtains:           | None                              |

#### 10 Key features

|                    |                                      |
|--------------------|--------------------------------------|
| Party wall U-value | 0.00 W/m <sup>2</sup> K              |
| Air permeability   | 3.0 m <sup>3</sup> /m <sup>2</sup> h |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 54.5000 (1b)              | x 2.5400 (2b)                   | = 138.4300 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.4300 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes    |             |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000 |             |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 | (18)        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 3      | (19)        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20)        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1163 | (21)        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1482                       | 0.1453 | 0.1424    | 0.1279 | 0.1250 | 0.1104 | 0.1104                      | 0.1075 | 0.1163      | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2487                       | 0.2458 | 0.2429    | 0.2284 | 0.2255 | 0.2109 | 0.2109                      | 0.2080 | 0.2168      | 0.2255 | 0.2313 | 0.2371 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W05 (Uw = 1.40)                                                |                         |                            | 1.6400                    | 1.3258                        | 2.1742       |                                | (27)                                                 |
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364      |                                | (27)                                                 |
| W02 (Uw = 1.40)                                                |                         |                            | 7.6100                    | 1.3258                        | 10.0890      |                                | (27)                                                 |
| door                                                           |                         |                            | 2.1000                    | 1.2500                        | 2.6250       |                                | (26a)                                                |
| External Wall 1                                                | 32.4000                 | 17.6500                    | 14.7500                   | 0.1500                        | 2.2125       | 140.0000                       | 2065.0000 (29a)                                      |
| Corridor wall                                                  | 43.3000                 | 2.1000                     | 41.2000                   | 0.1409                        | 5.8055       | 110.0000                       | 4532.0000 (29a)                                      |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 75.7000                   |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 34.0427      |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 19.4000                   | 0.0000                        | 0.0000       | 140.0000                       | 2716.0000 (32)                                       |
| Party Floor 1                                                  |                         |                            | 54.5000                   |                               |              | 40.0000                        | 2180.0000 (32d)                                      |
| Party Ceilings                                                 |                         |                            | 54.5000                   |                               |              | 80.0000                        | 4360.0000 (32b)                                      |
| Internal Wall                                                  |                         |                            | 73.4000                   |                               |              | 9.0000                         | 660.6000 (32c)                                       |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 16513.6000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 303.0018 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 5.2116 (36)                                          |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 39.2543 (37)                                         |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 11.3619 | 11.2292 | 11.0964 | 10.4326 | 10.2998 | 9.6360  | 9.6360  | 9.5033  | 9.9016  | 10.2998 | 10.5654 | 10.8309 (38) |
| Heat transfer coeff       | 50.6162 | 50.4834 | 50.3507 | 49.6869 | 49.5541 | 48.8903 | 48.8903 | 48.7575 | 49.1558 | 49.5541 | 49.8196 | 50.0852 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 49.6537 (39) |
| HLP                       | 0.9287  | 0.9263  | 0.9239  | 0.9117  | 0.9092  | 0.8971  | 0.8971  | 0.8946  | 0.9019  | 0.9092  | 0.9141  | 0.9190 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.9111 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 1.8227 (42)  |
| Average daily hot water use (litres/day) | 81.5674 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |                                          |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Energy conte                                                    | 89.7241                                  | 86.4614  | 83.1987  | 79.9360  | 76.6733  | 73.4106  | 73.4106  | 76.6733  | 79.9360  | 83.1987  | 86.4614  | 89.7241 (44)   |
| 133.0582                                                        | 116.3736                                 | 120.0871 | 104.6949 | 100.4572 | 86.6869  | 80.3282  | 92.1778  | 93.2787  | 108.7073 | 118.6625 | 128.8598 | (45)           |
| Energy content (annual)                                         | Total = Sum(45)m =                       |          |          |          |          |          |          |          |          |          |          | 1283.3722 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          |                                          |          |          |          |          |          |          |          |          |          |          |                |
| 19.9587                                                         | 17.4560                                  | 18.0131  | 15.7042  | 15.0686  | 13.0030  | 12.0492  | 13.8267  | 13.9918  | 16.3061  | 17.7994  | 19.3290  | (46)           |
| Water storage loss:                                             |                                          |          |          |          |          |          |          |          |          |          |          |                |
| Store volume                                                    |                                          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |                                          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |                                          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |                                          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)    |
| Total storage loss                                              |                                          |          |          |          |          |          |          |          |          |          |          |                |
| 22.9400                                                         | 20.7200                                  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | (56)           |
| If cylinder contains dedicated solar storage                    |                                          |          |          |          |          |          |          |          |          |          |          |                |
| 22.9400                                                         | 20.7200                                  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | (57)           |
| Primary loss                                                    | 23.2624                                  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | (59)           |
| Total heat required for water heating calculated for each month |                                          |          |          |          |          |          |          |          |          |          |          |                |
| 179.2606                                                        | 158.1048                                 | 166.2895 | 149.4069 | 146.6596 | 131.3989 | 126.5306 | 138.3802 | 137.9907 | 154.9097 | 163.3745 | 175.0622 | (62)           |
| Solar input                                                     | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (63)           |
| Output from w/h                                                 | Solar input (sum of months) = Sum(63)m = |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)    |
| 179.2606                                                        | 158.1048                                 | 166.2895 | 149.4069 | 146.6596 | 131.3989 | 126.5306 | 138.3802 | 137.9907 | 154.9097 | 163.3745 | 175.0622 | (64)           |
| Heat gains from water heating, kWh/month                        | Total per year (kWh/year) = Sum(64)m =   |          |          |          |          |          |          |          |          |          |          | 1827.3682 (64) |
| 81.2038                                                         | 72.0792                                  | 76.8909  | 70.5806  | 70.3639  | 64.5930  | 63.6710  | 67.6110  | 66.7848  | 73.1071  | 75.2249  | 79.8078  | (65)           |

#### 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.1657  | 12.5819  | 10.2323  | 7.7465   | 5.7906   | 4.8887   | 5.2824   | 6.8662   | 9.2158   | 11.7016  | 13.6575  | 14.5594 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 158.8961 | 160.5450 | 156.3899 | 147.5444 | 136.3784 | 125.8840 | 118.8731 | 117.2242 | 121.3793 | 130.2248 | 141.3908 | 151.8852 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 (71) |
| Water heating gains (Table 5)                                                       | 109.1449 | 107.2607 | 103.3480 | 98.0287  | 94.5752  | 89.7125  | 85.5794  | 90.8750  | 92.7566  | 98.2622  | 104.4790 | 107.2686 (72) |
| Total internal gains                                                                | 332.5471 | 330.7279 | 320.3106 | 303.6599 | 287.0846 | 270.8256 | 260.0752 | 265.3059 | 273.6921 | 290.5291 | 309.8677 | 324.0536 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| -----       |          |          |          |            |                                |                                   |                                    |                              | -----        |          |          |               |
| Northeast   |          |          |          | 1.6400     | 11.2829                        | 0.3700                            | 0.7900                             | 0.7700                       | 3.7482 (75)  |          |          |               |
| North       |          |          |          | 8.4000     | 10.6334                        | 0.3700                            | 0.8900                             | 0.7700                       | 20.3834 (74) |          |          |               |
| Southeast   |          |          |          | 7.6100     | 36.7938                        | 0.5600                            | 0.6800                             | 0.7700                       | 73.8907 (77) |          |          |               |
| -----       |          |          |          |            |                                |                                   |                                    |                              | -----        |          |          |               |
| Solar gains | 98.0223  | 172.4466 | 252.1496 | 342.2747   | 412.5714                       | 422.9506                          | 402.1702                           | 347.3383                     | 282.8027     | 194.7990 | 118.3658 | 83.2886 (83)  |
| Total gains | 430.5694 | 503.1745 | 572.4601 | 645.9346   | 699.6560                       | 693.7762                          | 662.2454                           | 612.6442                     | 556.4948     | 485.3280 | 428.2335 | 407.3422 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
| Jan                                                                         | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| 90.6253                                                                     | 90.8637 | 91.1033 | 92.3204 | 92.5677 | 93.8246 | 93.8246 | 94.0801 | 93.3178 | 92.5677 | 92.0744 | 91.5862 |              |
| alpha                                                                       | 7.0417  | 7.0576  | 7.0736  | 7.1547  | 7.1712  | 7.2550  | 7.2550  | 7.2720  | 7.2212  | 7.1712  | 7.1383  | 7.1057       |
| util living area                                                            | 0.9957  | 0.9868  | 0.9550  | 0.8437  | 0.6470  | 0.4502  | 0.3248  | 0.3659  | 0.6027  | 0.9023  | 0.9874  | 0.9970 (86)  |
| MIT                                                                         | 20.3632 | 20.5164 | 20.7195 | 20.9138 | 20.9875 | 20.9992 | 20.9999 | 20.9999 | 20.9942 | 20.8812 | 20.5868 | 20.3335 (87) |
| Th 2                                                                        | 20.1431 | 20.1452 | 20.1473 | 20.1576 | 20.1596 | 20.1700 | 20.1700 | 20.1721 | 20.1658 | 20.1596 | 20.1555 | 20.1514 (88) |
| util rest of house                                                          | 0.9942  | 0.9822  | 0.9405  | 0.8059  | 0.5930  | 0.3922  | 0.2635  | 0.3002  | 0.5330  | 0.8667  | 0.9821  | 0.9959 (89)  |
| MIT 2                                                                       | 19.3061 | 19.5283 | 19.8140 | 20.0706 | 20.1499 | 20.1696 | 20.1700 | 20.1624 | 20.1624 | 20.0405 | 19.6397 | 19.2695 (90) |
| Living area fraction                                                        | 19.7949 | 19.9852 | 20.2327 | 20.4605 | 20.5372 | 20.5532 | 20.5537 | 20.5548 | 20.5470 | 20.4292 | 20.0776 | 19.7615 (91) |
| MIT                                                                         | 19.7949 | 19.9852 | 20.2327 | 20.4605 | 20.5372 | 20.5532 | 20.5537 | 20.5548 | 20.5470 | 20.4292 | 20.0776 | 19.7615 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.7949 | 19.9852 | 20.2327 | 20.4605 | 20.5372 | 20.5532 | 20.5537 | 20.5548 | 20.5470 | 20.4292 | 20.0776 | 19.7615 (93) |

#### 8. Space heating requirement

|                   | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|-------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Utilisation       | 0.9933   | 0.9811   | 0.9422   | 0.8202   | 0.6176   | 0.4191   | 0.2919   | 0.3306   | 0.5652   | 0.8792   | 0.9815   | 0.9952 (94)   |
| Useful gains      | 427.6998 | 493.6744 | 539.3488 | 529.8102 | 432.1033 | 290.7424 | 193.2812 | 202.5342 | 314.5454 | 426.6966 | 420.3181 | 405.3984 (95) |
| Ext temp.         | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)   |
| Heat loss rate W  | 784.2930 | 761.5517 | 691.4495 | 574.4027 | 437.9197 | 291.0522 | 193.2993 | 202.5776 | 316.9081 | 487.0779 | 646.5406 | 779.4005 (97) |
| Month fracti      | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)  |
| Space heating kWh | 265.3054 | 180.0135 | 113.1630 | 32.1066  | 4.3274   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 44.9237  | 162.8802 | 278.2576 (98) |



|                      |  |              |                |
|----------------------|--|--------------|----------------|
| Space heating        |  |              | 1080.9773 (98) |
| Space heating per m2 |  | (98) / (4) = | 19.8344 (99)   |

Not applicable

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1080.9773 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 1189.0750 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1827.3682 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 2010.1050 (310a) |
| Electricity used for heat distribution                                                  | 31.9918 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 111.8860 (330a)  |
| Total electricity for the above, kWh/year                                               | 111.8860 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 250.1708 (332)   |
| Total delivered energy for all uses                                                     | 3561.2368 (338)  |

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 3407.0075          | 0.2160                        | 735.9136 (367)           |
| Electrical energy for heat distribution                                                    | 31.9918            | 0.5190                        | 16.6037 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 752.5174 (373)           |
| Space and water heating                                                                    |                    |                               | 752.5174 (376)           |
| Pumps and fans                                                                             | 111.8860           | 0.5190                        | 58.0689 (378)            |
| Energy for lighting                                                                        | 250.1708           | 0.5190                        | 129.8386 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 940.4249 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 17.2600 (384)            |

|                                                                                 |     |         |     |
|---------------------------------------------------------------------------------|-----|---------|-----|
| Total Floor Area                                                                | TFA | 17.2600 | ZC1 |
| Assumed number of occupants                                                     | N   | 54.5000 |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 1.8227  |     |
| CO2 emissions from appliances, equation (L14)                                   |     | 0.5190  |     |
| CO2 emissions from cooking, equation (L16)                                      |     | 17.2768 | ZC2 |
| Total CO2 emissions                                                             |     | 2.9861  | ZC3 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 37.5229 | ZC4 |
| Additional allowable electricity generation, kWh/m <sup>2</sup> /year           |     | 0.0000  | ZC5 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000  | ZC6 |
| Net CO2 emissions                                                               |     | 0.0000  | ZC7 |
|                                                                                 |     | 37.5229 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 54.5000 (1b)              | x 2.5400 (2b)                   | = 138.4300 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.4300 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1445 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3945 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 3 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3057 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3898 | 0.3821 | 0.3745 | 0.3363 | 0.3286 | 0.2904 | 0.2904 | 0.2828 | 0.3057 | 0.3286 | 0.3439 | 0.3592 (22b) |
| Effective ac    | 0.5760 | 0.5730 | 0.5701 | 0.5565 | 0.5540 | 0.5422 | 0.5422 | 0.5400 | 0.5467 | 0.5540 | 0.5591 | 0.5645 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2  | U-value<br>W/m2K | A x U<br>W/K                 | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------|------------------|------------------------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|------|
| TER Semi-glazed door                                                |                |                | 2.1000         | 1.2000           | 2.5200                       |                   |                | (26a)          |                |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                | 11.5200        | 1.3258           | 15.2727                      |                   |                | (27)           |                |                |                |                |      |
| External Wall 1                                                     | 32.4000        | 11.5200        | 20.8800        | 0.1800           | 3.7584                       |                   |                | (29a)          |                |                |                |                |      |
| Corridor wall                                                       | 43.3000        | 2.1000         | 41.2000        | 0.1800           | 7.4160                       |                   |                | (29a)          |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 75.7000        |                  |                              |                   |                | (31)           |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                |                  | (26)...(30) + (32) = 28.9671 |                   |                | (33)           |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                  |                              |                   |                |                |                |                |                |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                |                  |                              |                   | 250.0000       | (35)           |                |                |                |                |      |
| Total fabric heat loss                                              |                |                |                |                  |                              |                   | 3.1241         | (36)           |                |                |                |                |      |
|                                                                     |                |                |                |                  |                              |                   | (33) + (36) =  | 32.0912 (37)   |                |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                  |                              |                   |                |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>26.3114 | Feb<br>26.1766 | Mar<br>26.0445 | Apr<br>25.4241   | May<br>25.3080               | Jun<br>24.7676    | Jul<br>24.7676 | Aug<br>24.6676 | Sep<br>24.9758 | Oct<br>25.3080 | Nov<br>25.5428 | Dec<br>25.7883 | (38) |
| Heat transfer coeff                                                 | 58.4026        | 58.2678        | 58.1357        | 57.5153          | 57.3992                      | 56.8589           | 56.8589        | 56.7588        | 57.0670        | 57.3992        | 57.6341        | 57.8796        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                |                  |                              |                   |                |                |                |                |                | 57.5148        | (39) |
| HLP                                                                 | Jan<br>1.0716  | Feb<br>1.0691  | Mar<br>1.0667  | Apr<br>1.0553    | May<br>1.0532                | Jun<br>1.0433     | Jul<br>1.0433  | Aug<br>1.0414  | Sep<br>1.0471  | Oct<br>1.0532  | Nov<br>1.0575  | Dec<br>1.0620  | (40) |
| HLP (average)                                                       |                |                |                |                  |                              |                   |                |                |                |                |                | 1.0553         | (40) |
| Days in month                                                       | 31             | 28             | 31             | 30               | 31                           | 30                | 31             | 31             | 30             | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |         |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |                    |          | 1.8227 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |                    |          | 77.4890 (43)   |
| Jan                                                         | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov                | Dec      |                |
| Daily hot water use                                         | 85.2379  | 82.1383  | 79.0388  | 75.9392 | 72.8397 | 69.7401 | 69.7401 | 72.8397 | 75.9392 | 79.0388            | 82.1383  | 85.2379 (44)   |
| Energy conte                                                | 126.4053 | 110.5549 | 114.0828 | 99.4601 | 95.4343 | 82.3526 | 76.3118 | 87.5689 | 88.6147 | 103.2719           | 112.7294 | 122.4168 (45)  |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1219.2036 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |         |         |         |         |         |         |                    |          |                |
|                                                             | 18.9608  | 16.5832  | 17.1124  | 14.9190 | 14.3152 | 12.3529 | 11.4468 | 13.1353 | 13.2922 | 15.4908            | 16.9094  | 18.3625 (46)   |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |         |         |         |         |         |         |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |                    |          | 0.1290 (55)    |
| Total storage loss                                          |          |          |          |         |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 153.6655 | 135.1770 | 141.3429 | 125.8409 | 122.6945 | 108.7334 | 103.5719 | 114.8290 | 114.9955 | 130.5321 | 139.1102 | 149.6770 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 153.6655 | 135.1770 | 141.3429 | 125.8409 | 122.6945 | 108.7334 | 103.5719 | 114.8290 | 114.9955 | 130.5321 | 139.1102 | 149.6770 (64) |
|                                                                 | 63.8379  | 56.4572  | 59.7406  | 54.1751  | 53.5400  | 48.4869  | 47.1818  | 50.9248  | 50.5690  | 56.1460  | 58.5871  | 62.5117 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.1983  | 12.6108  | 10.2558  | 7.7643   | 5.8039   | 4.8999   | 5.2945   | 6.8820   | 9.2370   | 11.7285  | 13.6889  | 14.5929  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 158.8961 | 160.5450 | 156.3899 | 147.5444 | 136.3784 | 125.8840 | 118.8731 | 117.2242 | 121.3793 | 130.2248 | 141.3908 | 151.8852 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | (71) |
| Water heating gains (Table 5)                                                       | 85.8036  | 84.0136  | 80.2965  | 75.2432  | 71.9624  | 67.3429  | 63.4164  | 68.4473  | 70.2348  | 75.4651  | 81.3710  | 84.0211  | (72) |
| Total internal gains                                                                | 312.2384 | 310.5098 | 300.2827 | 283.8923 | 267.4851 | 251.4672 | 240.9244 | 245.8939 | 254.1914 | 270.7588 | 289.7911 | 303.8396 | (73) |

#### 6. Solar gains

| [Jan]       |            |          |          |          |                                |          |                                   |          |                                    |          |                              |          |              |  |
|-------------|------------|----------|----------|----------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|--------------|--|
|             | Area<br>m2 |          |          |          | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W   |  |
| North       | 5.4800     |          |          |          | 10.6334                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 17.8084 (74) |  |
| Northeast   | 1.0700     |          |          |          | 11.2829                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 3.6896 (75)  |  |
| Southeast   | 4.9700     |          |          |          | 36.7938                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 55.8860 (77) |  |
| Solar gains | 77.3840    | 136.7376 | 201.6104 | 276.4969 | 335.7665                       | 345.2594 | 327.8724                          | 281.5311 | 227.0507                           | 154.8999 | 93.5500                      | 65.6858  | (83)         |  |
| Total gains | 389.6224   | 447.2474 | 501.8931 | 560.3892 | 603.2516                       | 596.7265 | 568.7967                          | 527.4250 | 481.2421                           | 425.6588 | 383.3411                     | 369.5255 | (84)         |  |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 64.8040 | 64.9539 | 65.1015 | 65.8037 | 65.9368 | 66.5635 | 66.5635 | 66.6808 | 66.3207                   | 65.9368 | 65.6682 | 65.3896 |              |
| alpha                                                                       | 5.3203  | 5.3303  | 5.3401  | 5.3869  | 5.3958  | 5.4376  | 5.4376  | 5.4454  | 5.4214                    | 5.3958  | 5.3779  | 5.3593  |              |
| util living area                                                            | 0.9954  | 0.9898  | 0.9736  | 0.9191  | 0.7878  | 0.5930  | 0.4370  | 0.4895  | 0.7490                    | 0.9477  | 0.9900  | 0.9965  | (86)         |
| MIT                                                                         | 19.9730 | 20.1335 | 20.3800 | 20.6828 | 20.8973 | 20.9823 | 20.9972 | 20.9949 | 20.9415                   | 20.6605 | 20.2610 | 19.9420 | (87)         |
| Th 2                                                                        | 20.0241 | 20.0261 | 20.0281 | 20.0375 | 20.0392 | 20.0474 | 20.0474 | 20.0489 | 20.0443                   | 20.0392 | 20.0357 | 20.0320 | (88)         |
| util rest of house                                                          | 0.9940  | 0.9866  | 0.9651  | 0.8940  | 0.7326  | 0.5119  | 0.3439  | 0.3912  | 0.6699                    | 0.9258  | 0.9862  | 0.9954  | (89)         |
| MIT 2                                                                       | 18.6643 | 18.8987 | 19.2539 | 19.6789 | 19.9448 | 20.0364 | 20.0464 | 20.0469 | 20.0010                   | 19.6597 | 19.0923 | 18.6250 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4624  | (91)         |
| MIT                                                                         | 19.2694 | 19.4696 | 19.7746 | 20.1431 | 20.3852 | 20.4738 | 20.4860 | 20.4853 | 20.4359                   | 20.1225 | 19.6327 | 19.2339 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.2694 | 19.4696 | 19.7746 | 20.1431 | 20.3852 | 20.4738 | 20.4860 | 20.4853 | 20.4359                   | 20.1225 | 19.6327 | 19.2339 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec       |       |
| Useful gains         | 0.9924   | 0.9842   | 0.9624   | 0.8971   | 0.7536   | 0.5489   | 0.3871   | 0.4368   | 0.7042   | 0.9281       | 0.9842   | 0.9941    | (94)  |
| Ext temp.            | 386.6734 | 440.1748 | 483.0225 | 502.7043 | 454.6279 | 327.5592 | 220.1627 | 230.3874 | 338.8671 | 395.0398     | 377.2728 | 367.3576  | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000    | (96)  |
| Month fracti         | 874.2531 | 848.9417 | 771.7302 | 646.6511 | 498.5266 | 333.9769 | 220.9547 | 231.8747 | 361.5702 | 546.5821     | 722.3110 | 870.1584  | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000    | (97a) |
| Space heating        | 362.7593 | 274.6913 | 214.7985 | 103.6417 | 32.6607  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 112.7475     | 248.4275 | 374.0838  | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 1723.8103 | (98)  |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 31.6295   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1843.6473 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 362.7593 | 274.6913 | 214.7985 | 103.6417 | 32.6607  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 112.7475 | 248.4275 | 374.0838  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 387.9779 | 293.7875 | 229.7310 | 110.8467 | 34.9312  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 120.5855 | 265.6979 | 400.0896  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 153.6655 | 135.1770 | 141.3429 | 125.8409 | 122.6945 | 108.7334 | 103.5719 | 114.8290 | 114.9955 | 130.5321 | 139.1102 | 149.6770  | (64)            |
| Efficiency of water heater (217)m                                     | 87.0278  | 86.6674  | 85.9274  | 84.3015  | 81.8341  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.4261  | 86.3442  | 79.8000   | (216)           |
| Fuel for water heating, kWh/month                                     | 176.5706 | 155.9721 | 164.4911 | 149.2748 | 149.9308 | 136.2574 | 129.7894 | 143.8960 | 144.1047 | 154.6111 | 161.1113 | 171.7263  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1837.7355 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1843.6473 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 250.7461  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4007.1290 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1843.6473          | 0.2160                        | 398.2278 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1837.7355          | 0.2160                        | 396.9509 (264)           |
| Space and water heating                                                                           |                    |                               | 795.1787 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 250.7461           | 0.5190                        | 130.1372 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 964.2409 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 14.5904 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3878 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7142 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (14.5904 * 1.00) + 2.3878 + 0.7142, rounded to 2 d.p. |                    |                               | 17.6900 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-1-03                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be Lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 84 B                                                                    | DER           | 15.03   | TER            | 16.42      |
| Environmental                      | 90 B                                                                    | % DER<TER     | 8.45    |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.75                                                                    | DFEE          | 34.79   | TFEE           | 40.16      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 13.37   |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 59 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating: Mains gas (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 16.42 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 15.03 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 40.2 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 34.8 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.38 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK  
Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing West: 12.20 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.5000 (1b)              | x 2.5400 (2b)                   | = 148.5900 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 148.5900 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 3                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.7750 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1163 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1482                       | 0.1453 | 0.1424    | 0.1279 | 0.1250 | 0.1104 | 0.1104                      | 0.1075      | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2487                       | 0.2458 | 0.2429    | 0.2284 | 0.2255 | 0.2109 | 0.2109                      | 0.2080      | 0.2168 | 0.2255 | 0.2313 | 0.2371 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                    | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2          | U-value<br>W/m2K                         | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K   |
|------------------------------------------------------------|-------------|----------------|------------------------|------------------------------------------|--------------|-------------------|-----------------|
| W03 (Uw = 1.40)                                            |             |                | 8.4000                 | 1.3258                                   | 11.1364      |                   | (27)            |
| W02 (Uw = 1.40)                                            |             |                | 3.8000                 | 1.3258                                   | 5.0379       |                   | (27)            |
| door                                                       |             |                | 2.1000                 | 1.2500                                   | 2.6250       |                   | (26a)           |
| External Wall 1                                            | 37.1000     | 12.2000        | 24.9000                | 0.1500                                   | 3.7350       | 140.0000          | 3486.0000 (29a) |
| Corridor wall                                              | 25.4000     | 2.1000         | 23.3000                | 0.1409                                   | 3.2832       | 110.0000          | 2563.0000 (29a) |
| Total net area of external elements Aum(A, m2)             |             |                | 62.5000                |                                          |              |                   | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                        |             |                | (26) ... (30) + (32) = | 25.8175                                  |              |                   | (33)            |
| Party Wall 1                                               |             |                | 22.6000                | 0.0000                                   | 0.0000       | 140.0000          | 3164.0000 (32)  |
| Party Floor 1                                              |             |                | 58.5000                |                                          |              | 40.0000           | 2340.0000 (32d) |
| Party Ceilings                                             |             |                | 58.5000                |                                          |              | 80.0000           | 4680.0000 (32b) |
| Internal Wall                                              |             |                | 77.4000                |                                          |              | 9.0000            | 696.6000 (32c)  |
| Heat capacity Cm = Sum(A x k)                              |             |                |                        | (28) ... (30) + (32) + (32a) ... (32e) = | 16929.6000   |                   | (34)            |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K          |             |                |                        |                                          | 289.3949     |                   | (35)            |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) |             |                |                        |                                          | 4.0072       |                   | (36)            |
| Total fabric heat loss                                     |             |                |                        | (33) + (36) =                            | 29.8247      |                   | (37)            |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 12.1958 | 12.0533 | 11.9108 | 11.1983 | 11.0558 | 10.3433 | 10.3433 | 10.2007 | 10.6283 | 11.0558 | 11.3408 | 11.6258 (38) |
| Heat transfer coeff       | 42.0205 | 41.8780 | 41.7355 | 41.0230 | 40.8805 | 40.1679 | 40.1679 | 40.0254 | 40.4529 | 40.8805 | 41.1655 | 41.4505 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 40.9873 (39) |
| HLP                       | 0.7183  | 0.7159  | 0.7134  | 0.7012  | 0.6988  | 0.6866  | 0.6866  | 0.6842  | 0.6915  | 0.6988  | 0.7037  | 0.7086 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.7006 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                  |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.9389 (42)      |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 84.4730 (43)     |
| Daily hot water use                      | Jan 92.9203 | Feb 89.5414 | Mar 86.1625 | Apr 82.7836 | May 79.4046 | Jun 76.0257 | Jul 76.0257 | Aug 79.4046 | Sep 82.7836 | Oct 86.1625 | Nov 89.5414 | Dec 92.9203 (44) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy content (annual)                                         | 137.7982 | 120.5191 | 124.3650 | 108.4244 | 104.0358 | 89.7750  | 83.1897  | 95.4614  | 96.6015  | 112.5798            | 122.8896 | 133.4502 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1329.0895 (45) |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
| If cylinder contains dedicated solar storage                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| Primary loss                                                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 184.0006 | 162.2503 | 170.5674 | 153.1364 | 150.2382 | 134.4870 | 129.3921 | 141.6638 | 141.3135 | 158.7822            | 167.6016 | 179.6526 (62)  |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        | 184.0006 | 162.2503 | 170.5674 | 153.1364 | 150.2382 | 134.4870 | 129.3921 | 141.6638 | 141.3135 | 158.7822            | 167.6016 | 179.6526 (64)  |
|                                                                 | 82.7798  | 73.4576  | 78.3133  | 71.8207  | 71.5538  | 65.6198  | 64.6225  | 68.7028  | 67.8896  | 74.3947             | 76.6304  | 81.3341 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.0797  | 13.3937  | 10.8925  | 8.2463   | 6.1642   | 5.2041   | 5.6232   | 7.3092   | 9.8104   | 12.4566  | 14.5387  | 15.4988 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 169.1487 | 170.9039 | 166.4808 | 157.0644 | 145.1780 | 134.0065 | 126.5432 | 124.7879 | 129.2111 | 138.6274 | 150.5138 | 161.6854 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 (71) |
| Water heating gains (Table 5)                                                       | 111.2632 | 109.3119 | 105.2598 | 99.7510  | 96.1745  | 91.1386  | 86.8582  | 92.3425  | 94.2911  | 99.9929  | 106.4311 | 109.3200 (72) |
| Total internal gains                                                                | 347.5754 | 345.6933 | 334.7168 | 317.1455 | 299.6005 | 282.4329 | 271.1084 | 276.5235 | 285.3964 | 303.1607 | 323.5674 | 338.5880 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|
| West        |          |          |          |          | 8.4000     | 19.6403                        | 0.3700                            | 0.8900                             |          |          | 0.7700                       | 37.6488 (80)  |
| West        |          |          |          |          | 3.8000     | 19.6403                        | 0.5600                            | 0.6800                             |          |          | 0.7700                       | 19.6952 (80)  |
| -----       |          |          |          |          |            |                                |                                   |                                    |          |          |                              |               |
| Solar gains | 57.3441  | 112.1772 | 184.7398 | 269.4320 | 330.1990   | 338.0175                       | 321.8064                          | 276.4269                           | 214.8600 | 133.1077 | 71.5013                      | 47.1570 (83)  |
| Total gains | 404.9194 | 457.8704 | 519.4566 | 586.5775 | 629.7995   | 620.4504                       | 592.9148                          | 552.9505                           | 500.2565 | 436.2683 | 395.0688                     | 385.7450 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |          |          |          |          |          |          |          |          |          |          |          |              |
|-----------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |          |          |          |          |          |          |          |          |          |          |          | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec          |
| tau                                                                         | 111.9136 | 112.2944 | 112.6778 | 114.6350 | 115.0346 | 117.0752 | 117.0752 | 117.4920 | 116.2503 | 115.0346 | 114.2381 | 113.4526     |
| alpha                                                                       | 8.4609   | 8.4863   | 8.5119   | 8.6423   | 8.6690   | 8.8050   | 8.8050   | 8.8328   | 8.7500   | 8.6690   | 8.6159   | 8.5635       |
| util living area                                                            | 0.9959   | 0.9877   | 0.9496   | 0.8078   | 0.6006   | 0.4142   | 0.2981   | 0.3330   | 0.5565   | 0.8846   | 0.9869   | 0.9972 (86)  |
| MIT                                                                         | 20.5419  | 20.6591  | 20.8281  | 20.9653  | 20.9971  | 20.9999  | 21.0000  | 21.0000  | 20.9988  | 20.9396  | 20.7195  | 20.5207 (87) |
| Th 2                                                                        | 20.3247  | 20.3268  | 20.3290  | 20.3397  | 20.3419  | 20.3527  | 20.3527  | 20.3548  | 20.3483  | 20.3419  | 20.3376  | 20.3333 (88) |
| util rest of house                                                          | 0.9946   | 0.9837   | 0.9355   | 0.7737   | 0.5593   | 0.3724   | 0.2542   | 0.2863   | 0.5046   | 0.8513   | 0.9820   | 0.9962 (89)  |
| MIT 2                                                                       | 19.7163  | 19.8868  | 20.1238  | 20.3049  | 20.3395  | 20.3526  | 20.3527  | 20.3548  | 20.3476  | 20.2813  | 19.9838  | 19.6927 (90) |
| Living area fraction                                                        | 20.1143  | 20.2591  | 20.4633  | 20.6233  | 20.6565  | 20.6646  | 20.6647  | 20.6658  | 20.6615  | 20.5986  | 20.3384  | 20.0919 (91) |
| MIT                                                                         | 20.1143  | 20.2591  | 20.4633  | 20.6233  | 20.6565  | 20.6646  | 20.6647  | 20.6658  | 20.6615  | 20.5986  | 20.3384  | 20.0919 (92) |
| Temperature adjustment                                                      |          |          |          |          |          |          |          |          |          |          |          | 0.0000       |
| adjusted MIT                                                                | 20.1143  | 20.2591  | 20.4633  | 20.6233  | 20.6565  | 20.6646  | 20.6647  | 20.6658  | 20.6615  | 20.5986  | 20.3384  | 20.0919 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |               |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Useful gains         | 402.5046 | 450.1909 | 487.5767 | 462.6642 | 364.7469 | 243.5644 | 163.2695 | 170.7376 | 264.9462 | 377.3909 | 387.9459 | 384.1001 (95) |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)   |
| Heat loss rate W     | 664.5234 | 643.2088 | 582.7669 | 480.9227 | 366.1459 | 243.6038 | 163.2709 | 170.7412 | 265.4338 | 408.7480 | 544.9655 | 658.7253 (97) |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)  |
| Space heating kWh    | 194.9420 | 129.7080 | 70.8215  | 13.1461  | 1.0409   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 23.3297  | 113.0541 | 204.3211 (98) |
| Space heating        |          |          |          |          |          |          |          |          |          |          |          | 750.3634 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 12.8267 (99)  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

-----  
8c. Space cooling requirement  
-----

Not applicable

-----  
9b. Energy requirements  
-----

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 750.3634 (98)    |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 825.3998 (307a)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1873.0855 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 2060.3941 (310a) |
| Electricity used for heat distribution                                                  | 28.8579 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 120.0979 (330a)  |
| Total electricity for the above, kWh/year                                               | 120.0979 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 266.3127 (332)   |
| Total delivered energy for all uses                                                     | 3272.2044 (338)  |

-----  
12b. Carbon dioxide emissions - Community heating scheme  
-----

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 3073.2629          | 0.2160                        | 663.8248 (367)           |
| Electrical energy for heat distribution                                                    | 28.8579            | 0.5190                        | 14.9773 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 678.8021 (373)           |
| Space and water heating                                                                    |                    |                               | 678.8021 (376)           |
| Pumps and fans                                                                             | 120.0979           | 0.5190                        | 62.3308 (378)            |
| Energy for lighting                                                                        | 266.3127           | 0.5190                        | 138.2163 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 879.3491 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 15.0300 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 15.0300 ZC1 |
| Total Floor Area                                                                | TFA | 58.5000     |
| Assumed number of occupants                                                     | N   | 1.9389      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.1340 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.8296 ZC3  |
| Total CO2 emissions                                                             |     | 34.9936 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 34.9936 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.5000 (1b)              | x 2.5400 (2b)                   | = 148.5900 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 148.5900 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1346 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3846 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 3 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.2981 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3800 | 0.3726 | 0.3651 | 0.3279 | 0.3204 | 0.2832 | 0.2832 | 0.2757 | 0.2981 | 0.3204 | 0.3353 | 0.3502 (22b) |
| Effective ac    | 0.5722 | 0.5694 | 0.5667 | 0.5537 | 0.5513 | 0.5401 | 0.5401 | 0.5380 | 0.5444 | 0.5513 | 0.5562 | 0.5613 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2  | U-value<br>W/m2K | A x U<br>W/K         | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------|------------------|----------------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|------|
| TER Semi-glazed door                                                |                |                | 2.1000         | 1.2000           | 2.5200               |                   |                | (26a)          |                |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                | 12.2000        | 1.3258           | 16.1742              |                   |                | (27)           |                |                |                |                |      |
| External Wall 1                                                     | 37.1000        | 12.2000        | 24.9000        | 0.1800           | 4.4820               |                   |                | (29a)          |                |                |                |                |      |
| Corridor wall                                                       | 25.4000        | 2.1000         | 23.3000        | 0.1800           | 4.1940               |                   |                | (29a)          |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 62.5000        |                  |                      |                   |                | (31)           |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                |                  | (26)...(30) + (32) = | 27.3702           |                | (33)           |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                  |                      |                   |                | 250.0000 (35)  |                |                |                |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                |                  |                      |                   |                | 2.7572 (36)    |                |                |                |                |      |
| Total fabric heat loss                                              |                |                |                |                  |                      | (33) + (36) =     | 30.1274        | (37)           |                |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                  |                      |                   |                |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>28.0582 | Feb<br>27.9207 | Mar<br>27.7860 | Apr<br>27.1529   | May<br>27.0345       | Jun<br>26.4832    | Jul<br>26.4832 | Aug<br>26.3810 | Sep<br>26.6955 | Oct<br>27.0345 | Nov<br>27.2741 | Dec<br>27.5246 | (38) |
| Heat transfer coeff                                                 | 58.1857        | 58.0482        | 57.9134        | 57.2804          | 57.1619              | 56.6106           | 56.6106        | 56.5085        | 56.8230        | 57.1619        | 57.4015        | 57.6520        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                |                  |                      |                   |                |                |                |                |                | 57.2798        | (39) |
| HLP                                                                 | Jan<br>0.9946  | Feb<br>0.9923  | Mar<br>0.9900  | Apr<br>0.9792    | May<br>0.9771        | Jun<br>0.9677     | Jul<br>0.9677  | Aug<br>0.9660  | Sep<br>0.9713  | Oct<br>0.9771  | Nov<br>0.9812  | Dec<br>0.9855  | (40) |
| HLP (average)                                                       |                |                |                |                  |                      |                   |                |                |                |                |                | 0.9791         | (40) |
| Days in month                                                       | 31             | 28             | 31             | 30               | 31                   | 30                | 31             | 31             | 30             | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |                    |          |                |
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |                    |          | 1.9389 (42)    |
|                                                             |          |          |          |          |         |         |         |         |         |                    |          | 80.2494 (43)   |
| Jan                                                         | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct     | Nov                | Dec      |                |
| Daily hot water use                                         | 88.2743  | 85.0643  | 81.8544  | 78.6444  | 75.4344 | 72.2244 | 72.2244 | 75.4344 | 78.6444 | 81.8544            | 85.0643  | 88.2743 (44)   |
| Energy conte                                                | 130.9082 | 114.4932 | 118.1467 | 103.0032 | 98.8340 | 85.2862 | 79.0302 | 90.6883 | 91.7714 | 106.9508           | 116.7451 | 126.7776 (45)  |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         | Total = Sum(45)m = |          | 1262.6351 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |         |         |         |         |         |                    |          |                |
|                                                             | 19.6362  | 17.1740  | 17.7220  | 15.4505  | 14.8251 | 12.7929 | 11.8545 | 13.6033 | 13.7657 | 16.0426            | 17.5118  | 19.0166 (46)   |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |         |         |         |         |         |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |                    |          | 0.1290 (55)    |
| Total storage loss                                          |          |          |          |          |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 158.1684 | 139.1153 | 145.4069 | 129.3840 | 126.0941 | 111.6670 | 106.2904 | 117.9485 | 118.1522 | 134.2109 | 143.1259 | 154.0378 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 158.1684 | 139.1153 | 145.4069 | 129.3840 | 126.0941 | 111.6670 | 106.2904 | 117.9485 | 118.1522 | 134.2109 | 143.1259 | 154.0378 (64) |
|                                                                 | 65.3351  | 57.7666  | 61.0919  | 55.3532  | 54.6704  | 49.4623  | 48.0857  | 51.9620  | 51.6186  | 57.3692  | 59.9224  | 63.9617 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      | (66) |
| (66)m                                                                               | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.1287  | 13.4372  | 10.9279  | 8.2731   | 6.1842   | 5.2210   | 5.6415   | 7.3330   | 9.8423   | 12.4971  | 14.5860  | 15.5492  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 169.1487 | 170.9039 | 166.4808 | 157.0644 | 145.1780 | 134.0065 | 126.5432 | 124.7879 | 129.2111 | 138.6274 | 150.5138 | 161.6854 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | (71) |
| Water heating gains (Table 5)                                                       | 87.8160  | 85.9623  | 82.1128  | 76.8794  | 73.4817  | 68.6976  | 64.6313  | 69.8414  | 71.6925  | 77.1092  | 83.2255  | 85.9700  | (72) |
| Total internal gains                                                                | 327.1772 | 325.3872 | 314.6052 | 297.3008 | 279.9278 | 263.0089 | 251.8997 | 257.0461 | 265.8298 | 283.3175 | 303.4091 | 318.2884 | (73) |

#### 6. Solar gains

| [Jan]       |  |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d |          |               | Gains<br>W |
|-------------|--|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|----------|---------------|------------|
| -----       |  |          |          |          |            |                                |                                   |                                    |          |          |                              |          |               |            |
| West        |  |          |          |          | 12.2000    | 19.6403                        | 0.6300                            |                                    | 0.7000   |          | 0.7700                       |          | 73.2283 (80)  |            |
| -----       |  |          |          |          |            |                                |                                   |                                    |          |          |                              |          |               |            |
| Solar gains |  | 73.2283  | 143.2501 | 235.9125 | 344.0643   | 421.6637                       | 431.6479                          | 410.9464                           | 352.9969 | 274.3760 | 169.9783                     | 91.3071  | 60.2194 (83)  |            |
| Total gains |  | 400.4055 | 468.6373 | 550.5177 | 641.3651   | 701.5916                       | 694.6568                          | 662.8461                           | 610.0430 | 540.2058 | 453.2958                     | 394.7162 | 378.5078 (84) |            |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 69.8196 | 69.9850 | 70.1478 | 70.9231 | 71.0700 | 71.7622 | 71.7622 | 71.8919 | 71.4940 | 71.0700 | 70.7734 | 70.4659 |              |
| alpha                                                                       | 5.6546  | 5.6657  | 5.6765  | 5.7282  | 5.7380  | 5.7841  | 5.7841  | 5.7928  | 5.7663  | 5.7380  | 5.7182  | 5.6977  |              |
| util living area                                                            | 0.9961  | 0.9899  | 0.9667  | 0.8823  | 0.7135  | 0.5157  | 0.3750  | 0.4243  | 0.6904  | 0.9403  | 0.9909  | 0.9971  | (86)         |
| MIT                                                                         | 20.0535 | 20.2220 | 20.4914 | 20.7892 | 20.9486 | 20.9933 | 20.9991 | 20.9982 | 20.9683 | 20.7211 | 20.3263 | 20.0217 | (87)         |
| Th 2                                                                        | 20.0878 | 20.0898 | 20.0917 | 20.1007 | 20.1024 | 20.1103 | 20.1103 | 20.1118 | 20.1073 | 20.1024 | 20.0990 | 20.0954 | (88)         |
| util rest of house                                                          | 0.9948  | 0.9868  | 0.9565  | 0.8515  | 0.6580  | 0.4466  | 0.2996  | 0.3434  | 0.6146  | 0.9168  | 0.9875  | 0.9962  | (89)         |
| MIT 2                                                                       | 18.8288 | 19.0747 | 19.4606 | 19.8691 | 20.0571 | 20.1062 | 20.1100 | 20.1111 | 20.0846 | 19.7927 | 19.2344 | 18.7881 | (90)         |
| Living area fraction                                                        | 19.4192 | 19.6278 | 19.9575 | 20.3126 | 20.4869 | 20.5338 | 20.5386 | 20.5387 | 20.5106 | 20.2402 | 19.7608 | 19.3827 | (91)         |
| MIT                                                                         | 19.4192 | 19.6278 | 19.9575 | 20.3126 | 20.4869 | 20.5338 | 20.5386 | 20.5387 | 20.5106 | 20.2402 | 19.7608 | 19.3827 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.4192 | 19.6278 | 19.9575 | 20.3126 | 20.4869 | 20.5338 | 20.5386 | 20.5387 | 20.5106 | 20.2402 | 19.7608 | 19.3827 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 0.9936   | 0.9847   | 0.9547   | 0.8594   | 0.6825   | 0.4798   | 0.3360   | 0.3825   | 0.6500   | 0.9209   | 0.9858   | 0.9952    | (94)  |
| Ext temp.            | 397.8464 | 461.4833 | 525.6024 | 551.1703 | 478.8403 | 333.3036 | 222.6952 | 233.3149 | 351.1260 | 417.4595 | 389.1258 | 376.6914  | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Month fracti         | 879.7202 | 854.9202 | 779.3700 | 653.7200 | 502.2740 | 335.9174 | 222.9665 | 233.8742 | 364.2687 | 551.0533 | 726.7470 | 875.3156  | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating        | 358.5140 | 264.3896 | 188.8031 | 73.8358  | 17.4347  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 99.3938  | 243.0872 | 370.9764  | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 1616.4346 | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 27.6314   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 1728.8070 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                             | 358.5140 | 264.3896 | 188.8031 | 73.8358  | 17.4347  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 99.3938  | 243.0872 | 370.9764 (98)   |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000 (210)   |
| Space heating fuel (main heating system)                              | 383.4375 | 282.7696 | 201.9284 | 78.9687  | 18.6468  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 106.3036 | 259.9863 | 396.7662 (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (215)    |
| Water heating requirement                                             | 158.1684 | 139.1153 | 145.4069 | 129.3840 | 126.0941 | 111.6670 | 106.2904 | 117.9485 | 118.1522 | 134.2109 | 143.1259 | 154.0378 (64)   |
| Efficiency of water heater (217)m                                     | 86.9317  | 86.5012  | 85.5115  | 83.3819  | 80.9628  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.0270  | 86.2159  | 79.8000 (216)   |
| Fuel for water heating, kWh/month                                     | 181.9455 | 160.8246 | 170.0436 | 155.1704 | 155.7433 | 139.9336 | 133.1959 | 147.8051 | 148.0604 | 159.7236 | 166.0087 | 176.9035 (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1895.3584 (219) |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1728.8070 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 267.1781 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3966.3435 (238) |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1728.8070          | 0.2160                        | 373.4223 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1895.3584          | 0.2160                        | 409.3974 (264)           |
| Space and water heating                                                                           |                    |                               | 782.8197 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 267.1781           | 0.5190                        | 138.6654 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 960.4102 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 13.3815 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3703 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6654 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (13.3815 * 1.00) + 2.3703 + 0.6654, rounded to 2 d.p. |                    |                               | 16.4200 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-1-07                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 82 B                                                                    | DER           | 18.93   | TER            | 19.36      |
| Environmental                      | 88 B                                                                    | % DER<TER     | 2.24    |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.87                                                                    | DFEE          | 49.09   | TFEE           | 53.02      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 7.42    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 55 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 19.36 kgCO<sub>2</sub>/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 18.93 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)53.0 kWh/m<sup>2</sup>/yr

Dwelling Fabric Energy Efficiency (DFEE)49.1 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.14 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | 0.11 (max. 0.25) | 0.11 (max. 0.70) | OK |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day

Permitted by DBSCG 0.32 Fail

Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls:

No cylinderstat

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

Continuous supply and extract system

|                     |      |    |
|---------------------|------|----|
| Specific fan power: | 0.53 |    |
| Maximum             | 1.5  | OK |
| MVHR efficiency:    | 94%  |    |
| Minimum:            | 70%  | OK |

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail

Based on:

|                            |                                   |
|----------------------------|-----------------------------------|
| Overshading:               | Average                           |
| Windows facing North:      | 8.40 m <sup>2</sup> , No overhang |
| Windows facing North East: | 1.64 m <sup>2</sup> , No overhang |
| Windows facing South East: | 7.61 m <sup>2</sup> , No overhang |
| Air change rate:           | 0.50 ach                          |
| Blinds/curtains:           | None                              |

#### 10 Key features

|                       |                                      |
|-----------------------|--------------------------------------|
| Party wall U-value    | 0.00 W/m <sup>2</sup> K              |
| Exposed floor U-value | 0.11 W/m <sup>2</sup> K              |
| Air permeability      | 3.0 m <sup>3</sup> /m <sup>2</sup> h |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 54.5000 (1b)              | x 2.5400 (2b)                   | = 138.4300 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.4300 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 3                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.7750 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1163 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1482                       | 0.1453 | 0.1424    | 0.1279 | 0.1250 | 0.1104 | 0.1104                      | 0.1075      | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2487                       | 0.2458 | 0.2429    | 0.2284 | 0.2255 | 0.2109 | 0.2109                      | 0.2080      | 0.2168 | 0.2255 | 0.2313 | 0.2371 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K                         | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------------------------------|--------------------------------|-----------------|
| W05 (Uw = 1.40)                                                |                         |                            | 1.6400                    | 1.3258                        | 2.1742                               |                                | (27)            |
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364                              |                                | (27)            |
| W02 (Uw = 1.40)                                                |                         |                            | 7.6100                    | 1.3258                        | 10.0890                              |                                | (27)            |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400                               |                                | (26a)           |
| Heat Loss Floor 1                                              |                         |                            | 54.5000                   | 0.1100                        | 5.9950                               |                                | (28b)           |
| External Wall 1                                                | 32.4000                 | 17.6500                    | 14.7500                   | 0.1500                        | 2.2125                               | 140.0000                       | 2065.0000 (29a) |
| Corridor wall                                                  | 43.3000                 | 2.1000                     | 41.2000                   | 0.1409                        | 5.8055                               | 110.0000                       | 4532.0000 (29a) |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 130.2000                  |                               |                                      |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               |                                      | 40.3527                        | (33)            |
| Party Wall 1                                                   |                         |                            | 19.4000                   | 0.0000                        | 0.0000                               | 140.0000                       | 2716.0000 (32)  |
| Party Ceilings                                                 |                         |                            | 54.5000                   |                               |                                      | 80.0000                        | 4360.0000 (32b) |
| Internal Wall                                                  |                         |                            | 73.4000                   |                               |                                      | 9.0000                         | 660.6000 (32c)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               | (28)...(30) + (32) + (32a)...(32e) = |                                |                 |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |                                      |                                |                 |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |                                      |                                |                 |
| Total fabric heat loss                                         |                         |                            |                           |                               | (33) + (36) =                        |                                |                 |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 11.3619 | 11.2292 | 11.0964 | 10.4326 | 10.2998 | 9.6360  | 9.6360  | 9.5033  | 9.9016  | 10.2998 | 10.5654 | 10.8309 (38) |
| Heat transfer coeff       | 56.9262 | 56.7934 | 56.6607 | 55.9969 | 55.8641 | 55.2003 | 55.2003 | 55.0675 | 55.4658 | 55.8641 | 56.1296 | 56.3952 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 55.9637 (39) |
| HLP                       | 1.0445  | 1.0421  | 1.0396  | 1.0275  | 1.0250  | 1.0128  | 1.0128  | 1.0104  | 1.0177  | 1.0250  | 1.0299  | 1.0348 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.0269 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 1.8227 (42)  |
| Average daily hot water use (litres/day) | 81.5674 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |                                          |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Energy conte                                                    | 89.7241                                  | 86.4614  | 83.1987  | 79.9360  | 76.6733  | 73.4106  | 73.4106  | 76.6733  | 79.9360  | 83.1987  | 86.4614  | 89.7241 (44)   |
| 133.0582                                                        | 116.3736                                 | 120.0871 | 104.6949 | 100.4572 | 86.6869  | 80.3282  | 92.1778  | 93.2787  | 108.7073 | 118.6625 | 128.8598 | (45)           |
| Energy content (annual)                                         | Total = Sum(45)m =                       |          |          |          |          |          |          |          |          |          |          | 1283.3722 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          |                                          |          |          |          |          |          |          |          |          |          |          |                |
| 19.9587                                                         | 17.4560                                  | 18.0131  | 15.7042  | 15.0686  | 13.0030  | 12.0492  | 13.8267  | 13.9918  | 16.3061  | 17.7994  | 19.3290  | (46)           |
| Water storage loss:                                             |                                          |          |          |          |          |          |          |          |          |          |          |                |
| Store volume                                                    |                                          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |                                          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |                                          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |                                          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)    |
| Total storage loss                                              |                                          |          |          |          |          |          |          |          |          |          |          |                |
| 22.9400                                                         | 20.7200                                  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | (56)           |
| If cylinder contains dedicated solar storage                    |                                          |          |          |          |          |          |          |          |          |          |          |                |
| 22.9400                                                         | 20.7200                                  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | (57)           |
| Primary loss                                                    | 23.2624                                  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | (59)           |
| Total heat required for water heating calculated for each month |                                          |          |          |          |          |          |          |          |          |          |          |                |
| 179.2606                                                        | 158.1048                                 | 166.2895 | 149.4069 | 146.6596 | 131.3989 | 126.5306 | 138.3802 | 137.9907 | 154.9097 | 163.3745 | 175.0622 | (62)           |
| Solar input                                                     | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (63)           |
| Output from w/h                                                 | Solar input (sum of months) = Sum(63)m = |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)    |
| 179.2606                                                        | 158.1048                                 | 166.2895 | 149.4069 | 146.6596 | 131.3989 | 126.5306 | 138.3802 | 137.9907 | 154.9097 | 163.3745 | 175.0622 | (64)           |
| Heat gains from water heating, kWh/month                        | Total per year (kWh/year) = Sum(64)m =   |          |          |          |          |          |          |          |          |          |          | 1827.3682 (64) |
| 81.2038                                                         | 72.0792                                  | 76.8909  | 70.5806  | 70.3639  | 64.5930  | 63.6710  | 67.6110  | 66.7848  | 73.1071  | 75.2249  | 79.8078  | (65)           |

#### 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 14.1657  | 12.5819  | 10.2323  | 7.7465   | 5.7906   | 4.8887   | 5.2824   | 6.8662   | 9.2158   | 11.7016  | 13.6575  | 14.5594 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 158.8961 | 160.5450 | 156.3899 | 147.5444 | 136.3784 | 125.8840 | 118.8731 | 117.2242 | 121.3793 | 130.2248 | 141.3908 | 151.8852 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 109.1449 | 107.2607 | 103.3480 | 98.0287  | 94.5752  | 89.7125  | 85.5794  | 90.8750  | 92.7566  | 98.2622  | 104.4790 | 107.2686 (72) |
| Total internal gains                                                                |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 332.5471 | 330.7279 | 320.3106 | 303.6599 | 287.0846 | 270.8256 | 260.0752 | 265.3059 | 273.6921 | 290.5291 | 309.8677 | 324.0536 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| -----       |          |          |          |            |                                |                                   |                                    |                              |              |          |          |               |
| Northeast   |          |          |          | 1.6400     | 11.2829                        | 0.3700                            | 0.7900                             | 0.7700                       | 3.7482 (75)  |          |          |               |
| North       |          |          |          | 8.4000     | 10.6334                        | 0.3700                            | 0.8900                             | 0.7700                       | 20.3834 (74) |          |          |               |
| Southeast   |          |          |          | 7.6100     | 36.7938                        | 0.5600                            | 0.6800                             | 0.7700                       | 73.8907 (77) |          |          |               |
| -----       |          |          |          |            |                                |                                   |                                    |                              |              |          |          |               |
| Solar gains | 98.0223  | 172.4466 | 252.1496 | 342.2747   | 412.5714                       | 422.9506                          | 402.1702                           | 347.3383                     | 282.8027     | 194.7990 | 118.3658 | 83.2886 (83)  |
| Total gains | 430.5694 | 503.1745 | 572.4601 | 645.9346   | 699.6560                       | 693.7762                          | 662.2454                           | 612.6442                     | 556.4948     | 485.3280 | 428.2335 | 407.3422 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 69.9424 | 70.1059 | 70.2702 | 71.1032 | 71.2722 | 72.1293 | 72.1293 | 72.3031 | 71.7840 | 71.2722 | 70.9350 | 70.6010      |
| alpha                                                                       | 5.6628  | 5.6737  | 5.6847  | 5.7402  | 5.7515  | 5.8086  | 5.8086  | 5.8202  | 5.7856  | 5.7515  | 5.7290  | 5.7067       |
| util living area                                                            | 0.9938  | 0.9845  | 0.9573  | 0.8712  | 0.7027  | 0.5042  | 0.3661  | 0.4120  | 0.6610  | 0.9168  | 0.9852  | 0.9954 (86)  |
| MIT                                                                         | 20.1185 | 20.2932 | 20.5383 | 20.8058 | 20.9528 | 20.9941 | 20.9992 | 20.9985 | 20.9748 | 20.7698 | 20.3942 | 20.0845 (87) |
| Th 2                                                                        | 20.0464 | 20.0484 | 20.0504 | 20.0605 | 20.0625 | 20.0726 | 20.0726 | 20.0747 | 20.0686 | 20.0625 | 20.0585 | 20.0545 (88) |
| util rest of house                                                          | 0.9918  | 0.9796  | 0.9442  | 0.8372  | 0.6444  | 0.4335  | 0.2893  | 0.3299  | 0.5826  | 0.8857  | 0.9797  | 0.9938 (89)  |
| MIT 2                                                                       | 18.8872 | 19.1406 | 19.4887 | 19.8520 | 20.0222 | 20.0692 | 20.0724 | 20.0741 | 20.0516 | 19.8178 | 19.2962 | 18.8439 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 19.4565 | 19.6735 | 19.9740 | 20.2930 | 20.4525 | 20.4969 | 20.5009 | 20.5016 | 20.4785 | 20.2580 | 19.8039 | 19.4175 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.4565 | 19.6735 | 19.9740 | 20.2930 | 20.4525 | 20.4969 | 20.5009 | 20.5016 | 20.4785 | 20.2580 | 19.8039 | 19.4175 (93) |

#### 8. Space heating requirement

|                   | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|-------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Utilisation       | 0.9901   | 0.9772   | 0.9430   | 0.8463   | 0.6694   | 0.4661   | 0.3248   | 0.3680   | 0.6181   | 0.8930   | 0.9778   | 0.9925 (94)   |
| Useful gains      | 426.3166 | 491.7265 | 539.8231 | 546.6573 | 468.3686 | 323.3670 | 215.1203 | 225.4336 | 343.9566 | 433.4008 | 418.7113 | 404.2767 (95) |
| Ext temp.         | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)   |
| Heat loss rate W  |          |          |          |          |          |          |          |          |          |          |          |               |
|                   | 862.8018 | 839.0397 | 763.4457 | 637.9732 | 488.9507 | 325.5098 | 215.3333 | 225.8625 | 353.7873 | 539.5339 | 713.0660 | 858.1947 (97) |
| Month fracti      | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)  |
| Space heating kWh |          |          |          |          |          |          |          |          |          |          |          |               |
|                   | 324.7450 | 233.3945 | 166.3752 | 65.7474  | 15.3131  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 78.9630  | 211.9354 | 337.7150 (98) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                                                           |                    |                               |                          |                  |
|-----------------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|------------------|
| Space heating                                                                                             |                    |                               |                          | 1434.1887 (98)   |
| Space heating per m2                                                                                      |                    |                               | (98) / (4) =             | 26.3154 (99)     |
| -----                                                                                                     |                    |                               |                          |                  |
| 8c. Space cooling requirement                                                                             |                    |                               |                          |                  |
| Not applicable                                                                                            |                    |                               |                          |                  |
| -----                                                                                                     |                    |                               |                          |                  |
| 9b. Energy requirements                                                                                   |                    |                               |                          |                  |
| -----                                                                                                     |                    |                               |                          |                  |
| Fraction of space heat from secondary/supplementary system (Table 11)                                     |                    |                               |                          | 0.0000 (301)     |
| Fraction of space heat from community system                                                              |                    |                               |                          | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                                   |                    |                               |                          | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                                       |                    |                               |                          | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating                          |                    |                               |                          | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating                          |                    |                               |                          | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                                         |                    |                               |                          | 1.1000 (306)     |
| Space heating:                                                                                            |                    |                               |                          |                  |
| Annual space heating requirement                                                                          |                    |                               |                          | 1434.1887 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                                       |                    |                               |                          | 1577.6075 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)                   |                    |                               |                          | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                                     |                    |                               |                          | 0.0000 (309)     |
| Water heating                                                                                             |                    |                               |                          |                  |
| Annual water heating requirement                                                                          |                    |                               |                          | 1827.3682 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                                       |                    |                               |                          | 2010.1050 (310a) |
| Electricity used for heat distribution                                                                    |                    |                               |                          | 35.8771 (313)    |
| Annual totals kWh/year                                                                                    |                    |                               |                          |                  |
| Electricity for pumps and fans:                                                                           |                    |                               |                          |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)                               |                    |                               |                          |                  |
| mechanical ventilation fans (SFP = 0.6625)                                                                |                    |                               |                          | 111.8860 (330a)  |
| Total electricity for the above, kWh/year                                                                 |                    |                               |                          | 111.8860 (331)   |
| Electricity for lighting (calculated in Appendix L)                                                       |                    |                               |                          | 250.1708 (332)   |
| Total delivered energy for all uses                                                                       |                    |                               |                          | 3949.7694 (338)  |
| -----                                                                                                     |                    |                               |                          |                  |
| 12b. Carbon dioxide emissions - Community heating scheme                                                  |                    |                               |                          |                  |
| -----                                                                                                     |                    |                               |                          |                  |
|                                                                                                           | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |                  |
| Efficiency of heat source Boilers                                                                         |                    |                               | 93.9000 (367a)           |                  |
| Space heating from Boilers                                                                                | 3820.7801          | 0.2160                        | 825.2885 (367)           |                  |
| Electrical energy for heat distribution                                                                   | 35.8771            | 0.5190                        | 18.6202 (372)            |                  |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE)                |                    |                               | 843.9087 (373)           |                  |
| Space and water heating                                                                                   |                    |                               | 843.9087 (376)           |                  |
| Pumps and fans                                                                                            | 111.8860           | 0.5190                        | 58.0689 (378)            |                  |
| Energy for lighting                                                                                       | 250.1708           | 0.5190                        | 129.8386 (379)           |                  |
| Total CO2, kg/year                                                                                        |                    |                               | 1031.8162 (383)          |                  |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                               |                    |                               | 18.9300 (384)            |                  |
| -----                                                                                                     |                    |                               |                          |                  |
| 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES |                    |                               |                          |                  |
| DER                                                                                                       |                    |                               | 18.9300 ZC1              |                  |
| Total Floor Area                                                                                          |                    | TFA                           | 54.5000                  |                  |
| Assumed number of occupants                                                                               |                    | N                             | 1.8227                   |                  |
| CO2 emission factor in Table 12 for electricity displaced from grid                                       |                    | EF                            | 0.5190                   |                  |
| CO2 emissions from appliances, equation (L14)                                                             |                    |                               | 17.2768 ZC2              |                  |
| CO2 emissions from cooking, equation (L16)                                                                |                    |                               | 2.9861 ZC3               |                  |
| Total CO2 emissions                                                                                       |                    |                               | 39.1929 ZC4              |                  |
| Residual CO2 emissions offset from biofuel CHP                                                            |                    |                               | 0.0000 ZC5               |                  |
| Additional allowable electricity generation, kWh/m²/year                                                  |                    |                               | 0.0000 ZC6               |                  |
| Resulting CO2 emissions offset from additional allowable electricity generation                           |                    |                               | 0.0000 ZC7               |                  |
| Net CO2 emissions                                                                                         |                    |                               | 39.1929 ZC8              |                  |
| -----                                                                                                     |                    |                               |                          |                  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 54.5000 (1b)              | x 2.5400 (2b)                   | = 138.4300 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.4300 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour    |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|----------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                          |                              |                      |       |       | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 20.0000 / (5) = 0.1445 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                        |
| Measured/design AP50                                 |                              |                      |       |       | 5.0000                     |
| Infiltration rate                                    |                              |                      |       |       | 0.3945 (18)                |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.3057 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.3898 | 0.3821 | 0.3745 | 0.3363 | 0.3286 | 0.2904 | 0.2904 | 0.2828 | 0.3057 | 0.3286 | 0.3439 | 0.3592 (22b) |
| Effective ac    | 0.5760 | 0.5730 | 0.5701 | 0.5565 | 0.5540 | 0.5422 | 0.5422 | 0.5400 | 0.5467 | 0.5540 | 0.5591 | 0.5645 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 11.5200                   | 1.3258                        | 15.2727      |                                | (27)          |
| Heat Loss Floor 1                                              |                         |                            | 54.5000                   | 0.1300                        | 7.0850       |                                | (28b)         |
| External Wall 1                                                | 32.4000                 | 11.5200                    | 20.8800                   | 0.1800                        | 3.7584       |                                | (29a)         |
| Corridor wall                                                  | 43.3000                 | 2.1000                     | 41.2000                   | 0.1800                        | 7.4160       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 130.2000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 36.0521      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 3.1241 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 39.1762 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 26.3114 | 26.1766 | 26.0445 | 25.4241 | 25.3080 | 24.7676 | 24.7676 | 24.6676 | 24.9758 | 25.3080 | 25.5428 | 25.7883 (38) |
| Heat transfer coeff       | 65.4876 | 65.3528 | 65.2207 | 64.6003 | 64.4842 | 63.9439 | 63.9439 | 63.8438 | 64.1520 | 64.4842 | 64.7191 | 64.9646 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 64.5998 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.2016 | 1.1991 | 1.1967 | 1.1853 | 1.1832 | 1.1733 | 1.1733 | 1.1714 | 1.1771 | 1.1832 | 1.1875 | 1.1920 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.1853 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |         |         |         |         |         |         |          |          |                |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|----------|----------|----------------|
| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |          |          | 1.8227 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |          |          | 77.4890 (43)   |
| Daily hot water use                                         | Jan      | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec            |
| Energy conte                                                | 85.2379  | 82.1383  | 79.0388  | 75.9392 | 72.8397 | 69.7401 | 69.7401 | 72.8397 | 75.9392 | 79.0388  | 82.1383  | 85.2379 (44)   |
| Energy content (annual)                                     | 126.4053 | 110.5549 | 114.0828 | 99.4601 | 95.4343 | 82.3526 | 76.3118 | 87.5689 | 88.6147 | 103.2719 | 112.7294 | 122.4168 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |         |         |         |         |         |         |          |          | 1219.2036 (45) |
| Water storage loss:                                         | 18.9608  | 16.5832  | 17.1124  | 14.9190 | 14.3152 | 12.3529 | 11.4468 | 13.1353 | 13.2922 | 15.4908  | 16.9094  | 18.3625 (46)   |
| Store volume                                                |          |          |          |         |         |         |         |         |         |          |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |          |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |          |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |          |          | 0.1290 (55)    |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 153.6655 | 135.1770 | 141.3429 | 125.8409 | 122.6945 | 108.7334 | 103.5719 | 114.8290 | 114.9955 | 130.5321 | 139.1102 | 149.6770 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 153.6655 | 135.1770 | 141.3429 | 125.8409 | 122.6945 | 108.7334 | 103.5719 | 114.8290 | 114.9955 | 130.5321 | 139.1102 | 149.6770 (64) |
| Heat gains from water heating, kWh/month                        | 63.8379  | 56.4572  | 59.7406  | 54.1751  | 53.5400  | 48.4869  | 47.1818  | 50.9248  | 50.5690  | 56.1460  | 58.5871  | 62.5117 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.1983  | 12.6108  | 10.2558  | 7.7643   | 5.8039   | 4.8999   | 5.2945   | 6.8820   | 9.2370   | 11.7285  | 13.6889  | 14.5929 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 158.8961 | 160.5450 | 156.3899 | 147.5444 | 136.3784 | 125.8840 | 118.8731 | 117.2242 | 121.3793 | 130.2248 | 141.3908 | 151.8852 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 (71) |
| Water heating gains (Table 5)                                                       | 85.8036  | 84.0136  | 80.2965  | 75.2432  | 71.9624  | 67.3429  | 63.4164  | 68.4473  | 70.2348  | 75.4651  | 81.3710  | 84.0211 (72)  |
| Total internal gains                                                                | 312.2384 | 310.5098 | 300.2827 | 283.8923 | 267.4851 | 251.4672 | 240.9244 | 245.8939 | 254.1914 | 270.7588 | 289.7911 | 303.8396 (73) |

#### 6. Solar gains

| [Jan]       |            |          |          |          |                                |          |                                   |          |                                    |          |                              |               |              |
|-------------|------------|----------|----------|----------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|---------------|--------------|
|             | Area<br>m2 |          |          |          | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |               | Gains<br>W   |
| North       | 5.4800     |          |          |          | 10.6334                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |               | 17.8084 (74) |
| Northeast   | 1.0700     |          |          |          | 11.2829                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |               | 3.6896 (75)  |
| Southeast   | 4.9700     |          |          |          | 36.7938                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |               | 55.8860 (77) |
|             |            |          |          |          |                                |          |                                   |          |                                    |          |                              |               |              |
| Solar gains | 77.3840    | 136.7376 | 201.6104 | 276.4969 | 335.7665                       | 345.2594 | 327.8724                          | 281.5311 | 227.0507                           | 154.8999 | 93.5500                      | 65.6858 (83)  |              |
| Total gains | 389.6224   | 447.2474 | 501.8931 | 560.3892 | 603.2516                       | 596.7265 | 568.7967                          | 527.4250 | 481.2421                           | 425.6588 | 383.3411                     | 369.5255 (84) |              |

#### 7. Mean internal temperature (heating season)

|                                                                             |              |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|--------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) | 21.0000 (85) |         |         |         |         |         |         |         |         |         |         |              |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan          | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 57.7930      | 57.9121 | 58.0294 | 58.5867 | 58.6922 | 59.1882 | 59.1882 | 59.2810 | 58.9962 | 58.6922 | 58.4793 | 58.2583      |
| alpha                                                                       | 4.8529       | 4.8608  | 4.8686  | 4.9058  | 4.9128  | 4.9459  | 4.9459  | 4.9521  | 4.9331  | 4.9128  | 4.8986  | 4.8839       |
| util living area                                                            | 0.9957       | 0.9910  | 0.9780  | 0.9357  | 0.8284  | 0.6485  | 0.4868  | 0.5428  | 0.7949  | 0.9580  | 0.9912  | 0.9967 (86)  |
| MIT                                                                         | 19.7952      | 19.9599 | 20.2228 | 20.5594 | 20.8288 | 20.9618 | 20.9924 | 20.9873 | 20.8969 | 20.5498 | 20.1106 | 19.7634 (87) |
| Th 2                                                                        | 19.9187      | 19.9207 | 19.9226 | 19.9318 | 19.9335 | 19.9414 | 19.9414 | 19.9429 | 19.9384 | 19.9335 | 19.9300 | 19.9264 (88) |
| util rest of house                                                          | 0.9943       | 0.9880  | 0.9704  | 0.9133  | 0.7738  | 0.5563  | 0.3738  | 0.4251  | 0.7135  | 0.9387  | 0.9877  | 0.9955 (89)  |
| MIT 2                                                                       | 18.3298      | 18.5704 | 18.9507 | 19.4281 | 19.7726 | 19.9173 | 19.9388 | 19.9380 | 19.8601 | 19.4260 | 18.7976 | 18.2888 (90) |
| Living area fraction                                                        | 19.0074      | 19.2129 | 19.5389 | 19.9512 | 20.2610 | 20.4003 | 20.4259 | 20.4232 | 20.3395 | 19.9456 | 19.4047 | 18.9706 (92) |
| Temperature adjustment                                                      | 19.0074      | 19.2129 | 19.5389 | 19.9512 | 20.2610 | 20.4003 | 20.4259 | 20.4232 | 20.3395 | 19.9456 | 19.4047 | 18.9706 (93) |
| adjusted MIT                                                                | 19.0074      | 19.2129 | 19.5389 | 19.9512 | 20.2610 | 20.4003 | 20.4259 | 20.4232 | 20.3395 | 19.9456 | 19.4047 | 18.9706 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |                |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Useful gains         | 0.9926   | 0.9854   | 0.9671   | 0.9138   | 0.7920   | 0.5977   | 0.4263   | 0.4798   | 0.7469   | 0.9390   | 0.9854   | 0.9942 (94)    |
| Ext temp.            | 386.7367 | 440.6969 | 485.3604 | 512.0889 | 477.7910 | 356.6914 | 242.4835 | 253.0661 | 359.4495 | 399.6819 | 377.7319 | 367.3677 (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Month fracti         | 963.1533 | 935.3876 | 850.4056 | 713.9113 | 552.0468 | 370.8910 | 244.6460 | 256.8545 | 400.2780 | 602.6431 | 796.3496 | 959.5682 (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating per m2 | 428.8539 | 332.4322 | 271.5936 | 145.3122 | 55.2463  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 151.0031 | 301.4047 | 440.5971 (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 2126.4432 (98) |
|                      |          |          |          |          |          |          |          |          |          |          |          | 39.0173 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2274.2708 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 428.8539 | 332.4322 | 271.5936 | 145.3122 | 55.2463  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 151.0031 | 301.4047 | 440.5971  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 458.6673 | 355.5425 | 290.4745 | 155.4141 | 59.0870  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 161.5007 | 322.3580 | 471.2269  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 153.6655 | 135.1770 | 141.3429 | 125.8409 | 122.6945 | 108.7334 | 103.5719 | 114.8290 | 114.9955 | 130.5321 | 139.1102 | 149.6770  | (64)            |
| Efficiency of water heater (217)m                                     | 87.4083  | 87.1230  | 86.5287  | 85.1983  | 82.8409  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.2031  | 86.8236  | 87.5242   | (216)           |
| Fuel for water heating, kWh/month                                     | 175.8020 | 155.1565 | 163.3480 | 147.7036 | 148.1085 | 136.2574 | 129.7894 | 143.8960 | 144.1047 | 153.2011 | 160.2215 | 171.0122  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1828.6007 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2274.2708 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 250.7461  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4428.6177 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2274.2708          | 0.2160                        | 491.2425 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1828.6007          | 0.2160                        | 394.9778 (264)           |
| Space and water heating                                                                           |                    |                               | 886.2203 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 250.7461           | 0.5190                        | 130.1372 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1055.2825 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 16.2609 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3878 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7142 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (16.2609 * 1.00) + 2.3878 + 0.7142, rounded to 2 d.p. |                    |                               | 19.3600 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-2-01                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 85 B                                                                    | DER           | 14.67   | TER            | 15.61      |
| Environmental                      | 89 B                                                                    | % DER<TER     | 6.05    |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.86                                                                    | DFEE          | 37.14   | TFEE           | 40.71      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 8.76    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 71 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 15.61 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.67 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 40.7 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 37.1 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.38 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and TRVsOK  
Hot water controls: No cylinderstat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing North East: 1.92 m<sup>2</sup>, No overhang  
Windows facing West: 16.01 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 70.8000 (1b)              | x 2.5400 (2b)                   | = 179.8320 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.8000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 179.8320 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
|                                                                                              |                              |        |           |        |        |        | Air changes per hour        |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes         |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000      |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 (18) |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 2 (19)      |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
|                                                                                              | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind speed                                                                                   | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2631                       | 0.2599 | 0.2567    | 0.2408 | 0.2376 | 0.2216 | 0.2216                      | 0.2184      | 0.2280 | 0.2376 | 0.2439 | 0.2503 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364      |                                      | (27)            |
| W02 (Uw = 1.40)                                                |                         |                            | 7.6100                    | 1.3258                        | 10.0890      |                                      | (27)            |
| door                                                           |                         |                            | 2.1000                    | 1.2500                        | 2.6250       |                                      | (26a)           |
| W10 (Uw = 1.40)                                                |                         |                            | 1.9200                    | 1.3258                        | 2.5455       |                                      | (27)            |
| External Wall 1                                                | 54.1000                 | 17.9300                    | 36.1700                   | 0.1500                        | 5.4255       | 140.0000                             | 5063.8000 (29a) |
| Corridor wall                                                  | 9.1000                  | 2.1000                     | 7.0000                    | 0.1409                        | 0.9864       | 110.0000                             | 770.0000 (29a)  |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 63.2000                   |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 32.8077      |                                      | (33)            |
| Party Wall 1                                                   |                         |                            | 36.5000                   | 0.0000                        | 0.0000       | 140.0000                             | 5110.0000 (32)  |
| Party Floor                                                    |                         |                            | 70.8000                   |                               |              | 80.0000                              | 5664.0000 (32d) |
| Party Ceilings                                                 |                         |                            | 70.8000                   |                               |              | 80.0000                              | 5664.0000 (32b) |
| Internal Wall                                                  |                         |                            | 126.6000                  |                               |              | 9.0000                               | 1139.4000 (32c) |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 23411.2000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 330.6667 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 5.9440 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 38.7517 (37)    |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 15.6113 | 15.4222 | 15.2330 | 14.2872 | 14.0980 | 13.1522 | 13.1522 | 12.9631 | 13.5306 | 14.0980 | 14.4764 | 14.8547 (38) |
| Heat transfer coeff       | 54.3630 | 54.1739 | 53.9847 | 53.0389 | 52.8498 | 51.9040 | 51.9040 | 51.7148 | 52.2823 | 52.8498 | 53.2281 | 53.6064 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 52.9916 (39) |
| HLP                       | 0.7678  | 0.7652  | 0.7625  | 0.7491  | 0.7465  | 0.7331  | 0.7331  | 0.7304  | 0.7385  | 0.7465  | 0.7518  | 0.7572 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.7485 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 2.2654 (42)  |
| Average daily hot water use (litres/day) | 92.6347 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                    |               |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------------|---------------|----------------|
| Energy conte                                                    | 101.8982 | 98.1928  | 94.4874  | 90.7820  | 87.0766  | 83.3713  | 83.3713  | 87.0766  | 90.7820  | 94.4874            | 98.1928       | 101.8982 (44)  |
| 151.1121                                                        | 132.1636 | 136.3810 | 118.9003 | 114.0876 | 98.4490  | 91.2274  | 104.6848 | 105.9351 | 123.4571 | 134.7631           | 146.3440 (45) |                |
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          | Total = Sum(45)m = |               | 1457.5051 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |                    |               |                |
| 22.6668                                                         | 19.8245  | 20.4572  | 17.8350  | 17.1131  | 14.7673  | 13.6841  | 15.7027  | 15.8903  | 18.5186  | 20.2145            | 21.9516 (46)  |                |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                    |               |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                    |               | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                    |               | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                    |               | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                    |               | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                    |               |                |
| 22.9400                                                         | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000            | 22.9400 (56)  |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |                    |               |                |
| 22.9400                                                         | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000            | 22.9400 (57)  |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120            | 23.2624 (59)  |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |                    |               |                |
| Solar input                                                     | 197.3145 | 173.8948 | 182.5834 | 163.6123 | 160.2900 | 143.1610 | 137.4298 | 150.8872 | 150.6471 | 169.6595           | 179.4751      | 192.5464 (62)  |
| 0.0000                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000             | 0.0000 (63)   |                |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |                    |               | 0.0000 (63)    |
| Output from w/h                                                 | 197.3145 | 173.8948 | 182.5834 | 163.6123 | 160.2900 | 143.1610 | 137.4298 | 150.8872 | 150.6471 | 169.6595           | 179.4751      | 192.5464 (64)  |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |          |          |          |          |          |                    |               | 2001.5011 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |                    |               |                |
| 87.2067                                                         | 77.3294  | 82.3086  | 75.3039  | 74.8961  | 68.5039  | 67.2950  | 71.7696  | 70.9930  | 78.0114  | 80.5783            | 85.6213 (65)  |                |

#### 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 17.7550  | 15.7698  | 12.8249  | 9.7093   | 7.2578   | 6.1273   | 6.6208   | 8.6060   | 11.5509  | 14.6665  | 17.1180  | 18.2485 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 199.1570 | 201.2236 | 196.0158 | 184.9289 | 170.9337 | 157.7803 | 148.9929 | 146.9263 | 152.1341 | 163.2210 | 177.2161 | 190.3696 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 117.2133 | 115.0735 | 110.6298 | 104.5888 | 100.6667 | 95.1443  | 90.4503  | 96.4645  | 98.6014  | 104.8540 | 111.9143 | 115.0824 (72) |
| Total internal gains                                                                |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 391.1061 | 389.0477 | 376.4513 | 356.2078 | 335.8391 | 316.0327 | 303.0449 | 308.9776 | 319.2673 | 339.7224 | 363.2293 | 380.6813 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| West        |          |          |          | 8.4000     | 19.6403                        | 0.3700                            | 0.8900                             | 0.7700                       | 37.6488 (80) |          |          |               |
| West        |          |          |          | 7.6100     | 19.6403                        | 0.5600                            | 0.6800                             | 0.7700                       | 39.4423 (80) |          |          |               |
| Northeast   |          |          |          | 1.9200     | 11.2829                        | 0.3700                            | 0.6500                             | 0.7700                       | 3.6105 (75)  |          |          |               |
| Solar gains | 80.7017  | 158.1560 | 261.5982 | 383.9597   | 473.1374                       | 485.5805                          | 461.7763                           | 394.8582                     | 304.9841     | 187.9262 | 100.6666 | 66.3445 (83)  |
| Total gains | 471.8078 | 547.2037 | 638.0495 | 740.1675   | 808.9765                       | 801.6132                          | 764.8212                           | 703.8358                     | 624.2513     | 527.6486 | 463.8959 | 447.0259 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |          |          |          |          |          |          |          |          |                           |          |          |              |
|-----------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|----------|----------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |          |          |          |          |          |          |          |          |                           |          |          | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |          |          |          |          |          |          |          |          |                           |          |          |              |
|                                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep                       | Oct      | Nov      | Dec          |
| tau                                                                         | 119.6238 | 120.0415 | 120.4621 | 122.6102 | 123.0490 | 125.2913 | 125.2913 | 125.7495 | 124.3846                  | 123.0490 | 122.1745 | 121.3122     |
| alpha                                                                       | 8.9749   | 9.0028   | 9.0308   | 9.1740   | 9.2033   | 9.3528   | 9.3528   | 9.3833   | 9.2923                    | 9.2033   | 9.1450   | 9.0875       |
| util living area                                                            | 0.9986   | 0.9943   | 0.9665   | 0.8264   | 0.6051   | 0.4143   | 0.2986   | 0.3380   | 0.5764                    | 0.9194   | 0.9947   | 0.9991 (86)  |
| MIT                                                                         | 20.5114  | 20.6327  | 20.8140  | 20.9662  | 20.9978  | 20.9999  | 21.0000  | 21.0000  | 20.9989                   | 20.9275  | 20.6877  | 20.4912 (87) |
| Th 2                                                                        | 20.2813  | 20.2836  | 20.2860  | 20.2976  | 20.3000  | 20.3117  | 20.3117  | 20.3140  | 20.3070                   | 20.3000  | 20.2953  | 20.2906 (88) |
| util rest of house                                                          | 0.9981   | 0.9921   | 0.9548   | 0.7900   | 0.5606   | 0.3698   | 0.2519   | 0.2876   | 0.5193                    | 0.8885   | 0.9922   | 0.9988 (89)  |
| MIT 2                                                                       | 19.6292  | 19.8073  | 20.0645  | 20.2651  | 20.2983  | 20.3117  | 20.3117  | 20.3140  | 20.3064                   | 20.2279  | 19.8976  | 19.6076 (90) |
| Living area fraction                                                        |          |          |          |          |          |          |          |          | fLA = Living area / (4) = |          |          | 0.3559 (91)  |
| MIT                                                                         | 19.9432  | 20.1011  | 20.3313  | 20.5146  | 20.5473  | 20.5566  | 20.5567  | 20.5582  | 20.5529                   | 20.4769  | 20.1788  | 19.9221 (92) |
| Temperature adjustment                                                      |          |          |          |          |          |          |          |          |                           |          |          | 0.0000       |
| adjusted MIT                                                                | 19.9432  | 20.1011  | 20.3313  | 20.5146  | 20.5473  | 20.5566  | 20.5567  | 20.5582  | 20.5529                   | 20.4769  | 20.1788  | 19.9221 (93) |

#### 8. Space heating requirement

|                   | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|-------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Utilisation       | 0.9977   | 0.9914   | 0.9557   | 0.8016   | 0.5764   | 0.3857   | 0.2685   | 0.3055   | 0.5396   | 0.8971   | 0.9917   | 0.9985 (94)   |
| Useful gains      | 470.7432 | 542.4931 | 609.7647 | 593.3489 | 466.3018 | 309.1474 | 205.3663 | 215.0373 | 336.8621 | 473.3328 | 460.0529 | 446.3649 (95) |
| Ext temp.         | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)   |
| Heat loss rate W  | 850.4115 | 823.5030 | 746.6776 | 616.0268 | 467.5772 | 309.1730 | 205.3670 | 215.0395 | 337.3724 | 521.9926 | 696.1603 | 842.8051 (97) |
| Month fracti      | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)  |
| Space heating kWh | 282.4732 | 188.8386 | 101.8632 | 16.3281  | 0.9489   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 36.2029  | 169.9973 | 294.9515 (98) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                                                           |                    |                               |                          |                  |
|-----------------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|------------------|
| Space heating                                                                                             |                    |                               |                          | 1091.6038 (98)   |
| Space heating per m2                                                                                      |                    |                               | (98) / (4) =             | 15.4181 (99)     |
| -----                                                                                                     |                    |                               |                          |                  |
| 8c. Space cooling requirement                                                                             |                    |                               |                          |                  |
| -----                                                                                                     |                    |                               |                          |                  |
| Not applicable                                                                                            |                    |                               |                          |                  |
| -----                                                                                                     |                    |                               |                          |                  |
| 9b. Energy requirements                                                                                   |                    |                               |                          |                  |
| -----                                                                                                     |                    |                               |                          |                  |
| Fraction of space heat from secondary/supplementary system (Table 11)                                     |                    |                               |                          | 0.0000 (301)     |
| Fraction of space heat from community system                                                              |                    |                               |                          | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                                   |                    |                               |                          | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                                       |                    |                               |                          | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating                          |                    |                               |                          | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating                          |                    |                               |                          | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                                         |                    |                               |                          | 1.1000 (306)     |
| Space heating:                                                                                            |                    |                               |                          |                  |
| Annual space heating requirement                                                                          |                    |                               |                          | 1091.6038 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                                       |                    |                               |                          | 1200.7641 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)                   |                    |                               |                          | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                                     |                    |                               |                          | 0.0000 (309)     |
| Water heating                                                                                             |                    |                               |                          |                  |
| Annual water heating requirement                                                                          |                    |                               |                          | 2001.5011 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                                       |                    |                               |                          | 2201.6512 (310a) |
| Electricity used for heat distribution                                                                    |                    |                               |                          | 34.0242 (313)    |
| Annual totals kWh/year                                                                                    |                    |                               |                          |                  |
| Electricity for pumps and fans:                                                                           |                    |                               |                          |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)                               |                    |                               |                          |                  |
| mechanical ventilation fans (SFP = 0.6625)                                                                |                    |                               |                          | 145.3492 (330a)  |
| Total electricity for the above, kWh/year                                                                 |                    |                               |                          | 145.3492 (331)   |
| Electricity for lighting (calculated in Appendix L)                                                       |                    |                               |                          | 313.5586 (332)   |
| Total delivered energy for all uses                                                                       |                    |                               |                          | 3861.3232 (338)  |
| -----                                                                                                     |                    |                               |                          |                  |
| 12b. Carbon dioxide emissions - Community heating scheme                                                  |                    |                               |                          |                  |
| -----                                                                                                     |                    |                               |                          |                  |
|                                                                                                           | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |                  |
| Efficiency of heat source Boilers                                                                         |                    |                               | 93.9000 (367a)           |                  |
| Space heating from Boilers                                                                                | 3623.4455          | 0.2160                        | 782.6642 (367)           |                  |
| Electrical energy for heat distribution                                                                   | 34.0242            | 0.5190                        | 17.6585 (372)            |                  |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE)                |                    |                               | 800.3228 (373)           |                  |
| Space and water heating                                                                                   |                    |                               | 800.3228 (376)           |                  |
| Pumps and fans                                                                                            | 145.3492           | 0.5190                        | 75.4362 (378)            |                  |
| Energy for lighting                                                                                       | 313.5586           | 0.5190                        | 162.7369 (379)           |                  |
| Total CO2, kg/year                                                                                        |                    |                               | 1038.4959 (383)          |                  |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                               |                    |                               | 14.6700 (384)            |                  |
| -----                                                                                                     |                    |                               |                          |                  |
| 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES |                    |                               |                          |                  |
| DER                                                                                                       |                    |                               | 14.6700 ZC1              |                  |
| Total Floor Area                                                                                          |                    | TFA                           | 70.8000                  |                  |
| Assumed number of occupants                                                                               |                    | N                             | 2.2654                   |                  |
| CO2 emission factor in Table 12 for electricity displaced from grid                                       |                    | EF                            | 0.5190                   |                  |
| CO2 emissions from appliances, equation (L14)                                                             |                    |                               | 16.6690 ZC2              |                  |
| CO2 emissions from cooking, equation (L16)                                                                |                    |                               | 2.4487 ZC3               |                  |
| Total CO2 emissions                                                                                       |                    |                               | 33.7877 ZC4              |                  |
| Residual CO2 emissions offset from biofuel CHP                                                            |                    |                               | 0.0000 ZC5               |                  |
| Additional allowable electricity generation, kWh/m²/year                                                  |                    |                               | 0.0000 ZC6               |                  |
| Resulting CO2 emissions offset from additional allowable electricity generation                           |                    |                               | 0.0000 ZC7               |                  |
| Net CO2 emissions                                                                                         |                    |                               | 33.7877 ZC8              |                  |
| -----                                                                                                     |                    |                               |                          |                  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 70.8000 (1b)              | x 2.5400 (2b)                   | = 179.8320 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.8000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 179.8320 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m3 per hour                             |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 3 * 10 = 30.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 30.0000 / (5) = 0.1668 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.4168 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 2 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3543 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4517 | 0.4429 | 0.4340 | 0.3897 | 0.3809 | 0.3366 | 0.3366 | 0.3277 | 0.3543 | 0.3809 | 0.3986 | 0.4163 (22b) |
| Effective ac    | 0.6020 | 0.5981 | 0.5942 | 0.5759 | 0.5725 | 0.5566 | 0.5566 | 0.5537 | 0.5628 | 0.5725 | 0.5794 | 0.5867 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                            |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------------|------------------|----------------|-------------------|----------------|----------------|----------------------------|----------------|----------------|----------------|------|
| TER Semi-glazed door                                                |                |                | 2.1000               | 1.2000           | 2.5200         |                   |                | (26a)          |                            |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                | 15.6000              | 1.3258           | 20.6818        |                   |                | (27)           |                            |                |                |                |      |
| External Wall 1                                                     | 54.1000        | 15.6000        | 38.5000              | 0.1800           | 6.9300         |                   |                | (29a)          |                            |                |                |                |      |
| Corridor wall                                                       | 9.1000         | 2.1000         | 7.0000               | 0.1800           | 1.2600         |                   |                | (29a)          |                            |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 63.2000              |                  |                |                   |                | (31)           |                            |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26)...(30) + (32) = |                  | 31.3918        |                   |                | (33)           |                            |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                      |                  |                |                   |                |                | 250.0000 (35)              |                |                |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                      |                  |                |                   |                |                | 3.8265 (36)                |                |                |                |      |
| Total fabric heat loss                                              |                |                |                      |                  |                |                   |                |                | (33) + (36) = 35.2183 (37) |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                      |                  |                |                   |                |                |                            |                |                |                |      |
| (38)m                                                               | Jan<br>35.7272 | Feb<br>35.4921 | Mar<br>35.2617       | Apr<br>34.1792   | May<br>33.9766 | Jun<br>33.0338    | Jul<br>33.0338 | Aug<br>32.8592 | Sep<br>33.3970             | Oct<br>33.9766 | Nov<br>34.3863 | Dec<br>34.8147 | (38) |
| Heat transfer coeff                                                 | 70.9456        | 70.7104        | 70.4800              | 69.3975          | 69.1949        | 68.2521           | 68.2521        | 68.0775        | 68.6153                    | 69.1949        | 69.6047        | 70.0330        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                      |                  |                |                   |                |                |                            |                |                |                | (39) |
| HLP                                                                 | Jan<br>1.0021  | Feb<br>0.9987  | Mar<br>0.9955        | Apr<br>0.9802    | May<br>0.9773  | Jun<br>0.9640     | Jul<br>0.9640  | Aug<br>0.9615  | Sep<br>0.9691              | Oct<br>0.9773  | Nov<br>0.9831  | Dec<br>0.9892  | (40) |
| HLP (average)                                                       |                |                |                      |                  |                |                   |                |                |                            |                |                | 0.9802         | (40) |
| Days in month                                                       | 31             | 28             | 31                   | 30               | 31             | 30                | 31             | 31             | 30                         | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |          |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|----------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |          |                    |          | 2.2654 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |          |                    |          | 88.0030 (43)   |
| Daily hot water use                                         | 96.8033  | 93.2832  | 89.7631  | 86.2429  | 82.7228  | 79.2027 | 79.2027 | 82.7228 | 86.2429  | 89.7631            | 93.2832  | 96.8033 (44)   |
| Energy conte                                                | 143.5565 | 125.5554 | 129.5620 | 112.9552 | 108.3833 | 93.5265 | 86.6661 | 99.4506 | 100.6383 | 117.2843           | 128.0249 | 139.0268 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |          | Total = Sum(45)m = |          | 1384.6298 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |          |         |         |         |          |                    |          |                |
|                                                             | 21.5335  | 18.8333  | 19.4343  | 16.9433  | 16.2575  | 14.0290 | 12.9999 | 14.9176 | 15.0957  | 17.5926            | 19.2037  | 20.8540 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |          |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |          |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |          |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |          |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |          |                    |          | 0.1290 (55)    |
| Total storage loss                                          |          |          |          |          |          |         |         |         |          |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 170.8166 | 150.1775 | 156.8221 | 139.3360 | 135.6434 | 119.9073 | 113.9262 | 126.7107 | 127.0191 | 144.5444 | 154.4057 | 166.2869 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 170.8166 | 150.1775 | 156.8221 | 139.3360 | 135.6434 | 119.9073 | 113.9262 | 126.7107 | 127.0191 | 144.5444 | 154.4057 | 166.2869 (64) |
|                                                                 | 69.5406  | 61.4448  | 64.8875  | 58.6622  | 57.8455  | 52.2022  | 50.6246  | 54.8754  | 54.5669  | 60.8051  | 63.6729  | 68.0345 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.7603  | 15.7745  | 12.8287  | 9.7121   | 7.2599   | 6.1291   | 6.6228   | 8.6085   | 11.5543  | 14.6709  | 17.1231  | 18.2539  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 199.1570 | 201.2236 | 196.0158 | 184.9289 | 170.9337 | 157.7803 | 148.9929 | 146.9263 | 152.1341 | 163.2210 | 177.2161 | 190.3696 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | (71) |
| Water heating gains (Table 5)                                                       | 93.4686  | 91.4358  | 87.2143  | 81.4753  | 77.7494  | 72.5030  | 68.0438  | 73.7573  | 75.7873  | 81.7273  | 88.4346  | 91.4443  | (72) |
| Total internal gains                                                                | 370.3667 | 368.4147 | 356.0396 | 336.0972 | 315.9239 | 296.3933 | 283.6403 | 289.2729 | 299.4566 | 319.6000 | 342.7547 | 360.0486 | (73) |

#### 6. Solar gains

| [Jan]       | Area<br>m2 |          |          |          | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |               | Gains<br>W   |  |
|-------------|------------|----------|----------|----------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|---------------|--------------|--|
| Northeast   | 1.6700     |          |          |          | 11.2829                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |               | 5.7585       |  |
| West        | 13.9300    |          |          |          | 19.6403                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |               | 83.6123 (75) |  |
|             |            |          |          |          |                                |          |                                   |          |                                    |          |                              |               |              |  |
| Solar gains | 89.3708    | 175.2851 | 290.4843 | 427.5366 | 528.0776                       | 542.5594 | 515.7156                          | 440.1199 | 339.0168                           | 208.4065 | 111.5004                     | 73.4614 (83)  |              |  |
| Total gains | 459.7375   | 543.6997 | 646.5239 | 763.6339 | 844.0015                       | 838.9527 | 799.3559                          | 729.3928 | 638.4734                           | 528.0066 | 454.2551                     | 433.5100 (84) |              |  |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 69.3020 | 69.5324 | 69.7598 | 70.8479 | 71.0553 | 72.0368 | 72.0368 | 72.2216 | 71.6556 | 71.0553 | 70.6370 | 70.2050 |              |
| alpha                                                                       | 5.6201  | 5.6355  | 5.6507  | 5.7232  | 5.7370  | 5.8025  | 5.8025  | 5.8148  | 5.7770  | 5.7370  | 5.7091  | 5.6803  |              |
| util living area                                                            | 0.9970  | 0.9918  | 0.9710  | 0.8885  | 0.7169  | 0.5149  | 0.3749  | 0.4275  | 0.7023  | 0.9485  | 0.9929  | 0.9978  | (86)         |
| MIT                                                                         | 20.0097 | 20.1827 | 20.4620 | 20.7793 | 20.9474 | 20.9934 | 20.9991 | 20.9982 | 20.9656 | 20.7003 | 20.2934 | 19.9833 | (87)         |
| Th 2                                                                        | 20.0816 | 20.0844 | 20.0871 | 20.0999 | 20.1023 | 20.1134 | 20.1134 | 20.1155 | 20.1091 | 20.1023 | 20.0974 | 20.0924 | (88)         |
| util rest of house                                                          | 0.9960  | 0.9892  | 0.9619  | 0.8587  | 0.6614  | 0.4462  | 0.2998  | 0.3463  | 0.6265  | 0.9275  | 0.9902  | 0.9971  | (89)         |
| MIT 2                                                                       | 18.7604 | 19.0138 | 19.4160 | 19.8562 | 20.0557 | 20.1094 | 20.1131 | 20.1148 | 20.0844 | 19.7657 | 19.1859 | 18.7299 | (90)         |
| Living area fraction                                                        | 19.2051 | 19.4298 | 19.7883 | 20.1848 | 20.3731 | 20.4241 | 20.4285 | 20.4292 | 20.3981 | 20.0984 | 19.5801 | 19.1760 | (92)         |
| Temperature adjustment                                                      | 19.2051 | 19.4298 | 19.7883 | 20.1848 | 20.3731 | 20.4241 | 20.4285 | 20.4292 | 20.3981 | 20.0984 | 19.5801 | 19.1760 | (93)         |

#### 8. Space heating requirement

|                                  |           |           |          |          |          |          |          |          |          |          |          |           |       |
|----------------------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation                      | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains                     | 0.9947    | 0.9868    | 0.9583   | 0.8618   | 0.6788   | 0.4705   | 0.3266   | 0.3753   | 0.6521   | 0.9274   | 0.9881   | 0.9961    | (94)  |
| Ext temp.                        | 457.3197  | 536.5045  | 619.5700 | 658.0832 | 572.8788 | 394.7450 | 261.0338 | 273.7189 | 416.3766 | 489.6704 | 448.8341 | 431.8233  | (95)  |
| Heat loss rate W                 | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Month fracti                     | 1057.4477 | 1027.4111 | 936.5568 | 783.1358 | 600.1338 | 397.5050 | 261.3016 | 274.2999 | 432.1429 | 657.2397 | 868.6738 | 1048.8165 | (97)  |
| Space heating kWh                | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating per m <sup>2</sup> | 446.4952  | 329.8893  | 235.8382 | 90.0379  | 20.2777  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 124.6716 | 302.2846 | 459.0429  | (98)  |
|                                  |           |           |          |          |          |          |          |          |          |          |          | 2008.5374 | (98)  |
|                                  |           |           |          |          |          |          |          |          |          |          |          | 28.3692   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2148.1683 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 446.4952 | 329.8893 | 235.8382 | 90.0379  | 20.2777  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 124.6716 | 302.2846 | 459.0429  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 477.5350 | 352.8227 | 252.2333 | 96.2972  | 21.6874  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 133.3386 | 323.2990 | 490.9550  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 170.8166 | 150.1775 | 156.8221 | 139.3360 | 135.6434 | 119.9073 | 113.9262 | 126.7107 | 127.0191 | 144.5444 | 154.4057 | 166.2869  | (64)            |
| Efficiency of water heater (217)m                                     | 87.2623  | 86.8568  | 85.8999  | 83.6838  | 81.0462  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.4223  | 86.5752  | 87.3842   | (216)           |
| Fuel for water heating, kWh/month                                     | 195.7507 | 172.9025 | 182.5637 | 166.5030 | 167.3656 | 150.2598 | 142.7647 | 158.7853 | 159.1718 | 171.2159 | 178.3487 | 190.2940  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2035.9255 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2148.1683 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 313.6516  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4572.7454 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2148.1683          | 0.2160                        | 464.0044 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2035.9255          | 0.2160                        | 439.7599 (264)           |
| Space and water heating                                                                           |                    |                               | 903.7643 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 313.6516           | 0.5190                        | 162.7852 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1105.4744 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.7650 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.2992 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5498 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.7650 * 1.00) + 2.2992 + 0.5498, rounded to 2 d.p. |                    |                               | 15.6100 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-2-04                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 84 B                                                                    | DER           | 15.72   | TER            | 16.65      |
| Environmental                      | 90 B                                                                    | % DER<TER     | 5.56    |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.73                                                                    | DFEE          | 35.89   | TFEE           | 39.15      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 8.32    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 54 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating: Mains gas (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 16.65 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 15.72 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 39.1 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 35.9 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.14 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK

Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing North East: 1.64 m<sup>2</sup>, No overhang  
Windows facing South East: 12.20 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 54.1000 (1b)              | x 2.5400 (2b)                   | = 137.4140 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.1000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 137.4140 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 3                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.7750 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1163 (21) |        |        |        |               |
|                                                                                              | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind speed                                                                                   | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482                       | 0.1453 | 0.1424    | 0.1279 | 0.1250 | 0.1104 | 0.1104                      | 0.1075      | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2487                       | 0.2458 | 0.2429    | 0.2284 | 0.2255 | 0.2109 | 0.2109                      | 0.2080      | 0.2168 | 0.2255 | 0.2313 | 0.2371 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W05 (Uw = 1.40)                                                |                         |                            | 1.6400                    | 1.3258                        | 2.1742       |                                | (27)                                                 |
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364      |                                | (27)                                                 |
| W02 (Uw = 1.40)                                                |                         |                            | 3.8000                    | 1.3258                        | 5.0379       |                                | (27)                                                 |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                | (26a)                                                |
| External Wall 1                                                | 31.5800                 | 13.8400                    | 17.7400                   | 0.1500                        | 2.6610       | 140.0000                       | 2483.6000 (29a)                                      |
| Corridor wall                                                  | 41.5500                 | 2.1000                     | 39.4500                   | 0.1409                        | 5.5589       | 110.0000                       | 4339.5000 (29a)                                      |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 73.1300                   | (26)...(30) + (32) =          |              | 29.5084                        | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           |                               |              |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 14.9000                   | 0.0000                        | 0.0000       | 140.0000                       | 2086.0000 (32)                                       |
| Party Floor                                                    |                         |                            | 54.1000                   |                               |              | 80.0000                        | 4328.0000 (32d)                                      |
| Party Ceilings                                                 |                         |                            | 54.1000                   |                               |              | 80.0000                        | 4328.0000 (32b)                                      |
| Internal Wall                                                  |                         |                            | 82.3000                   |                               |              | 9.0000                         | 740.7000 (32c)                                       |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 18305.8000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 338.3697 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 4.1024 (36)                                          |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 33.6108 (37)                           |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 11.2786 | 11.1468 | 11.0150 | 10.3560 | 10.2242 | 9.5653  | 9.5653  | 9.4335  | 9.8289  | 10.2242 | 10.4878 | 10.7514 (38) |
| Heat transfer coeff       | 44.8894 | 44.7576 | 44.6258 | 43.9669 | 43.8351 | 43.1761 | 43.1761 | 43.0443 | 43.4397 | 43.8351 | 44.0987 | 44.3622 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 43.9339 (39) |
| HLP                       | 0.8297  | 0.8273  | 0.8249  | 0.8127  | 0.8103  | 0.7981  | 0.7981  | 0.7956  | 0.8030  | 0.8103  | 0.8151  | 0.8200 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.8121 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 1.8109 (42)  |
| Average daily hot water use (litres/day) | 81.2736 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy conte                                                    | 89.4009  | 86.1500  | 82.8991  | 79.6481  | 76.3972  | 73.1462  | 73.1462  | 76.3972  | 79.6481  | 82.8991             | 86.1500  | 89.4009 (44)   |
| Energy content (annual)                                         | 132.5790 | 115.9545 | 119.6546 | 104.3178 | 100.0954 | 86.3747  | 80.0389  | 91.8458  | 92.9427  | 108.3158            | 118.2351 | 128.3957 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1278.7499 (45) |
|                                                                 | 19.8869  | 17.3932  | 17.9482  | 15.6477  | 15.0143  | 12.9562  | 12.0058  | 13.7769  | 13.9414  | 16.2474             | 17.7353  | 19.2594 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |                     |          |                |
| Solar input                                                     | 178.7814 | 157.6857 | 165.8570 | 149.0298 | 146.2978 | 131.0867 | 126.2413 | 138.0482 | 137.6547 | 154.5182            | 162.9471 | 174.5981 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum (63)m =                       |          |          |          |          |          |          |          |          |          |                     |          | 0.0000 (63)    |
| Output from w/h                                                 | 178.7814 | 157.6857 | 165.8570 | 149.0298 | 146.2978 | 131.0867 | 126.2413 | 138.0482 | 137.6547 | 154.5182            | 162.9471 | 174.5981 (64)  |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 81.0444  | 71.9398  | 76.7471  | 70.4553  | 70.2436  | 64.4892  | 63.5748  | 67.5006  | 66.6731  | 72.9769             | 75.0828  | 79.6535 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 14.0736  | 12.5001  | 10.1657  | 7.6961   | 5.7529   | 4.8569   | 5.2480   | 6.8216   | 9.1559   | 11.6255  | 13.5687  | 14.4648 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 157.8632 | 159.5014 | 155.3733 | 146.5853 | 135.4919 | 125.0657 | 118.1003 | 116.4622 | 120.5902 | 129.3783 | 140.4717 | 150.8979 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 108.9307 | 107.0533 | 103.1547 | 97.8545  | 94.4135  | 89.5683  | 85.4501  | 90.7267  | 92.6015  | 98.0872  | 104.2816 | 107.0611 (72) |
| Total internal gains                                                                |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 331.0317 | 329.2189 | 318.8579 | 302.3001 | 285.8225 | 269.6550 | 258.9626 | 264.1746 | 272.5118 | 289.2552 | 308.4862 | 322.5880 (73) |

#### 6. Solar gains

|             |          |            |               |               |          |              |          |          |          |          |          |               |
|-------------|----------|------------|---------------|---------------|----------|--------------|----------|----------|----------|----------|----------|---------------|
| [Jan]       |          |            |               |               |          |              |          |          |          |          |          |               |
|             | Area     | Solar flux | g             | FF            | Access   | Gains        |          |          |          |          |          |               |
|             | m2       | Table 6a   | Specific data | Specific data | factor   | W            |          |          |          |          |          |               |
|             |          | W/m2       | or Table 6b   | or Table 6c   | Table 6d |              |          |          |          |          |          |               |
| Northeast   | 1.6400   | 11.2829    | 0.3700        | 0.7900        | 0.7700   | 3.7482 (75)  |          |          |          |          |          |               |
| Southeast   | 8.4000   | 36.7938    | 0.3700        | 0.8900        | 0.7700   | 70.5309 (77) |          |          |          |          |          |               |
| Southeast   | 3.8000   | 36.7938    | 0.5600        | 0.6800        | 0.7700   | 36.8968 (77) |          |          |          |          |          |               |
| Solar gains | 111.1759 | 190.6188   | 264.1199      | 332.8004      | 377.8235 | 377.3168     | 362.8475 | 328.9180 | 287.8517 | 211.5660 | 133.3899 | 94.9967 (83)  |
| Total gains | 442.2076 | 519.8376   | 582.9778      | 635.1004      | 663.6460 | 646.9718     | 621.8101 | 593.0926 | 560.3635 | 500.8212 | 441.8761 | 417.5847 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |          |          |          |          |          |          |          |          |                           |          |          |              |
|-----------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|----------|----------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |          |          |          |          |          |          |          |          |                           |          |          |              |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |          |          |          |          |          |          |          |          |                           |          |          | 21.0000 (85) |
|                                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep                       | Oct      | Nov      | Dec          |
| tau                                                                         | 113.2772 | 113.6108 | 113.9463 | 115.6540 | 116.0017 | 117.7721 | 117.7721 | 118.1327 | 117.0575                  | 116.0017 | 115.3084 | 114.6233     |
| alpha                                                                       | 8.5518   | 8.5741   | 8.5964   | 8.7103   | 8.7334   | 8.8515   | 8.8515   | 8.8755   | 8.8038                    | 8.7334   | 8.6872   | 8.6416       |
| util living area                                                            | 0.9955   | 0.9823   | 0.9361   | 0.8023   | 0.6109   | 0.4270   | 0.3055   | 0.3338   | 0.5339                    | 0.8503   | 0.9830   | 0.9970 (86)  |
| MIT                                                                         | 20.5601  | 20.7014  | 20.8558  | 20.9680  | 20.9968  | 20.9999  | 21.0000  | 21.0000  | 20.9992                   | 20.9572  | 20.7456  | 20.5317 (87) |
| Th 2                                                                        | 20.2276  | 20.2297  | 20.2318  | 20.2423  | 20.2444  | 20.2550  | 20.2550  | 20.2571  | 20.2508                   | 20.2444  | 20.2402  | 20.2360 (88) |
| util rest of house                                                          | 0.9937   | 0.9759   | 0.9167   | 0.7625   | 0.5627   | 0.3773   | 0.2538   | 0.2799   | 0.4764                    | 0.8071   | 0.9757   | 0.9958 (89)  |
| MIT 2                                                                       | 19.6538  | 19.8572  | 20.0685  | 20.2123  | 20.2421  | 20.2549  | 20.2550  | 20.2571  | 20.2503                   | 20.2057  | 19.9307  | 19.6197 (90) |
| Living area fraction                                                        |          |          |          |          |          |          |          |          | fLA = Living area / (4) = |          |          | 0.5102 (91)  |
| MIT                                                                         | 20.1162  | 20.2879  | 20.4702  | 20.5978  | 20.6271  | 20.6350  | 20.6351  | 20.6361  | 20.6324                   | 20.5891  | 20.3464  | 20.0850 (92) |
| Temperature adjustment                                                      |          |          |          |          |          |          |          |          |                           |          |          | 0.0000       |
| adjusted MIT                                                                | 20.1162  | 20.2879  | 20.4702  | 20.5978  | 20.6271  | 20.6350  | 20.6351  | 20.6361  | 20.6324                   | 20.5891  | 20.3464  | 20.0850 (93) |

#### 8. Space heating requirement

|                   |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                   | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Utilisation       | 0.9933   | 0.9764   | 0.9232   | 0.7817   | 0.5872   | 0.4027   | 0.2802   | 0.3074   | 0.5058   | 0.8277   | 0.9769   | 0.9955 (94)   |
| Useful gains      | 439.2668 | 507.5836 | 538.2149 | 496.4344 | 389.7194 | 260.5176 | 174.2171 | 182.3366 | 283.4138 | 414.5282 | 431.6691 | 415.7236 (95) |
| Ext temp.         | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)   |
| Heat loss rate W  | 709.9781 | 688.7252 | 623.4300 | 514.3150 | 391.3217 | 260.5672 | 174.2187 | 182.3402 | 283.7648 | 437.8717 | 584.1493 | 704.6937 (97) |
| Month fracti      | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)  |
| Space heating kWh | 201.4092 | 121.7271 | 63.4001  | 12.8740  | 1.1921   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 17.3676  | 109.7858 | 214.9937 (98) |



|                      |              |               |
|----------------------|--------------|---------------|
| Space heating        |              | 742.7497 (98) |
| Space heating per m2 | (98) / (4) = | 13.7292 (99)  |

Not applicable

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 742.7497  | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 817.0246  | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 1822.7459 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 2005.0205 | (310a) |
| Electricity used for heat distribution                                                  | 28.2205   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |           |        |
| mechanical ventilation fans (SFP = 0.6625)                                              | 111.0649  | (330a) |
| Total electricity for the above, kWh/year                                               | 111.0649  | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 248.5446  | (332)  |
| Total delivered energy for all uses                                                     | 3181.6546 | (338)  |

|                                                                                                       | Energy<br>kWh/year | Emission factor<br>kg CO <sub>2</sub> /kWh | Emissions<br>kg CO <sub>2</sub> /year |
|-------------------------------------------------------------------------------------------------------|--------------------|--------------------------------------------|---------------------------------------|
| Efficiency of heat source Boilers                                                                     |                    |                                            | 93.9000 (367a)                        |
| Space heating from Boilers                                                                            | 3005.3729          | 0.2160                                     | 649.1605 (367)                        |
| Electrical energy for heat distribution                                                               | 28.2205            | 0.5190                                     | 14.6464 (372)                         |
| Total CO <sub>2</sub> associated with community systems<br>(negative value allowed since DFEE ≤ TFEE) |                    |                                            | 663.8070 (373)                        |
| Space and water heating                                                                               |                    |                                            | 663.8070 (376)                        |
| Pumps and fans                                                                                        | 111.0649           | 0.5190                                     | 57.6427 (378)                         |
| Energy for lighting                                                                                   | 248.5446           | 0.5190                                     | 128.9946 (379)                        |
| Total CO <sub>2</sub> , kg/year                                                                       |                    |                                            | 850.4443 (383)                        |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                           |                    |                                            | 15.7200 (384)                         |

|                                                                                 |     |         |     |
|---------------------------------------------------------------------------------|-----|---------|-----|
| Total Floor Area                                                                |     | 15.7200 | ZC1 |
| Assumed number of occupants                                                     | TFA | 54.1000 |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | N   | 1.8109  |     |
| CO2 emissions from appliances, equation (L14)                                   | EF  | 0.5190  |     |
| CO2 emissions from cooking, equation (L16)                                      |     | 17.2914 | ZC2 |
| Total CO2 emissions                                                             |     | 3.0030  | ZC3 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 36.0144 | ZC4 |
| Additional allowable electricity generation, kWh/m <sup>2</sup> /year           |     | 0.0000  | ZC5 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000  | ZC6 |
| Net CO2 emissions                                                               |     | 0.0000  | ZC7 |
|                                                                                 |     | 36.0144 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 54.1000 (1b)              | x 2.5400 (2b)                   | = 137.4140 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.1000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 137.4140 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1455 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3955 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 3 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3065 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.3908 | 0.3832 | 0.3755 | 0.3372 | 0.3295 | 0.2912 | 0.2912 | 0.2836 | 0.3065 | 0.3295 | 0.3449 | 0.3602 (22b) |
|                 | 0.5764 | 0.5734 | 0.5705 | 0.5569 | 0.5543 | 0.5424 | 0.5424 | 0.5402 | 0.5470 | 0.5543 | 0.5595 | 0.5649 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2  | U-value<br>W/m2K | A x U<br>W/K                 | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------|------------------|------------------------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|------|
| TER Semi-glazed door                                                |                |                | 2.1000         | 1.2000           | 2.5200                       |                   |                | (26a)          |                |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                | 11.4200        | 1.3258           | 15.1402                      |                   |                | (27)           |                |                |                |                |      |
| External Wall 1                                                     | 31.5800        | 11.4200        | 20.1600        | 0.1800           | 3.6288                       |                   |                | (29a)          |                |                |                |                |      |
| Corridor wall                                                       | 41.5500        | 2.1000         | 39.4500        | 0.1800           | 7.1010                       |                   |                | (29a)          |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 73.1300        |                  |                              |                   |                | (31)           |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                |                  | (26)...(30) + (32) = 28.3900 |                   |                | (33)           |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                  |                              |                   |                | 250.0000 (35)  |                |                |                |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                |                  |                              |                   |                | 2.4099 (36)    |                |                |                |                |      |
| Total fabric heat loss                                              |                |                |                |                  |                              | (33) + (36) =     | 30.7999        | (37)           |                |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                  |                              |                   |                |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>26.1369 | Feb<br>26.0024 | Mar<br>25.8706 | Apr<br>25.2514   | May<br>25.1355               | Jun<br>24.5962    | Jul<br>24.5962 | Aug<br>24.4963 | Sep<br>24.8040 | Oct<br>25.1355 | Nov<br>25.3699 | Dec<br>25.6149 | (38) |
| Heat transfer coeff                                                 | 56.9368        | 56.8023        | 56.6705        | 56.0512          | 55.9354                      | 55.3961           | 55.3961        | 55.2962        | 55.6038        | 55.9354        | 56.1698        | 56.4148        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                |                  |                              |                   |                |                |                |                |                | 56.0507        | (39) |
| HLP                                                                 | Jan<br>1.0524  | Feb<br>1.0500  | Mar<br>1.0475  | Apr<br>1.0361    | May<br>1.0339                | Jun<br>1.0240     | Jul<br>1.0240  | Aug<br>1.0221  | Sep<br>1.0278  | Oct<br>1.0339  | Nov<br>1.0383  | Dec<br>1.0428  | (40) |
| HLP (average)                                                       |                |                |                |                  |                              |                   |                |                |                |                |                | 1.0361         | (40) |
| Days in month                                                       | 31             | 28             | 31             | 30               | 31                           | 30                | 31             | 31             | 30             | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |         |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |                    |          |                |
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |                    |          | 1.8109 (42)    |
|                                                             |          |          |          |         |         |         |         |         |         |                    |          | 77.2099 (43)   |
| Jan                                                         | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov                | Dec      |                |
| Daily hot water use                                         | 84.9309  | 81.8425  | 78.7541  | 75.6657 | 72.5773 | 69.4889 | 69.4889 | 72.5773 | 75.6657 | 78.7541            | 81.8425  | 84.9309 (44)   |
| Energy conte                                                | 125.9501 | 110.1567 | 113.6719 | 99.1019 | 95.0906 | 82.0560 | 76.0369 | 87.2535 | 88.2956 | 102.9000           | 112.3234 | 121.9759 (45)  |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1214.8124 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |         |         |         |         |         |         |                    |          |                |
|                                                             | 18.8925  | 16.5235  | 17.0508  | 14.8653 | 14.2636 | 12.3084 | 11.4055 | 13.0880 | 13.2443 | 15.4350            | 16.8485  | 18.2964 (46)   |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |         |         |         |         |         |         |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |                    |          | 0.1290 (55)    |
| Total storage loss                                          |          |          |          |         |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 153.2102 | 134.7788 | 140.9320 | 125.4827 | 122.3508 | 108.4368 | 103.2971 | 114.5136 | 114.6764 | 130.1601 | 138.7042 | 149.2361 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 153.2102 | 134.7788 | 140.9320 | 125.4827 | 122.3508 | 108.4368 | 103.2971 | 114.5136 | 114.6764 | 130.1601 | 138.7042 | 149.2361 (64) |
|                                                                 | 63.6865  | 56.3248  | 59.6040  | 54.0560  | 53.4257  | 48.3882  | 47.0904  | 50.8199  | 50.4629  | 56.0224  | 58.4521  | 62.3651 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.1072  | 12.5299  | 10.1900  | 7.7145   | 5.7667   | 4.8685   | 5.2606   | 6.8379   | 9.1778   | 11.6533  | 13.6011  | 14.4993  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 157.8632 | 159.5014 | 155.3733 | 146.5853 | 135.4919 | 125.0657 | 118.1003 | 116.4622 | 120.5902 | 129.3783 | 140.4717 | 150.8979 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | (71) |
| Water heating gains (Table 5)                                                       | 85.6001  | 83.8166  | 80.1129  | 75.0778  | 71.8088  | 67.2059  | 63.2935  | 68.3063  | 70.0874  | 75.2989  | 81.1835  | 83.8241  | (72) |
| Total internal gains                                                                | 310.7348 | 309.0121 | 298.8404 | 282.5417 | 266.2315 | 250.3042 | 239.8186 | 244.7706 | 253.0195 | 269.4946 | 288.4205 | 302.3854 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          |          |          |          |          |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|---------------|
| Northeast   |          |          |          |          |          |          |          |          |          |          |          |          | 1.3500     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 4.6551 (75)   |
| Southeast   |          |          |          |          |          |          |          |          |          |          |          |          | 10.0700    | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       | 113.2339 (77) |
|             |          |          |          |          |          |          |          |          |          |          |          |          |            |                                |                                   |                                    |                              |               |
| Solar gains | 117.8890 | 202.3547 | 280.9776 | 355.0290 | 403.9455 | 403.7883 | 388.1448 | 351.2283 | 306.5565 | 224.7525 | 141.4854 | 100.7062 | (83)       |                                |                                   |                                    |                              |               |
| Total gains | 428.6237 | 511.3668 | 579.8181 | 637.5707 | 670.1770 | 654.0925 | 627.9634 | 595.9989 | 559.5760 | 494.2471 | 429.9059 | 403.0916 | (84)       |                                |                                   |                                    |                              |               |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 65.9845 | 66.1407 | 66.2946 | 67.0270 | 67.1658 | 67.8197 | 67.8197 | 67.9422 | 67.5663 | 67.1658 | 66.8855 | 66.5950 |              |
| alpha                                                                       | 5.3990  | 5.4094  | 5.4196  | 5.4685  | 5.4777  | 5.5213  | 5.5213  | 5.5295  | 5.5044  | 5.4777  | 5.4590  | 5.4397  |              |
| util living area                                                            | 0.9925  | 0.9805  | 0.9502  | 0.8703  | 0.7224  | 0.5334  | 0.3869  | 0.4246  | 0.6561  | 0.9055  | 0.9823  | 0.9945  | (86)         |
| MIT                                                                         | 20.0714 | 20.2696 | 20.5210 | 20.7813 | 20.9361 | 20.9900 | 20.9986 | 20.9977 | 20.9707 | 20.7621 | 20.3648 | 20.0317 | (87)         |
| Th 2                                                                        | 20.0399 | 20.0419 | 20.0439 | 20.0534 | 20.0552 | 20.0634 | 20.0634 | 20.0649 | 20.0602 | 20.0552 | 20.0516 | 20.0478 | (88)         |
| util rest of house                                                          | 0.9902  | 0.9748  | 0.9359  | 0.8370  | 0.6649  | 0.4592  | 0.3052  | 0.3395  | 0.5783  | 0.8728  | 0.9760  | 0.9927  | (89)         |
| MIT 2                                                                       | 18.8187 | 19.1054 | 19.4613 | 19.8157 | 19.9987 | 20.0574 | 20.0629 | 20.0641 | 20.0399 | 19.8018 | 19.2525 | 18.7671 | (90)         |
| Living area fraction                                                        | 19.4578 | 19.6993 | 20.0019 | 20.3083 | 20.4769 | 20.5332 | 20.5403 | 20.5403 | 20.5147 | 20.2917 | 19.8200 | 19.4122 | (92)         |
| Temperature adjustment                                                      | 19.4578 | 19.6993 | 20.0019 | 20.3083 | 20.4769 | 20.5332 | 20.5403 | 20.5403 | 20.5147 | 20.2917 | 19.8200 | 19.4122 | (93)         |

#### 8. Space heating requirement

|                                  |          |          |          |          |          |          |          |          |          |          |          |           |       |
|----------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains                     | 423.6362 | 497.1676 | 542.2503 | 539.7970 | 463.3996 | 324.9735 | 217.8579 | 228.2333 | 345.2285 | 435.8674 | 418.7919 | 399.5591  | (95)  |
| Ext temp.                        | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Heat loss rate W                 | 863.0340 | 840.6336 | 765.1601 | 639.4520 | 490.9397 | 328.6744 | 218.2748 | 228.9453 | 356.6840 | 542.1100 | 714.4774 | 858.1954  | (97)  |
| Month fracti                     | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating kWh                | 326.9120 | 230.8091 | 165.8449 | 71.7516  | 20.4898  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 79.0445  | 212.8935 | 341.2254  | (98)  |
| Space heating                    |          |          |          |          |          |          |          |          |          |          |          | 1448.9708 | (98)  |
| Space heating per m <sup>2</sup> |          |          |          |          |          |          |          |          |          |          |          | 26.7832   | (99)  |

#### 8c. Space cooling requirement

Not applicable

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1549.7014 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 326.9120 | 230.8091 | 165.8449 | 71.7516  | 20.4898  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 79.0445  | 212.8935 | 341.2254  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 349.6384 | 246.8547 | 177.3742 | 76.7397  | 21.9143  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 84.5395  | 227.6936 | 364.9469  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 153.2102 | 134.7788 | 140.9320 | 125.4827 | 122.3508 | 108.4368 | 103.2971 | 114.5136 | 114.6764 | 130.1601 | 138.7042 | 149.2361  | (64)            |
| Efficiency of water heater (217)m                                     | 86.7866  | 86.2371  | 85.2488  | 83.3866  | 81.1767  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 83.5315  | 85.9534  | 86.9524   | (216)           |
| Fuel for water heating, kWh/month                                     | 176.5367 | 156.2886 | 165.3184 | 150.4831 | 150.7215 | 135.8857 | 129.4450 | 143.5008 | 143.7047 | 155.8216 | 161.3714 | 171.6295  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1840.7068 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1549.7014 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 249.1383  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3714.5465 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1549.7014          | 0.2160                        | 334.7355 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1840.7068          | 0.2160                        | 397.5927 (264)           |
| Space and water heating                                                                           |                    |                               | 732.3282 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 249.1383           | 0.5190                        | 129.3028 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 900.5560 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 13.5366 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3901 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7195 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (13.5366 * 1.00) + 2.3901 + 0.7195, rounded to 2 d.p. |                    |                               | 16.6500 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-2-06                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 85 B                                                                    | DER           | 14.23   | TER            | 14.84      |
| Environmental                      | 89 B                                                                    | % DER<TER     | 4.14    |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.08                                                                    | DFEE          | 39.06   | TFEE           | 42.75      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 8.62    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 94 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating: Mains gas (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 14.84 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.23 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 42.7 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 39.1 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.18 (max. 0.20) | 0.18 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK

Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing South East: 7.61 m<sup>2</sup>, No overhang  
Windows facing South West: 12.20 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 93.5000 (1b)              | x 2.5400 (2b)                   | = 237.4900 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 237.4900 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes    |             |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000 |             |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 | (18)        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 1      | (19)        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.9250 | (20)        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1388 | (21)        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1769                       | 0.1734 | 0.1700    | 0.1526 | 0.1492 | 0.1318 | 0.1318                      | 0.1283 | 0.1388      | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2774                       | 0.2739 | 0.2705    | 0.2531 | 0.2497 | 0.2323 | 0.2323                      | 0.2288 | 0.2393      | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364      |                                | (27)                                                 |
| W02 (Uw = 1.40)                                                |                         |                            | 11.4100                   | 1.3258                        | 15.1269      |                                | (27)                                                 |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                | (26a)                                                |
| External Wall 1                                                | 70.4000                 | 19.8100                    | 50.5900                   | 0.1500                        | 7.5885       | 140.0000                       | 7082.6000 (29a)                                      |
| Corridor wall                                                  | 3.8100                  | 2.1000                     | 1.7100                    | 0.1409                        | 0.2410       | 110.0000                       | 188.1000 (29a)                                       |
| Exposed ceiling                                                | 23.9000                 |                            | 23.9000                   | 0.1800                        | 4.3020       | 9.0000                         | 215.1000 (30)                                        |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 98.1100                   |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 41.3347      |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 42.3000                   | 0.0000                        | 0.0000       | 140.0000                       | 5922.0000 (32)                                       |
| Party Floor                                                    |                         |                            | 93.5000                   |                               |              | 80.0000                        | 7480.0000 (32d)                                      |
| Party Ceilings                                                 |                         |                            | 69.6000                   |                               |              | 80.0000                        | 5568.0000 (32b)                                      |
| Internal Wall                                                  |                         |                            | 79.7000                   |                               |              | 9.0000                         | 717.3000 (32c)                                       |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 27173.1000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 290.6214 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 16.8632 (36)                                         |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 58.1979 (37)                                         |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 21.7408 | 21.4689 | 21.1971 | 19.8378 | 19.5660 | 18.2067 | 18.2067 | 17.9349 | 18.7504 | 19.5660 | 20.1097 | 20.6534 (38) |
| Heat transfer coeff       | 79.9387 | 79.6669 | 79.3950 | 78.0358 | 77.7639 | 76.4046 | 76.4046 | 76.1328 | 76.9483 | 77.7639 | 78.3076 | 78.8513 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 77.9678 (39) |
| HLP                       | 0.8550  | 0.8521  | 0.8491  | 0.8346  | 0.8317  | 0.8172  | 0.8172  | 0.8143  | 0.8230  | 0.8317  | 0.8375  | 0.8433 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.8339 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |               |
|------------------------------------------|---------------|
| Assumed occupancy                        | 2.6707 (42)   |
| Average daily hot water use (litres/day) | 102.7665 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                                          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|---------------------|----------|----------------|
| Energy conte                                                    | 113.0432 | 108.9325 | 104.8219 | 100.7112 | 96.6005  | 92.4899  | 92.4899  | 96.6005                                  | 100.7112 | 104.8219            | 108.9325 | 113.0432 (44)  |
| Energy content (annual)                                         | 167.6398 | 146.6188 | 151.2975 | 131.9048 | 126.5658 | 109.2167 | 101.2053 | 116.1346                                 | 117.5216 | 136.9601            | 149.5026 | 162.3502 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |                                          |          | Total = Sum (45)m = |          | 1616.9178 (45) |
|                                                                 | 25.1460  | 21.9928  | 22.6946  | 19.7857  | 18.9849  | 16.3825  | 15.1808  | 17.4202                                  | 17.6282  | 20.5440             | 22.4254  | 24.3525 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |                                          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |                                          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |                                          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400                                  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400                                  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |                     |          |                |
|                                                                 | 213.8422 | 188.3500 | 197.4999 | 176.6168 | 172.7682 | 153.9287 | 147.4077 | 162.3370                                 | 162.2336 | 183.1625            | 194.2146 | 208.5526 (62)  |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |                     |          | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          |                                          |          |                     |          |                |
|                                                                 | 213.8422 | 188.3500 | 197.4999 | 176.6168 | 172.7682 | 153.9287 | 147.4077 | 162.3370                                 | 162.2336 | 183.1625            | 194.2146 | 208.5526 (64)  |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |                     |          | 2160.9138 (64) |
|                                                                 | 92.7021  | 82.1357  | 87.2683  | 79.6280  | 79.0451  | 72.0841  | 70.6127  | 75.5767                                  | 74.8455  | 82.5011             | 85.4792  | 90.9434 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 21.8751   | 19.4292   | 15.8009   | 11.9623   | 8.9420    | 7.5492    | 8.1572    | 10.6030   | 14.2313   | 18.0699   | 21.0902   | 22.4830 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 245.3715  | 247.9177  | 241.5014  | 227.8418  | 210.5991  | 194.3933  | 183.5669  | 181.0207  | 187.4370  | 201.0966  | 218.3393  | 234.5451 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533 (69)   |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 (71) |
| Water heating gains (Table 5)                                                       |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 124.5997  | 122.2258  | 117.2962  | 110.5944  | 106.2434  | 100.1169  | 94.9095   | 101.5815  | 103.9521  | 110.8886  | 118.7211  | 122.2357 (72)  |
| Total internal gains                                                                |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 454.9062  | 452.6327  | 437.6584  | 413.4585  | 388.8443  | 365.1193  | 349.6935  | 356.2651  | 368.6804  | 393.1150  | 421.2107  | 442.3237 (73)  |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          |          | Gains<br>W   |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|----------|--------------|---------------|
| Southwest   |          |          |          | 8.4000     | 36.7938                        | 0.3700                            | 0.8900                             | 0.7700                       |          |          | 70.5309 (79) |               |
| Southeast   |          |          |          | 7.6100     | 36.7938                        | 0.5600                            | 0.6800                             | 0.7700                       |          |          | 73.8907 (77) |               |
| Southwest   |          |          |          | 3.8000     | 36.7938                        | 0.5600                            | 0.6800                             | 0.7700                       |          |          | 36.8968 (79) |               |
| -----       |          |          |          |            |                                |                                   |                                    |                              |          |          |              |               |
| Solar gains | 181.3184 | 308.8523 | 422.5852 | 523.6036   | 586.4796                       | 582.2385                          | 561.3401                           | 514.4317                     | 457.5704 | 341.3476 | 217.1777     | 155.1708 (83) |
| Total gains | 636.2246 | 761.4850 | 860.2436 | 937.0620   | 975.3239                       | 947.3578                          | 911.0335                           | 870.6968                     | 826.2508 | 734.4626 | 638.3883     | 597.4945 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 94.4234 | 94.7456 | 95.0700 | 96.7260 | 97.0641 | 98.7909 | 98.7909 | 99.1437 | 98.0929 | 97.0641 | 96.3902 | 95.7255      |
| alpha                                                                       | 7.2949  | 7.3164  | 7.3380  | 7.4484  | 7.4709  | 7.5861  | 7.5861  | 7.6096  | 7.5395  | 7.4709  | 7.4260  | 7.3817       |
| util living area                                                            | 0.9976  | 0.9909  | 0.9673  | 0.8850  | 0.7192  | 0.5145  | 0.3689  | 0.4020  | 0.6342  | 0.9198  | 0.9920  | 0.9985 (86)  |
| MIT                                                                         | 20.3455 | 20.5062 | 20.7015 | 20.8922 | 20.9796 | 20.9985 | 20.9999 | 20.9998 | 20.9935 | 20.8751 | 20.5733 | 20.3181 (87) |
| Th 2                                                                        | 20.2060 | 20.2084 | 20.2109 | 20.2234 | 20.2259 | 20.2385 | 20.2385 | 20.2410 | 20.2335 | 20.2259 | 20.2209 | 20.2159 (88) |
| util rest of house                                                          | 0.9968  | 0.9878  | 0.9566  | 0.8542  | 0.6671  | 0.4541  | 0.3051  | 0.3358  | 0.5676  | 0.8902  | 0.9887  | 0.9979 (89)  |
| MIT 2                                                                       | 19.3335 | 19.5683 | 19.8469 | 20.1091 | 20.2090 | 20.2377 | 20.2385 | 20.2409 | 20.2293 | 20.0957 | 19.6769 | 19.3016 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 19.6788 | 19.8883 | 20.1385 | 20.3763 | 20.4719 | 20.4972 | 20.4982 | 20.4998 | 20.4901 | 20.3616 | 19.9827 | 19.6484 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.6788 | 19.8883 | 20.1385 | 20.3763 | 20.4719 | 20.4972 | 20.4982 | 20.4998 | 20.4901 | 20.3616 | 19.9827 | 19.6484 (93) |

#### 8. Space heating requirement

|                   |           |           |           |          |          |          |          |          |          |          |           |                |
|-------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
|                   | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec            |
| Utilisation       | 0.9960    | 0.9862    | 0.9555    | 0.8607   | 0.6841   | 0.4747   | 0.3269   | 0.3584   | 0.5902   | 0.8960   | 0.9875    | 0.9973 (94)    |
| Useful gains      | 633.7006  | 750.9716  | 821.9471  | 806.5502 | 667.2318 | 449.7343 | 297.8020 | 312.0508 | 487.6791 | 658.0583 | 630.3805  | 595.9060 (95)  |
| Ext temp.         | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000 (96)    |
| Heat loss rate W  |           |           |           |          |          |          |          |          |          |          |           |                |
|                   | 1229.3618 | 1194.0717 | 1082.8279 | 895.5615 | 682.1370 | 450.5773 | 297.8435 | 312.1323 | 491.7041 | 759.1003 | 1008.8158 | 1218.1267 (97) |
| Month fracti      | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000 (97a)   |
| Space heating kWh |           |           |           |          |          |          |          |          |          |          |           |                |
|                   | 443.1719  | 297.7632  | 194.0953  | 64.0882  | 11.0894  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 75.1752  | 272.4735  | 462.9322 (98)  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                                                           |                    |                               |                          |
|-----------------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating                                                                                             |                    |                               | 1820.7890 (98)           |
| Space heating per m2                                                                                      |                    | (98) / (4) =                  | 19.4737 (99)             |
| -----                                                                                                     |                    |                               |                          |
| 8c. Space cooling requirement                                                                             |                    |                               |                          |
| Not applicable                                                                                            |                    |                               |                          |
| -----                                                                                                     |                    |                               |                          |
| 9b. Energy requirements                                                                                   |                    |                               |                          |
| -----                                                                                                     |                    |                               |                          |
| Fraction of space heat from secondary/supplementary system (Table 11)                                     |                    |                               | 0.0000 (301)             |
| Fraction of space heat from community system                                                              |                    |                               | 1.0000 (302)             |
| Fraction of heat from community Boilers                                                                   |                    |                               | 1.0000 (303a)            |
| Fraction of total space heat from community Boilers                                                       |                    |                               | 1.0000 (304a)            |
| Factor for control and charging method (Table 4c(3)) for community space heating                          |                    |                               | 1.0000 (305)             |
| Factor for control and charging method (Table 4c(3)) for community water heating                          |                    |                               | 1.0000 (305a)            |
| Distribution loss factor (Table 12c) for community heating system                                         |                    |                               | 1.1000 (306)             |
| Space heating:                                                                                            |                    |                               |                          |
| Annual space heating requirement                                                                          |                    |                               | 1820.7890 (98)           |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                                       |                    |                               | 2002.8679 (307a)         |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)                   |                    |                               | 0.0000 (308)             |
| Space heating fuel for secondary/supplementary system                                                     |                    |                               | 0.0000 (309)             |
| Water heating                                                                                             |                    |                               |                          |
| Annual water heating requirement                                                                          |                    |                               | 2160.9138 (64)           |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                                       |                    |                               | 2377.0052 (310a)         |
| Electricity used for heat distribution                                                                    |                    |                               | 43.7987 (313)            |
| Annual totals kWh/year                                                                                    |                    |                               |                          |
| Electricity for pumps and fans:                                                                           |                    |                               |                          |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)                               |                    |                               |                          |
| mechanical ventilation fans (SFP = 0.6625)                                                                |                    |                               | 191.9513 (330a)          |
| Total electricity for the above, kWh/year                                                                 |                    |                               | 191.9513 (331)           |
| Electricity for lighting (calculated in Appendix L)                                                       |                    |                               | 386.3202 (332)           |
| Total delivered energy for all uses                                                                       |                    |                               | 4958.1446 (338)          |
| -----                                                                                                     |                    |                               |                          |
| 12b. Carbon dioxide emissions - Community heating scheme                                                  |                    |                               |                          |
| -----                                                                                                     |                    |                               |                          |
|                                                                                                           | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
| Efficiency of heat source Boilers                                                                         |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                                | 4664.4016          | 0.2160                        | 1007.5107 (367)          |
| Electrical energy for heat distribution                                                                   | 43.7987            | 0.5190                        | 22.7315 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE)                |                    |                               | 1030.2423 (373)          |
| Space and water heating                                                                                   |                    |                               | 1030.2423 (376)          |
| Pumps and fans                                                                                            | 191.9513           | 0.5190                        | 99.6227 (378)            |
| Energy for lighting                                                                                       | 386.3202           | 0.5190                        | 200.5002 (379)           |
| Total CO2, kg/year                                                                                        |                    |                               | 1330.3652 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                               |                    |                               | 14.2300 (384)            |
| -----                                                                                                     |                    |                               |                          |
| 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES |                    |                               |                          |
| DER                                                                                                       |                    |                               | 14.2300 ZC1              |
| Total Floor Area                                                                                          |                    | TFA                           | 93.5000                  |
| Assumed number of occupants                                                                               |                    | N                             | 2.6707                   |
| CO2 emission factor in Table 12 for electricity displaced from grid                                       |                    | EF                            | 0.5190                   |
| CO2 emissions from appliances, equation (L14)                                                             |                    |                               | 15.5510 ZC2              |
| CO2 emissions from cooking, equation (L16)                                                                |                    |                               | 1.9582 ZC3               |
| Total CO2 emissions                                                                                       |                    |                               | 31.7393 ZC4              |
| Residual CO2 emissions offset from biofuel CHP                                                            |                    |                               | 0.0000 ZC5               |
| Additional allowable electricity generation, kWh/m²/year                                                  |                    |                               | 0.0000 ZC6               |
| Resulting CO2 emissions offset from additional allowable electricity generation                           |                    |                               | 0.0000 ZC7               |
| Net CO2 emissions                                                                                         |                    |                               | 31.7393 ZC8              |
| -----                                                                                                     |                    |                               |                          |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 93.5000 (1b)              | x 2.5400 (2b)                   | = 237.4900 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 237.4900 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | =               | 0 * 40 = 0.0000 (6a)    |
| Number of open flues                                                      | 0               | +                    | 0                           | =               | 0 * 20 = 0.0000 (6b)    |
| Number of intermittent fans                                               |                 |                      |                             |                 | 3 * 10 = 30.0000 (7a)   |
| Number of passive vents                                                   |                 |                      |                             |                 | 0 * 10 = 0.0000 (7b)    |
| Number of flueless gas fires                                              |                 |                      |                             |                 | 0 * 40 = 0.0000 (7c)    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 30.0000 / (5) = | 0.1263 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.3763 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 1 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.9250 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3481 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4438 | 0.4351 | 0.4264 | 0.3829 | 0.3742 | 0.3307 | 0.3307 | 0.3220 | 0.3481 | 0.3742 | 0.3916 | 0.4090 (22b) |
| Effective ac    | 0.5985 | 0.5947 | 0.5909 | 0.5733 | 0.5700 | 0.5547 | 0.5547 | 0.5518 | 0.5606 | 0.5700 | 0.5767 | 0.5836 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 19.8100                   | 1.3258                        | 26.2633      |                                | (27)          |
| External Wall 1                                                | 70.4000                 | 19.8100                    | 50.5900                   | 0.1800                        | 9.1062       |                                | (29a)         |
| Corridor wall                                                  | 3.8100                  | 2.1000                     | 1.7100                    | 0.1800                        | 0.3078       |                                | (29a)         |
| Exposed ceiling                                                | 23.9000                 |                            | 23.9000                   | 0.1300                        | 3.1070       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 98.1100                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 41.3043      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 14.5507 (36)  |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 55.8550 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec           |
|---------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|---------------|
| (38)m                     | 46.9047  | 46.6049  | 46.3111  | 44.9312  | 44.6730  | 43.4711 | 43.4711 | 43.2485 | 43.9341 | 44.6730  | 45.1953  | 45.7413 (38)  |
| Heat transfer coeff       | 102.7596 | 102.4599 | 102.1661 | 100.7861 | 100.5280 | 99.3261 | 99.3261 | 99.1035 | 99.7890 | 100.5280 | 101.0503 | 101.5963 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |         |         |         |         |          |          | 100.7849 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.0990 | 1.0958 | 1.0927 | 1.0779 | 1.0752 | 1.0623 | 1.0623 | 1.0599 | 1.0673 | 1.0752 | 1.0808 | 1.0866 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.0779 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

| Assumed occupancy                                           |          |          |          |          |          |          |         |          |          |          |          | 2.6707 (42)                       |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|----------|-----------------------------------|
| Average daily hot water use (litres/day)                    |          |          |          |          |          |          |         |          |          |          |          | 97.6282 (43)                      |
|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov      | Dec                               |
| Daily hot water use                                         | 107.3910 | 103.4859 | 99.5808  | 95.6756  | 91.7705  | 87.8654  | 87.8654 | 91.7705  | 95.6756  | 99.5808  | 103.4859 | 107.3910 (44)                     |
| Energy conte                                                | 159.2578 | 139.2879 | 143.7326 | 125.3096 | 120.2375 | 103.7558 | 96.1450 | 110.3278 | 111.6455 | 130.1121 | 142.0275 | 154.2327 (45)                     |
| Energy content (annual)                                     |          |          |          |          |          |          |         |          |          |          |          | Total = Sum(45)m = 1536.0719 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 23.8887  | 20.8932  | 21.5599  | 18.7964  | 18.0356  | 15.5634  | 14.4218 | 16.5492  | 16.7468  | 19.5168  | 21.3041  | 23.1349 (46)                      |
| Water storage loss:                                         |          |          |          |          |          |          |         |          |          |          |          |                                   |
| Store volume                                                |          |          |          |          |          |          |         |          |          |          |          | 2.0000 (47)                       |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |          |         |          |          |          |          | 0.2388 (48)                       |
| Temperature factor from Table 2b                            |          |          |          |          |          |          |         |          |          |          |          | 0.5400 (49)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |          |         |          |          |          |          | 0.1290 (55)                       |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 186.5179 | 163.9100 | 170.9928 | 151.6904 | 147.4977 | 130.1366 | 123.4052 | 137.5880 | 138.0263 | 157.3722 | 168.4083 | 181.4928 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 186.5179 | 163.9100 | 170.9928 | 151.6904 | 147.4977 | 130.1366 | 123.4052 | 137.5880 | 138.0263 | 157.3722 | 168.4083 | 181.4928 (64) |
| Heat gains from water heating, kWh/month                        | 74.7613  | 66.0109  | 69.5992  | 62.7701  | 61.7871  | 55.6034  | 53.7763  | 58.4921  | 58.2268  | 65.0704  | 68.3288  | 73.0905 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       |      |
| (66)m                                                                               | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 21.9221   | 19.4710   | 15.8349   | 11.9880   | 8.9612    | 7.5654    | 8.1747    | 10.6258   | 14.2619   | 18.1087   | 21.1356   | 22.5313   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 245.3715  | 247.9177  | 241.5014  | 227.8418  | 210.5991  | 194.3933  | 183.5669  | 181.0207  | 187.4370  | 201.0966  | 218.3393  | 234.5451  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | (69) |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | (71) |
| Water heating gains (Table 5)                                                       | 100.4857  | 98.2305   | 93.5473   | 87.1806   | 83.0472   | 77.2270   | 72.2800   | 78.6184   | 80.8705   | 87.4602   | 94.9011   | 98.2399   | (72) |
| Total internal gains                                                                | 433.8392  | 431.6791  | 416.9435  | 393.0704  | 368.6674  | 345.2457  | 330.0815  | 336.3248  | 348.6293  | 372.7254  | 400.4359  | 421.3763  | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|----------|----------|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|
| Southeast   |          |          |          |           | 7.6100     | 36.7938                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 85.5720       |
| Southwest   |          |          |          |           | 12.2000    | 36.7938                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 137.1850 (77) |
|             |          |          |          |           |            |                                |                                   |                                    |          |          |                              |               |
| Solar gains | 222.7570 | 379.4376 | 519.1630 | 643.2681  | 720.5139   | 715.3035                       | 689.6289                          | 632.0001                           | 562.1437 | 419.3593 | 266.8115                     | 190.6336 (83) |
| Total gains | 656.5962 | 811.1167 | 936.1065 | 1036.3386 | 1089.1813  | 1060.5492                      | 1019.7105                         | 968.3250                           | 910.7731 | 792.0848 | 667.2474                     | 612.0098 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 63.1868 | 63.3717 | 63.5539 | 64.4241 | 64.5896 | 65.3711 | 65.3711 | 65.5179 | 65.0678                   | 64.5896 | 64.2557 | 63.9104 |              |
| alpha                                                                       | 5.2125  | 5.2248  | 5.2369  | 5.2949  | 5.3060  | 5.3581  | 5.3581  | 5.3679  | 5.3379                    | 5.3060  | 5.2837  | 5.2607  |              |
| util living area                                                            | 0.9959  | 0.9874  | 0.9647  | 0.9010  | 0.7709  | 0.5833  | 0.4260  | 0.4664  | 0.7061                    | 0.9327  | 0.9896  | 0.9971  | (86)         |
| MIT                                                                         | 19.9231 | 20.1390 | 20.4130 | 20.7092 | 20.9030 | 20.9826 | 20.9973 | 20.9956 | 20.9536                   | 20.6877 | 20.2429 | 19.8857 | (87)         |
| Th 2                                                                        | 20.0016 | 20.0042 | 20.0068 | 20.0189 | 20.0212 | 20.0317 | 20.0317 | 20.0337 | 20.0277                   | 20.0212 | 20.0166 | 20.0118 | (88)         |
| util rest of house                                                          | 0.9945  | 0.9834  | 0.9537  | 0.8721  | 0.7138  | 0.5019  | 0.3336  | 0.3707  | 0.6252                    | 0.9062  | 0.9857  | 0.9961  | (89)         |
| MIT 2                                                                       | 18.5753 | 18.8900 | 19.2826 | 19.6957 | 19.9332 | 20.0210 | 20.0308 | 20.0320 | 19.9946                   | 19.6792 | 19.0518 | 18.5282 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3412  | (91)         |
| MIT                                                                         | 19.0351 | 19.3161 | 19.6683 | 20.0414 | 20.2641 | 20.3491 | 20.3605 | 20.3608 | 20.3218                   | 20.0233 | 19.4582 | 18.9914 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.0351 | 19.3161 | 19.6683 | 20.0414 | 20.2641 | 20.3491 | 20.3605 | 20.3608 | 20.3218                   | 20.0233 | 19.4582 | 18.9914 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |              |           |           |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|--------------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov       | Dec       |       |
| Useful gains         | 651.7952  | 794.7654  | 888.5331  | 904.5792  | 793.9135 | 561.2855 | 372.4262 | 390.6888 | 592.8344 | 717.8486     | 655.6950  | 608.7824  | (94)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.0000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000    | 4.2000    | (96)  |
| Heat loss rate W     | 1514.1781 | 1477.0764 | 1345.3491 | 1122.9037 | 860.9273 | 571.0316 | 373.5175 | 392.5274 | 620.8659 | 947.3010     | 1248.7950 | 1502.7473 | (97)  |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000    | 1.0000    | (97a) |
| Space heating kWh    | 641.6129  | 458.5130  | 339.8711  | 157.1936  | 49.8582  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 170.7126     | 427.0320  | 665.1099  | (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |              |           | 2909.9033 | (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          | (98) / (4) = |           | 31.1220   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 3112.1961 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 641.6129 | 458.5130 | 339.8711 | 157.1936 | 49.8582  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 170.7126 | 427.0320 | 665.1099  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 686.2170 | 490.3882 | 363.4985 | 168.1215 | 53.3243  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 182.5804 | 456.7187 | 711.3475  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 186.5179 | 163.9100 | 170.9928 | 151.6904 | 147.4977 | 130.1366 | 123.4052 | 137.5880 | 138.0263 | 157.3722 | 168.4083 | 181.4928  | (64)            |
| Efficiency of water heater (217)m                                     | 87.8470  | 87.4134  | 86.6128  | 84.9089  | 82.2569  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.0311  | 87.1933  | 79.8000   | (216)           |
| Fuel for water heating, kWh/month                                     | 212.3212 | 187.5112 | 197.4220 | 178.6507 | 179.3133 | 163.0785 | 154.6431 | 172.4160 | 172.9653 | 185.0761 | 193.1435 | 206.3092  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2202.8502 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3112.1961 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 387.1505  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5777.1968 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 3112.1961          | 0.2160                        | 672.2343 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2202.8502          | 0.2160                        | 475.8156 (264)           |
| Space and water heating                                                                           |                    |                               | 1148.0500 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 387.1505           | 0.5190                        | 200.9311 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1387.9061 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.2786 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.1490 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.4163 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.2786 * 1.00) + 2.1490 + 0.4163, rounded to 2 d.p. |                    |                               | 14.8400 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-3-01                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 83 B                                                                    | DER           | 18.46   | TER            | 18.55      |
| Environmental                      | 87 B                                                                    | % DER<TER     | 0.51    |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.07                                                                    | DFEE          | 51.87   | TFEE           | 55.41      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 6.38    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 71 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating: Mains gas (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 18.55 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 18.46 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 55.4 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 51.9 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.18 (max. 0.20) | 0.18 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK  
Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing North East: 1.92 m<sup>2</sup>, No overhang  
Windows facing North West: 16.01 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 71.2000 (1b)              | x 2.4000 (2b)                   | = 170.8800 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 71.2000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 170.8800 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
|                                                                                              |                              |        |           |        |        |        | Air changes per hour        |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes         |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000      |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 (18) |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 2 (19)      |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
|                                                                                              |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
|                                                                                              |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2631                       | 0.2599 | 0.2567    | 0.2408 | 0.2376 | 0.2216 | 0.2216                      | 0.2184      | 0.2280 | 0.2376 | 0.2439 | 0.2503 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2          | U-value<br>W/m2K | A x U<br>W/K                             | K-value<br>kJ/m2K | A x K<br>kJ/K   |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|------------------------|------------------|------------------------------------------|-------------------|-----------------|----------------|----------------|----------------|----------------|---------------------|
| W10 (Uw = 1.40)                                                     |                |                | 1.9200                 | 1.3258           | 2.5455                                   |                   | (27)            |                |                |                |                |                     |
| W03 (Uw = 1.40)                                                     |                |                | 8.4000                 | 1.3258           | 11.1364                                  |                   | (27)            |                |                |                |                |                     |
| W02 (Uw = 1.40)                                                     |                |                | 7.6100                 | 1.3258           | 10.0890                                  |                   | (27)            |                |                |                |                |                     |
| door                                                                |                |                | 2.1000                 | 1.4000           | 2.9400                                   |                   | (26a)           |                |                |                |                |                     |
| External Wall 1                                                     | 53.7400        | 17.9300        | 35.8100                | 0.1500           | 5.3715                                   | 140.0000          | 5013.4000 (29a) |                |                |                |                |                     |
| Corridor wall                                                       | 7.8000         | 2.1000         | 5.7000                 | 0.1409           | 0.8032                                   | 110.0000          | 627.0000 (29a)  |                |                |                |                |                     |
| Exposed ceiling                                                     | 35.8000        |                | 35.8000                | 0.1800           | 6.4440                                   | 9.0000            | 322.2000 (30)   |                |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 97.3400                |                  |                                          |                   | (31)            |                |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26) ... (30) + (32) = |                  | 39.3295                                  |                   | (33)            |                |                |                |                |                     |
| Party Wall 1                                                        |                |                | 39.3000                | 0.0000           | 0.0000                                   | 140.0000          | 5502.0000 (32)  |                |                |                |                |                     |
| Party Floor                                                         |                |                | 71.2000                |                  |                                          | 80.0000           | 5696.0000 (32d) |                |                |                |                |                     |
| Party Ceilings                                                      |                |                | 35.4000                |                  |                                          | 80.0000           | 2832.0000 (32b) |                |                |                |                |                     |
| Internal Wall                                                       |                |                | 123.8000               |                  |                                          | 9.0000            | 1114.2000 (32c) |                |                |                |                |                     |
| Heat capacity Cm = Sum(A x k)                                       |                |                |                        |                  | (28) ... (30) + (32) + (32a) ... (32e) = |                   | 21106.8000 (34) |                |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                        |                  |                                          |                   | 296.4438 (35)   |                |                |                |                |                     |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                        |                  |                                          |                   | 15.4420 (36)    |                |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                        |                  | (33) + (36) =                            |                   | 54.7715 (37)    |                |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                        |                  |                                          |                   |                 |                |                |                |                |                     |
| (38)m                                                               | Jan<br>14.8342 | Feb<br>14.6545 | Mar<br>14.4747         | Apr<br>13.5760   | May<br>13.3962                           | Jun<br>12.4975    | Jul<br>12.4975  | Aug<br>12.3178 | Sep<br>12.8570 | Oct<br>13.3962 | Nov<br>13.7557 | Dec<br>14.1152 (38) |
| Heat transfer coeff                                                 | 69.6057        | 69.4260        | 69.2462                | 68.3475          | 68.1678                                  | 67.2690           | 67.2690         | 67.0893        | 67.6285        | 68.1678        | 68.5273        | 68.8867 (39)        |
| Average = Sum(39)m / 12 =                                           |                |                |                        |                  |                                          |                   |                 |                |                |                |                | 68.3026 (39)        |
| HLP                                                                 | Jan<br>0.9776  | Feb<br>0.9751  | Mar<br>0.9726          | Apr<br>0.9599    | May<br>0.9574                            | Jun<br>0.9448     | Jul<br>0.9448   | Aug<br>0.9423  | Sep<br>0.9498  | Oct<br>0.9574  | Nov<br>0.9625  | Dec<br>0.9675 (40)  |
| HLP (average)                                                       |                |                |                        |                  |                                          |                   |                 |                |                |                |                | 0.9593 (40)         |
| Days in month                                                       | 31             | 28             | 31                     | 30               | 31                                       | 30                | 31              | 31             | 30             | 31             | 30             | 31 (41)             |

#### 4. Water heating energy requirements (kWh/year)

|                                          |     |     |     |     |     |     |     |     |     |     |     |              |
|------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|
| Assumed occupancy                        |     |     |     |     |     |     |     |     |     |     |     | 2.2749 (42)  |
| Average daily hot water use (litres/day) |     |     |     |     |     |     |     |     |     |     |     | 92.8725 (43) |
| Jan                                      | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |              |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Daily hot water use                                             | 102.1598 | 98.4449  | 94.7300  | 91.0151  | 87.3002  | 83.5853  | 83.5853  | 87.3002  | 91.0151  | 94.7300  | 98.4449  | 102.1598 (44) |
| Energy conte                                                    | 151.5000 | 132.5029 | 136.7311 | 119.2055 | 114.3805 | 98.7017  | 91.4616  | 104.9536 | 106.2070 | 123.7741 | 135.1091 | 146.7197 (45) |
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          |          |          |               |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 22.7250  | 19.8754  | 20.5097  | 17.8808  | 17.1571  | 14.8053  | 13.7192  | 15.7430  | 15.9311  | 18.5661  | 20.2664  | 22.0080 (46)  |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |               |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)   |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)   |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (56)  |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (57)  |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 197.7024 | 174.2341 | 182.9335 | 163.9175 | 160.5829 | 143.4137 | 137.6640 | 151.1560 | 150.9190 | 169.9765 | 179.8211 | 192.9221 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
|                                                                 |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)   |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 197.7024 | 174.2341 | 182.9335 | 163.9175 | 160.5829 | 143.4137 | 137.6640 | 151.1560 | 150.9190 | 169.9765 | 179.8211 | 192.9221 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 87.3357  | 77.4422  | 82.4250  | 75.4054  | 74.9934  | 68.5879  | 67.3729  | 71.8590  | 71.0834  | 78.1168  | 80.6934  | 85.7462 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 17.8374  | 15.8430  | 12.8844  | 9.7543   | 7.2915   | 6.1558   | 6.6515   | 8.6459   | 11.6045  | 14.7346  | 17.1975  | 18.3332 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 200.0814 | 202.1576 | 196.9256 | 185.7873 | 171.7272 | 158.5126 | 149.6845 | 147.6083 | 152.8403 | 163.9786 | 178.0388 | 191.2533 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 117.3867 | 115.2413 | 110.7863 | 104.7298 | 100.7976 | 95.2610  | 90.5550  | 96.5846  | 98.7270  | 104.9957 | 112.0741 | 115.2503 (72) |
| Total internal gains                                                                |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 392.4290 | 390.3655 | 377.7199 | 357.3949 | 336.9398 | 317.0529 | 304.0146 | 309.9624 | 320.2954 | 340.8325 | 364.4339 | 381.9603 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
|             |          |          |          | 1.9200     | 11.2829                        | 0.3700                            | 0.6500                             | 0.7700                       | 3.6105 (75)  |          |          |               |
| Northeast   |          |          |          | 8.4000     | 11.2829                        | 0.3700                            | 0.8900                             | 0.7700                       | 21.6285 (81) |          |          |               |
| Northwest   |          |          |          | 7.6100     | 11.2829                        | 0.5600                            | 0.6800                             | 0.7700                       | 22.6588 (81) |          |          |               |
|             |          |          |          |            |                                |                                   |                                    |                              |              |          |          |               |
| Solar gains | 47.8979  | 97.4975  | 175.6594 | 288.4833   | 387.7781                       | 413.4125                          | 386.7389                           | 308.3128                     | 214.0438     | 119.1496 | 60.2679  | 39.1158 (83)  |
| Total gains | 440.3269 | 487.8630 | 553.3793 | 645.8782   | 724.7180                       | 730.4655                          | 690.7535                           | 618.2752                     | 534.3391     | 459.9821 | 424.7018 | 421.0761 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |              |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 84.2316 | 84.4497 | 84.6689 | 85.7822 | 86.0084 | 87.1575 | 87.1575 | 87.3910 | 86.6942 | 86.0084 | 85.5572 | 85.1107      |
| alpha                                                                       | 6.6154  | 6.6300  | 6.6446  | 6.7188  | 6.7339  | 6.8105  | 6.8105  | 6.8261  | 6.7796  | 6.7339  | 6.7038  | 6.6740       |
| util living area                                                            | 0.9990  | 0.9977  | 0.9913  | 0.9511  | 0.8057  | 0.5827  | 0.4277  | 0.4970  | 0.8055  | 0.9802  | 0.9975  | 0.9993 (86)  |
| MIT                                                                         | 20.1456 | 20.2535 | 20.4609 | 20.7478 | 20.9407 | 20.9942 | 20.9994 | 20.9984 | 20.9570 | 20.6938 | 20.3730 | 20.1276 (87) |
| Th 2                                                                        | 20.1020 | 20.1041 | 20.1063 | 20.1169 | 20.1190 | 20.1296 | 20.1296 | 20.1317 | 20.1253 | 20.1190 | 20.1147 | 20.1105 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.9986  | 0.9968  | 0.9878  | 0.9321  | 0.7509  | 0.5067  | 0.3436  | 0.4044  | 0.7298  | 0.9691  | 0.9964  | 0.9990 (89)  |
| MIT 2                                                                       | 18.9586 | 19.1178 | 19.4206 | 19.8309 | 20.0674 | 20.1264 | 20.1294 | 20.1312 | 20.0948 | 19.7661 | 19.3009 | 18.9388 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 19.3837 | 19.5245 | 19.7932 | 20.1593 | 20.3801 | 20.4372 | 20.4410 | 20.4418 | 20.4036 | 20.0983 | 19.6849 | 19.3646 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.3837 | 19.5245 | 19.7932 | 20.1593 | 20.3801 | 20.4372 | 20.4410 | 20.4418 | 20.4036 | 20.0983 | 19.6849 | 19.3646 (93) |

#### 8. Space heating requirement

|                   |           |           |          |          |          |          |          |          |          |          |          |                |
|-------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation       | 0.9981    | 0.9960    | 0.9862   | 0.9332   | 0.7681   | 0.5339   | 0.3738   | 0.4377   | 0.7557   | 0.9688   | 0.9956   | 0.9986 (94)    |
| Useful gains      | 439.5108  | 485.8899  | 545.7179 | 602.7303 | 556.6845 | 389.9908 | 258.1795 | 270.6102 | 403.7799 | 445.6392 | 422.8262 | 420.4912 (95)  |
| Ext temp.         | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Heat loss rate W  |           |           |          |          |          |          |          |          |          |          |          |                |
|                   | 1049.9127 | 1015.3225 | 920.5031 | 769.5455 | 591.7047 | 392.6608 | 258.3792 | 271.1595 | 426.3039 | 647.4804 | 862.4095 | 1044.6388 (97) |
| Month fracti      | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating kWh |           |           |          |          |          |          |          |          |          |          |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                      |          |          |          |          |         |        |        |        |        |          |              |                |
|----------------------|----------|----------|----------|----------|---------|--------|--------|--------|--------|----------|--------------|----------------|
| Space heating        | 454.1390 | 355.7787 | 278.8402 | 120.1070 | 26.0550 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 150.1699 | 316.5000     | 464.3658 (98)  |
| Space heating per m2 |          |          |          |          |         |        |        |        |        |          |              | 2165.9555 (98) |
|                      |          |          |          |          |         |        |        |        |        |          | (98) / (4) = | 30.4207 (99)   |

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 2165.9555 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 2382.5510 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2005.2428 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 2205.7671 (310a) |
| Electricity used for heat distribution                                                  | 45.8832 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 138.1138 (330a)  |
| Total electricity for the above, kWh/year                                               | 138.1138 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 315.0141 (332)   |
| Total delivered energy for all uses                                                     | 5041.4460 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 4886.3878          | 0.2160                        | 1055.4598 (367)          |
| Electrical energy for heat distribution                                                    | 45.8832            | 0.5190                        | 23.8134 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 1079.2731 (373)          |
| Space and water heating                                                                    |                    |                               | 1079.2731 (376)          |
| Pumps and fans                                                                             | 138.1138           | 0.5190                        | 71.6810 (378)            |
| Energy for lighting                                                                        | 315.0141           | 0.5190                        | 163.4923 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1314.4465 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 18.4600 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 18.4600 ZC1 |
| Total Floor Area                                                                | 71.2000 TFA |
| Assumed number of occupants                                                     | 2.2749 N    |
| CO2 emission factor in Table 12 for electricity displaced from grid             | 0.5190 EF   |
| CO2 emissions from appliances, equation (L14)                                   | 16.6523 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.4382 ZC3  |
| Total CO2 emissions                                                             | 37.5504 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 37.5504 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 71.2000 (1b)              | x 2.4000 (2b)                   | = 170.8800 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 71.2000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 170.8800 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 3 * 10 = 30.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour       |
| Pressure test                                                             |                 |                      |       |                             | 30.0000 / (5) = 0.1756 (8) |
| Measured/design AP50                                                      |                 |                      |       |                             | Yes                        |
| Infiltration rate                                                         |                 |                      |       |                             | 5.0000                     |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0.4256 (18)                |
|                                                                           |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3617 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4612 | 0.4522 | 0.4431 | 0.3979 | 0.3889 | 0.3436 | 0.3436 | 0.3346 | 0.3617 | 0.3889 | 0.4069 | 0.4250 (22b) |
| Effective ac    | 0.6064 | 0.6022 | 0.5982 | 0.5792 | 0.5756 | 0.5590 | 0.5590 | 0.5560 | 0.5654 | 0.5756 | 0.5828 | 0.5903 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 15.7000                   | 1.3258                        | 20.8144      |                                | (27)          |
| External Wall 1                                                | 53.7400                 | 15.7000                    | 38.0400                   | 0.1800                        | 6.8472       |                                | (29a)         |
| Corridor wall                                                  | 7.8000                  | 2.1000                     | 5.7000                    | 0.1800                        | 1.0260       |                                | (29a)         |
| Exposed ceiling                                                | 35.8000                 |                            | 35.8000                   | 0.1300                        | 4.6540       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 97.3400                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 35.8616      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 13.5745 (36)  |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 49.4361 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 34.1925 | 33.9597 | 33.7314 | 32.6592 | 32.4586 | 31.5247 | 31.5247 | 31.3518 | 31.8845 | 32.4586 | 32.8644 | 33.2887 (38) |
| Heat transfer coeff       | 83.6286 | 83.3957 | 83.1675 | 82.0953 | 81.8947 | 80.9608 | 80.9608 | 80.7879 | 81.3205 | 81.8947 | 82.3005 | 82.7248 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 82.0943 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.1746 | 1.1713 | 1.1681 | 1.1530 | 1.1502 | 1.1371 | 1.1371 | 1.1347 | 1.1421 | 1.1502 | 1.1559 | 1.1619 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.1530 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |          |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|----------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |          |                    |          | 2.2749 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |          |                    |          | 88.2289 (43)   |
| Daily hot water use                                         | 97.0518  | 93.5227  | 89.9935  | 86.4643  | 82.9352  | 79.4060 | 79.4060 | 82.9352 | 86.4643  | 89.9935            | 93.5227  | 97.0518 (44)   |
| Energy conte                                                | 143.9250 | 125.8778 | 129.8946 | 113.2452 | 108.6615 | 93.7666 | 86.8885 | 99.7059 | 100.8967 | 117.5854           | 128.3536 | 139.3837 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |          | Total = Sum(45)m = |          | 1388.1845 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 21.5888  | 18.8817  | 19.4842  | 16.9868  | 16.2992  | 14.0650 | 13.0333 | 14.9559 | 15.1345  | 17.6378            | 19.2530  | 20.9076 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |          |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |          |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |          |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |          |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |          |                    |          | 0.1290 (55)    |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 171.1852 | 150.4998 | 157.1547 | 139.6260 | 135.9216 | 120.1474 | 114.1487 | 126.9660 | 127.2775 | 144.8455 | 154.7344 | 166.6439 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 171.1852 | 150.4998 | 157.1547 | 139.6260 | 135.9216 | 120.1474 | 114.1487 | 126.9660 | 127.2775 | 144.8455 | 154.7344 | 166.6439 (64) |
| Heat gains from water heating, kWh/month                        | 69.6632  | 61.5520  | 64.9981  | 58.7587  | 57.9381  | 52.2820  | 50.6986  | 54.9603  | 54.6528  | 60.9052  | 63.7822  | 68.1532 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.8423  | 15.8474  | 12.8879  | 9.7570   | 7.2935   | 6.1575   | 6.6533   | 8.6483   | 11.6077  | 14.7386  | 17.2022  | 18.3382  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 200.0814 | 202.1576 | 196.9256 | 185.7873 | 171.7272 | 158.5126 | 149.6845 | 147.6083 | 152.8403 | 163.9786 | 178.0388 | 191.2533 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | (71) |
| Water heating gains (Table 5)                                                       | 93.6333  | 91.5952  | 87.3630  | 81.6093  | 77.8737  | 72.6139  | 68.1432  | 73.8714  | 75.9066  | 81.8619  | 88.5864  | 91.6038  | (72) |
| Total internal gains                                                                | 371.6805 | 369.7238 | 357.3001 | 337.2771 | 317.0179 | 297.4076 | 284.6046 | 290.2515 | 300.4782 | 320.7027 | 343.9508 | 361.3188 | (73) |

#### 6. Solar gains

| [Jan]       |  |  | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |          |          |          |               |
|-------------|--|--|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|----------|----------|----------|---------------|
| Northeast   |  |  | 1.6800     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 5.7930 (75)  |          |          |          |          |          |               |
| Northwest   |  |  | 14.0200    | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 48.3440 (81) |          |          |          |          |          |               |
| Solar gains |  |  | 54.1370    | 110.1973                       | 198.5405                          | 326.0606                           | 438.2894                     | 467.2629     | 437.1149 | 348.4731 | 241.9248 | 134.6699 | 68.1183  | 44.2110 (83)  |
| Total gains |  |  | 425.8175   | 479.9211                       | 555.8406                          | 663.3377                           | 755.3074                     | 764.6705     | 721.7195 | 638.7246 | 542.4029 | 455.3726 | 412.0691 | 405.5297 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct                       | Nov     | Dec     |              |
| tau                                                                         | 59.1238 | 59.2889 | 59.4517 | 60.2281 | 60.3756 | 61.0720 | 61.0720 | 61.2028 | 60.8019 | 60.3756                   | 60.0779 | 59.7698 |              |
| alpha                                                                       | 4.9416  | 4.9526  | 4.9634  | 5.0152  | 5.0250  | 5.0715  | 5.0715  | 5.0802  | 5.0535  | 5.0250                    | 5.0052  | 4.9847  |              |
| util living area                                                            | 0.9980  | 0.9961  | 0.9883  | 0.9519  | 0.8375  | 0.6441  | 0.4865  | 0.5657  | 0.8486  | 0.9795                    | 0.9961  | 0.9985  | (86)         |
| MIT                                                                         | 19.7241 | 19.8639 | 20.1368 | 20.5229 | 20.8298 | 20.9661 | 20.9933 | 20.9864 | 20.8668 | 20.4649                   | 20.0335 | 19.7037 | (87)         |
| Th 2                                                                        | 19.9404 | 19.9430 | 19.9456 | 19.9578 | 19.9600 | 19.9707 | 19.9707 | 19.9726 | 19.9666 | 19.9600                   | 19.9554 | 19.9506 | (88)         |
| util rest of house                                                          | 0.9974  | 0.9947  | 0.9841  | 0.9342  | 0.7849  | 0.5542  | 0.3764  | 0.4475  | 0.7770  | 0.9690                    | 0.9945  | 0.9980  | (89)         |
| MIT 2                                                                       | 18.2415 | 18.4474 | 18.8456 | 19.4015 | 19.7985 | 19.9492 | 19.9683 | 19.9672 | 19.8590 | 19.3317                   | 18.7045 | 18.2190 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         | 0.3581  | (91)         |
| MIT                                                                         | 18.7725 | 18.9547 | 19.3081 | 19.8031 | 20.1679 | 20.3134 | 20.3354 | 20.3322 | 20.2199 | 19.7375                   | 19.1805 | 18.7507 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |                           |         | 0.0000  |              |
| adjusted MIT                                                                | 18.7725 | 18.9547 | 19.3081 | 19.8031 | 20.1679 | 20.3134 | 20.3354 | 20.3322 | 20.2199 | 19.7375                   | 19.1805 | 18.7507 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |          |              |           |       |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|--------------|-----------|-------|
| Utilisation          | 0.9963    | 0.9929    | 0.9807    | 0.9310   | 0.7965   | 0.5853   | 0.4161   | 0.4901   | 0.7969   | 0.9660   | 0.9928       | 0.9971    | (94)  |
| Useful gains         | 424.2329  | 476.5016  | 545.0880  | 617.5752 | 601.5932 | 447.5745 | 300.2753 | 313.0120 | 432.2517 | 439.9051 | 409.1169     | 404.3412  | (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000       | 4.2000    | (96)  |
| Heat loss rate W     | 1210.3168 | 1172.1049 | 1065.2150 | 895.0937 | 693.4728 | 462.5635 | 302.4191 | 317.6734 | 497.6762 | 748.3153 | 994.2308     | 1203.7058 | (97)  |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000       | 1.0000    | (97a) |
| Space heating kWh    | 584.8464  | 467.4454  | 386.9745  | 199.8133 | 68.3585  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 229.4572 | 421.2820     | 594.7272  | (98)  |
| Space heating        |           |           |           |          |          |          |          |          |          |          |              | 2952.9046 | (98)  |
| Space heating per m2 |           |           |           |          |          |          |          |          |          |          | (98) / (4) = | 41.4734   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 3158.1868 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 584.8464 | 467.4454 | 386.9745 | 199.8133 | 68.3585  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 229.4572 | 421.2820 | 594.7272  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 625.5042 | 499.9416 | 413.8765 | 213.7041 | 73.1107  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 245.4088 | 450.5690 | 636.0719  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 171.1852 | 150.4998 | 157.1547 | 139.6260 | 135.9216 | 120.1474 | 114.1487 | 126.9660 | 127.2775 | 144.8455 | 154.7344 | 166.6439  | (64)            |
| Efficiency of water heater (217)m                                     | 87.8333  | 87.6381  | 87.1259  | 85.7694  | 83.0873  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 86.0358  | 87.3536  | 79.8000   | (216)           |
| Fuel for water heating, kWh/month                                     | 194.8977 | 171.7288 | 180.3765 | 162.7924 | 163.5890 | 150.5606 | 143.0435 | 159.1053 | 159.4956 | 168.3549 | 177.1357 | 189.5408  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2020.6208 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3158.1868 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 315.1004  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5568.9079 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 3158.1868          | 0.2160                        | 682.1683 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2020.6208          | 0.2160                        | 436.4541 (264)           |
| Space and water heating                                                                           |                    |                               | 1118.6224 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 315.1004           | 0.5190                        | 163.5371 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1321.0845 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 15.7110 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.2969 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5467 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (15.7110 * 1.00) + 2.2969 + 0.5467, rounded to 2 d.p. |                    |                               | 18.5500 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-3-02                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - be lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 83 B                                                                    | DER           | 18.46   | TER            | 18.55      |
| Environmental                      | 87 B                                                                    | % DER<TER     | 0.51    |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.07                                                                    | DFEE          | 51.87   | TFEE           | 55.41      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 6.38    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 71 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating: Mains gas (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 18.55 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 18.46 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 55.4 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 51.9 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.18 (max. 0.20) | 0.18 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK

Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing North East: 1.92 m<sup>2</sup>, No overhang  
Windows facing North West: 16.01 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 71.2000 (1b)              | x 2.4000 (2b)                   | = 170.8800 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 71.2000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 170.8800 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |               |        |              |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|---------------|--------|--------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |               |        |              |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |               |        |              |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |               |        |              |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |               |        |              |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |               |        |              |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |               |        |              |
|                                                                                              |                              |        |           |        |        |        | Air changes per hour        |             |        |               |        |              |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |               |        |              |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes         |        |               |        |              |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000      |        |               |        |              |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 (18) |        |               |        |              |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 2 (19)      |        |               |        |              |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |               |        |              |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |               |        |              |
|                                                                                              |                              |        |           |        |        |        |                             |             |        |               |        |              |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct           | Nov    | Dec          |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000        | 4.5000 | 4.7000 (22)  |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750        | 1.1250 | 1.1750 (22a) |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371        | 0.1434 | 0.1498 (22b) |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |               |        |              |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        | 0.5000 (23a)  |        |              |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        | 79.9000 (23c) |        |              |
| Effective ac                                                                                 | 0.2631                       | 0.2599 | 0.2567    | 0.2408 | 0.2376 | 0.2216 | 0.2216                      | 0.2184      | 0.2280 | 0.2376        | 0.2439 | 0.2503 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K                         | K-value<br>kJ/m2K | A x K<br>kJ/K   |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------------|------------------|--------------------------------------|-------------------|-----------------|----------------|----------------|----------------|----------------|---------------------|
| W10 (Uw = 1.40)                                                     |                |                | 1.9200               | 1.3258           | 2.5455                               |                   | (27)            |                |                |                |                |                     |
| W03 (Uw = 1.40)                                                     |                |                | 8.4000               | 1.3258           | 11.1364                              |                   | (27)            |                |                |                |                |                     |
| W02 (Uw = 1.40)                                                     |                |                | 7.6100               | 1.3258           | 10.0890                              |                   | (27)            |                |                |                |                |                     |
| door                                                                |                |                | 2.1000               | 1.4000           | 2.9400                               |                   | (26a)           |                |                |                |                |                     |
| External Wall 1                                                     | 53.7400        | 17.9300        | 35.8100              | 0.1500           | 5.3715                               | 140.0000          | 5013.4000 (29a) |                |                |                |                |                     |
| Corridor wall                                                       | 7.8000         | 2.1000         | 5.7000               | 0.1409           | 0.8032                               | 110.0000          | 627.0000 (29a)  |                |                |                |                |                     |
| Exposed ceiling                                                     | 35.8000        |                | 35.8000              | 0.1800           | 6.4440                               | 9.0000            | 322.2000 (30)   |                |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 97.3400              |                  |                                      |                   | (31)            |                |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26)...(30) + (32) = | 39.3295          |                                      |                   | (33)            |                |                |                |                |                     |
| Party Wall 1                                                        |                |                | 39.3000              | 0.0000           | 0.0000                               | 140.0000          | 5502.0000 (32)  |                |                |                |                |                     |
| Party Floor                                                         |                |                | 71.2000              |                  |                                      | 80.0000           | 5696.0000 (32d) |                |                |                |                |                     |
| Party Ceilings                                                      |                |                | 35.4000              |                  |                                      | 80.0000           | 2832.0000 (32b) |                |                |                |                |                     |
| Internal Wall                                                       |                |                | 123.8000             |                  |                                      | 9.0000            | 1114.2000 (32c) |                |                |                |                |                     |
| Heat capacity Cm = Sum(A x k)                                       |                |                |                      |                  | (28)...(30) + (32) + (32a)...(32e) = |                   | 21106.8000 (34) |                |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                      |                  |                                      |                   | 296.4438 (35)   |                |                |                |                |                     |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                      |                  |                                      |                   | 15.4420 (36)    |                |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                      |                  |                                      | (33) + (36) =     | 54.7715 (37)    |                |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                      |                  |                                      |                   |                 |                |                |                |                |                     |
| (38)m                                                               | Jan<br>14.8342 | Feb<br>14.6545 | Mar<br>14.4747       | Apr<br>13.5760   | May<br>13.3962                       | Jun<br>12.4975    | Jul<br>12.4975  | Aug<br>12.3178 | Sep<br>12.8570 | Oct<br>13.3962 | Nov<br>13.7557 | Dec<br>14.1152 (38) |
| Heat transfer coeff                                                 | 69.6057        | 69.4260        | 69.2462              | 68.3475          | 68.1678                              | 67.2690           | 67.2690         | 67.0893        | 67.6285        | 68.1678        | 68.5273        | 68.8867 (39)        |
| Average = Sum(39)m / 12 =                                           |                |                |                      |                  |                                      |                   |                 |                |                |                |                | 68.3026 (39)        |
| HLP                                                                 | Jan<br>0.9776  | Feb<br>0.9751  | Mar<br>0.9726        | Apr<br>0.9599    | May<br>0.9574                        | Jun<br>0.9448     | Jul<br>0.9448   | Aug<br>0.9423  | Sep<br>0.9498  | Oct<br>0.9574  | Nov<br>0.9625  | Dec<br>0.9675 (40)  |
| HLP (average)                                                       |                |                |                      |                  |                                      |                   |                 |                |                |                |                | 0.9593 (40)         |
| Days in month                                                       | 31             | 28             | 31                   | 30               | 31                                   | 30                | 31              | 31             | 30             | 31             | 30             | 31 (41)             |

#### 4. Water heating energy requirements (kWh/year)

|                                          |     |     |     |     |     |     |     |     |     |     |     |              |
|------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|
| Assumed occupancy                        |     |     |     |     |     |     |     |     |     |     |     | 2.2749 (42)  |
| Average daily hot water use (litres/day) |     |     |     |     |     |     |     |     |     |     |     | 92.8725 (43) |
| Jan                                      | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |              |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Daily hot water use                                             | 102.1598 | 98.4449  | 94.7300  | 91.0151  | 87.3002  | 83.5853  | 83.5853  | 87.3002  | 91.0151  | 94.7300  | 98.4449  | 102.1598 (44) |
| Energy conte                                                    | 151.5000 | 132.5029 | 136.7311 | 119.2055 | 114.3805 | 98.7017  | 91.4616  | 104.9536 | 106.2070 | 123.7741 | 135.1091 | 146.7197 (45) |
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          |          |          |               |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 22.7250  | 19.8754  | 20.5097  | 17.8808  | 17.1571  | 14.8053  | 13.7192  | 15.7430  | 15.9311  | 18.5661  | 20.2664  | 22.0080 (46)  |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |               |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)   |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)   |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (56)  |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (57)  |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 197.7024 | 174.2341 | 182.9335 | 163.9175 | 160.5829 | 143.4137 | 137.6640 | 151.1560 | 150.9190 | 169.9765 | 179.8211 | 192.9221 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
|                                                                 |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)   |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 197.7024 | 174.2341 | 182.9335 | 163.9175 | 160.5829 | 143.4137 | 137.6640 | 151.1560 | 150.9190 | 169.9765 | 179.8211 | 192.9221 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 87.3357  | 77.4422  | 82.4250  | 75.4054  | 74.9934  | 68.5879  | 67.3729  | 71.8590  | 71.0834  | 78.1168  | 80.6934  | 85.7462 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 17.8374  | 15.8430  | 12.8844  | 9.7543   | 7.2915   | 6.1558   | 6.6515   | 8.6459   | 11.6045  | 14.7346  | 17.1975  | 18.3332 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 200.0814 | 202.1576 | 196.9256 | 185.7873 | 171.7272 | 158.5126 | 149.6845 | 147.6083 | 152.8403 | 163.9786 | 178.0388 | 191.2533 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 117.3867 | 115.2413 | 110.7863 | 104.7298 | 100.7976 | 95.2610  | 90.5550  | 96.5846  | 98.7270  | 104.9957 | 112.0741 | 115.2503 (72) |
| Total internal gains                                                                |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 392.4290 | 390.3655 | 377.7199 | 357.3949 | 336.9398 | 317.0529 | 304.0146 | 309.9624 | 320.2954 | 340.8325 | 364.4339 | 381.9603 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |  | Gains<br>W    |
|-------------|----------|----------|----------|------------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|--|---------------|
|             |          |          |          |            |                                |          |                                   |          |                                    |          |                              |  |               |
| Northeast   |          |          |          | 1.9200     | 11.2829                        |          | 0.3700                            |          | 0.6500                             |          | 0.7700                       |  | 3.6105 (75)   |
| Northwest   |          |          |          | 8.4000     | 11.2829                        |          | 0.3700                            |          | 0.8900                             |          | 0.7700                       |  | 21.6285 (81)  |
| Northwest   |          |          |          | 7.6100     | 11.2829                        |          | 0.5600                            |          | 0.6800                             |          | 0.7700                       |  | 22.6588 (81)  |
|             |          |          |          |            |                                |          |                                   |          |                                    |          |                              |  |               |
| Solar gains | 47.8979  | 97.4975  | 175.6594 | 288.4833   | 387.7781                       | 413.4125 | 386.7389                          | 308.3128 | 214.0438                           | 119.1496 | 60.2679                      |  | 39.1158 (83)  |
| Total gains | 440.3269 | 487.8630 | 553.3793 | 645.8782   | 724.7180                       | 730.4655 | 690.7535                          | 618.2752 | 534.3391                           | 459.9821 | 424.7018                     |  | 421.0761 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 84.2316 | 84.4497 | 84.6689 | 85.7822 | 86.0084 | 87.1575 | 87.1575 | 87.3910 | 86.6942 | 86.0084 | 85.5572 | 85.1107      |
| alpha                                                                       | 6.6154  | 6.6300  | 6.6446  | 6.7188  | 6.7339  | 6.8105  | 6.8105  | 6.8261  | 6.7796  | 6.7339  | 6.7038  | 6.6740       |
| util living area                                                            | 0.9990  | 0.9977  | 0.9913  | 0.9511  | 0.8057  | 0.5827  | 0.4277  | 0.4970  | 0.8055  | 0.9802  | 0.9975  | 0.9993 (86)  |
| MIT                                                                         | 20.1456 | 20.2535 | 20.4609 | 20.7478 | 20.9407 | 20.9942 | 20.9994 | 20.9984 | 20.9570 | 20.6938 | 20.3730 | 20.1276 (87) |
| Th 2                                                                        | 20.1020 | 20.1041 | 20.1063 | 20.1169 | 20.1190 | 20.1296 | 20.1296 | 20.1317 | 20.1253 | 20.1190 | 20.1147 | 20.1105 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.9986  | 0.9968  | 0.9878  | 0.9321  | 0.7509  | 0.5067  | 0.3436  | 0.4044  | 0.7298  | 0.9691  | 0.9964  | 0.9990 (89)  |
| MIT 2                                                                       | 18.9586 | 19.1178 | 19.4206 | 19.8309 | 20.0674 | 20.1264 | 20.1294 | 20.1312 | 20.0948 | 19.7661 | 19.3009 | 18.9388 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 19.3837 | 19.5245 | 19.7932 | 20.1593 | 20.3801 | 20.4372 | 20.4410 | 20.4418 | 20.4036 | 20.0983 | 19.6849 | 19.3646 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.3837 | 19.5245 | 19.7932 | 20.1593 | 20.3801 | 20.4372 | 20.4410 | 20.4418 | 20.4036 | 20.0983 | 19.6849 | 19.3646 (93) |

#### 8. Space heating requirement

|                   |           |           |          |          |          |          |          |          |          |          |          |                |
|-------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation       | 0.9981    | 0.9960    | 0.9862   | 0.9332   | 0.7681   | 0.5339   | 0.3738   | 0.4377   | 0.7557   | 0.9688   | 0.9956   | 0.9986 (94)    |
| Useful gains      | 439.5108  | 485.8899  | 545.7179 | 602.7303 | 556.6845 | 389.9908 | 258.1795 | 270.6102 | 403.7799 | 445.6392 | 422.8262 | 420.4912 (95)  |
| Ext temp.         | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Heat loss rate W  |           |           |          |          |          |          |          |          |          |          |          |                |
|                   | 1049.9127 | 1015.3225 | 920.5031 | 769.5455 | 591.7047 | 392.6608 | 258.3792 | 271.1595 | 426.3039 | 647.4804 | 862.4095 | 1044.6388 (97) |
| Month fracti      | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating kWh |           |           |          |          |          |          |          |          |          |          |          |                |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                      |          |          |          |          |         |        |        |        |        |          |              |                |
|----------------------|----------|----------|----------|----------|---------|--------|--------|--------|--------|----------|--------------|----------------|
|                      | 454.1390 | 355.7787 | 278.8402 | 120.1070 | 26.0550 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 150.1699 | 316.5000     | 464.3658 (98)  |
| Space heating        |          |          |          |          |         |        |        |        |        |          |              | 2165.9555 (98) |
| Space heating per m2 |          |          |          |          |         |        |        |        |        |          | (98) / (4) = | 30.4207 (99)   |

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 2165.9555 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 2382.5510 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2005.2428 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 2205.7671 (310a) |
| Electricity used for heat distribution                                                  | 45.8832 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 138.1138 (330a)  |
| Total electricity for the above, kWh/year                                               | 138.1138 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 315.0141 (332)   |
| Total delivered energy for all uses                                                     | 5041.4460 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 4886.3878          | 0.2160                        | 1055.4598 (367)          |
| Electrical energy for heat distribution                                                    | 45.8832            | 0.5190                        | 23.8134 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 1079.2731 (373)          |
| Space and water heating                                                                    |                    |                               | 1079.2731 (376)          |
| Pumps and fans                                                                             | 138.1138           | 0.5190                        | 71.6810 (378)            |
| Energy for lighting                                                                        | 315.0141           | 0.5190                        | 163.4923 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1314.4465 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 18.4600 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 18.4600 ZC1 |
| Total Floor Area                                                                | TFA 71.2000 |
| Assumed number of occupants                                                     | N 2.2749    |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF 0.5190   |
| CO2 emissions from appliances, equation (L14)                                   | 16.6523 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.4382 ZC3  |
| Total CO2 emissions                                                             | 37.5504 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 37.5504 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 71.2000 (1b)              | x 2.4000 (2b)                   | = 170.8800 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 71.2000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 170.8800 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour    |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|----------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                          |                              |                      |       |       | 3 * 10 = 30.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 30.0000 / (5) = 0.1756 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                        |
| Measured/design AP50                                 |                              |                      |       |       | 5.0000                     |
| Infiltration rate                                    |                              |                      |       |       | 0.4256 (18)                |
| Number of sides sheltered                            |                              |                      |       |       | 2 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.3617 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4612 | 0.4522 | 0.4431 | 0.3979 | 0.3889 | 0.3436 | 0.3436 | 0.3346 | 0.3617 | 0.3889 | 0.4069 | 0.4250 (22b) |
| Effective ac    | 0.6064 | 0.6022 | 0.5982 | 0.5792 | 0.5756 | 0.5590 | 0.5590 | 0.5560 | 0.5654 | 0.5756 | 0.5828 | 0.5903 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 15.7000                   | 1.3258                        | 20.8144      |                                | (27)          |
| External Wall 1                                                | 53.7400                 | 15.7000                    | 38.0400                   | 0.1800                        | 6.8472       |                                | (29a)         |
| Corridor wall                                                  | 7.8000                  | 2.1000                     | 5.7000                    | 0.1800                        | 1.0260       |                                | (29a)         |
| Exposed ceiling                                                | 35.8000                 |                            | 35.8000                   | 0.1300                        | 4.6540       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 97.3400                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 35.8616      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 13.5745 (36)  |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 49.4361 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 34.1925 | 33.9597 | 33.7314 | 32.6592 | 32.4586 | 31.5247 | 31.5247 | 31.3518 | 31.8845 | 32.4586 | 32.8644 | 33.2887 (38) |
| Heat transfer coeff       | 83.6286 | 83.3957 | 83.1675 | 82.0953 | 81.8947 | 80.9608 | 80.9608 | 80.7879 | 81.3205 | 81.8947 | 82.3005 | 82.7248 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 82.0943 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.1746 | 1.1713 | 1.1681 | 1.1530 | 1.1502 | 1.1371 | 1.1371 | 1.1347 | 1.1421 | 1.1502 | 1.1559 | 1.1619 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.1530 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |          |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|----------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |          |                    |          | 2.2749 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |          |                    |          | 88.2289 (43)   |
| Daily hot water use                                         | 97.0518  | 93.5227  | 89.9935  | 86.4643  | 82.9352  | 79.4060 | 79.4060 | 82.9352 | 86.4643  | 89.9935            | 93.5227  | 97.0518 (44)   |
| Energy conte                                                | 143.9250 | 125.8778 | 129.8946 | 113.2452 | 108.6615 | 93.7666 | 86.8885 | 99.7059 | 100.8967 | 117.5854           | 128.3536 | 139.3837 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |          | Total = Sum(45)m = |          | 1388.1845 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 21.5888  | 18.8817  | 19.4842  | 16.9868  | 16.2992  | 14.0650 | 13.0333 | 14.9559 | 15.1345  | 17.6378            | 19.2530  | 20.9076 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |          |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |          |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |          |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |          |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |          |                    |          | 0.1290 (55)    |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 171.1852 | 150.4998 | 157.1547 | 139.6260 | 135.9216 | 120.1474 | 114.1487 | 126.9660 | 127.2775 | 144.8455 | 154.7344 | 166.6439 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 171.1852 | 150.4998 | 157.1547 | 139.6260 | 135.9216 | 120.1474 | 114.1487 | 126.9660 | 127.2775 | 144.8455 | 154.7344 | 166.6439 (64) |
| Heat gains from water heating, kWh/month                        | 69.6632  | 61.5520  | 64.9981  | 58.7587  | 57.9381  | 52.2820  | 50.6986  | 54.9603  | 54.6528  | 60.9052  | 63.7822  | 68.1532 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.8423  | 15.8474  | 12.8879  | 9.7570   | 7.2935   | 6.1575   | 6.6533   | 8.6483   | 11.6077  | 14.7386  | 17.2022  | 18.3382 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 200.0814 | 202.1576 | 196.9256 | 185.7873 | 171.7272 | 158.5126 | 149.6845 | 147.6083 | 152.8403 | 163.9786 | 178.0388 | 191.2533 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 (71) |
| Water heating gains (Table 5)                                                       | 93.6333  | 91.5952  | 87.3630  | 81.6093  | 77.8737  | 72.6139  | 68.1432  | 73.8714  | 75.9066  | 81.8619  | 88.5864  | 91.6038 (72)  |
| Total internal gains                                                                | 371.6805 | 369.7238 | 357.3001 | 337.2771 | 317.0179 | 297.4076 | 284.6046 | 290.2515 | 300.4782 | 320.7027 | 343.9508 | 361.3188 (73) |

#### 6. Solar gains

| [Jan]       |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |          |               |
|-------------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|----------|---------------|
| Northeast   |          |          | 1.6800     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 5.7930 (75)  |          |          |          |               |
| Northwest   |          |          | 14.0200    | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 48.3440 (81) |          |          |          |               |
|             |          |          |            |                                |                                   |                                    |                              |              |          |          |          |               |
| Solar gains | 54.1370  | 110.1973 | 198.5405   | 326.0606                       | 438.2894                          | 467.2629                           | 437.1149                     | 348.4731     | 241.9248 | 134.6699 | 68.1183  | 44.2110 (83)  |
| Total gains | 425.8175 | 479.9211 | 555.8406   | 663.3377                       | 755.3074                          | 764.6705                           | 721.7195                     | 638.7246     | 542.4029 | 455.3726 | 412.0691 | 405.5297 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 59.1238 | 59.2889 | 59.4517 | 60.2281 | 60.3756 | 61.0720 | 61.0720 | 61.2028 | 60.8019                   | 60.3756 | 60.0779 | 59.7698      |
| alpha                                                                       | 4.9416  | 4.9526  | 4.9634  | 5.0152  | 5.0250  | 5.0715  | 5.0715  | 5.0802  | 5.0535                    | 5.0250  | 5.0052  | 4.9847       |
| util living area                                                            | 0.9980  | 0.9961  | 0.9883  | 0.9519  | 0.8375  | 0.6441  | 0.4865  | 0.5657  | 0.8486                    | 0.9795  | 0.9961  | 0.9985 (86)  |
| MIT                                                                         | 19.7241 | 19.8639 | 20.1368 | 20.5229 | 20.8298 | 20.9661 | 20.9933 | 20.9864 | 20.8668                   | 20.4649 | 20.0335 | 19.7037 (87) |
| Th 2                                                                        | 19.9404 | 19.9430 | 19.9456 | 19.9578 | 19.9600 | 19.9707 | 19.9707 | 19.9726 | 19.9666                   | 19.9600 | 19.9554 | 19.9506 (88) |
| util rest of house                                                          | 0.9974  | 0.9947  | 0.9841  | 0.9342  | 0.7849  | 0.5542  | 0.3764  | 0.4475  | 0.7770                    | 0.9690  | 0.9945  | 0.9980 (89)  |
| MIT 2                                                                       | 18.2415 | 18.4474 | 18.8456 | 19.4015 | 19.7985 | 19.9492 | 19.9683 | 19.9672 | 19.8590                   | 19.3317 | 18.7045 | 18.2190 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3581 (91)  |
| MIT                                                                         | 18.7725 | 18.9547 | 19.3081 | 19.8031 | 20.1679 | 20.3134 | 20.3354 | 20.3322 | 20.2199                   | 19.7375 | 19.1805 | 18.7507 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.7725 | 18.9547 | 19.3081 | 19.8031 | 20.1679 | 20.3134 | 20.3354 | 20.3322 | 20.2199                   | 19.7375 | 19.1805 | 18.7507 (93) |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|                      | 0.9963    | 0.9929    | 0.9807    | 0.9310   | 0.7965   | 0.5853   | 0.4161   | 0.4901   | 0.7969   | 0.9660       | 0.9928   | 0.9971 (94)    |
| Useful gains         | 424.2329  | 476.5016  | 545.0880  | 617.5752 | 601.5932 | 447.5745 | 300.2753 | 313.0120 | 432.2517 | 439.9051     | 409.1169 | 404.3412 (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 1210.3168 | 1172.1049 | 1065.2150 | 895.0937 | 693.4728 | 462.5635 | 302.4191 | 317.6734 | 497.6762 | 748.3153     | 994.2308 | 1203.7058 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 584.8464  | 467.4454  | 386.9745  | 199.8133 | 68.3585  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 229.4572     | 421.2820 | 594.7272 (98)  |
| Space heating        |           |           |           |          |          |          |          |          |          |              |          | 2952.9046 (98) |
| Space heating per m2 |           |           |           |          |          |          |          |          |          | (98) / (4) = |          | 41.4734 (99)   |

#### 8c. Space cooling requirement

Not applicable

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 3158.1868 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 584.8464 | 467.4454 | 386.9745 | 199.8133 | 68.3585  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 229.4572 | 421.2820 | 594.7272  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 625.5042 | 499.9416 | 413.8765 | 213.7041 | 73.1107  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 245.4088 | 450.5690 | 636.0719  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 171.1852 | 150.4998 | 157.1547 | 139.6260 | 135.9216 | 120.1474 | 114.1487 | 126.9660 | 127.2775 | 144.8455 | 154.7344 | 166.6439  | (64)            |
| Efficiency of water heater (217)m                                     | 87.8333  | 87.6381  | 87.1259  | 85.7694  | 83.0873  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 86.0358  | 87.3536  | 79.8000   | (216)           |
| Fuel for water heating, kWh/month                                     | 194.8977 | 171.7288 | 180.3765 | 162.7924 | 163.5890 | 150.5606 | 143.0435 | 159.1053 | 159.4956 | 168.3549 | 177.1357 | 189.5408  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2020.6208 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3158.1868 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 315.1004  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5568.9079 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 3158.1868          | 0.2160                        | 682.1683 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2020.6208          | 0.2160                        | 436.4541 (264)           |
| Space and water heating                                                                           |                    |                               | 1118.6224 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 315.1004           | 0.5190                        | 163.5371 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1321.0845 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 15.7110 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.2969 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5467 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (15.7110 * 1.00) + 2.2969 + 0.5467, rounded to 2 d.p. |                    |                               | 18.5500 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-3-03                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - be lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 77 C                                                                    | DER           | 28.24   | TER            | 27.50      |
| Environmental                      | 81 B                                                                    | % DER<TER     | -2.69   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.34                                                                    | DFEE          | 87.10   | TFEE           | 97.13      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 10.32   |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 58 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating: Mains gas (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 27.50 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 28.24 kgCO<sub>2</sub>/m<sup>2</sup> Fail  
Excess emissions = 0.74 kgCO<sub>2</sub>/m<sup>2</sup> (2.7%)

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 97.1 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 87.1 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.18 (max. 0.20) | 0.18 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK

Hot water controls:

No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail

Based on:

Overshading: Average  
Windows facing West: 12.20 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Thermal bridging y-value 0.033 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.3000 (1b)              | x 2.4000 (2b)                   | = 139.9200 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.3000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 139.9200 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes    |             |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000 |             |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 | (18)        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 3      | (19)        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20)        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1163 | (21)        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1482                       | 0.1453 | 0.1424    | 0.1279 | 0.1250 | 0.1104 | 0.1104                      | 0.1075 | 0.1163      | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2487                       | 0.2458 | 0.2429    | 0.2284 | 0.2255 | 0.2109 | 0.2109                      | 0.2080 | 0.2168      | 0.2255 | 0.2313 | 0.2371 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K                         | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K    |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------------------------------|--------------------------------|------------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364                              |                                | (27)             |
| W02 (Uw = 1.40)                                                |                         |                            | 3.8000                    | 1.3258                        | 5.0379                               |                                | (27)             |
| entrance door                                                  |                         |                            | 2.1000                    | 1.4000                        | 2.9400                               |                                | (26a)            |
| External Wall 1                                                | 41.0000                 | 12.2000                    | 28.8000                   | 0.1500                        | 4.3200                               | 140.0000                       | 4032.0000 (29a)  |
| Corridor Wall                                                  | 277.0000                | 2.1000                     | 274.9000                  | 0.1500                        | 41.2350                              | 110.0000                       | 30239.0000 (29a) |
| Exposed ceiling                                                | 6.7000                  |                            | 6.7000                    | 0.1800                        | 1.2060                               | 9.0000                         | 60.3000 (30)     |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 324.7000                  |                               |                                      |                                | (31)             |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 65.8752                              |                                | (33)             |
| Party Wall 1                                                   |                         |                            | 27.7000                   | 0.0000                        | 0.0000                               | 140.0000                       | 3878.0000 (32)   |
| Party Floor                                                    |                         |                            | 58.3000                   |                               |                                      | 80.0000                        | 4664.0000 (32d)  |
| Party Ceilings                                                 |                         |                            | 51.6000                   |                               |                                      | 80.0000                        | 4128.0000 (32b)  |
| Internal Wall                                                  |                         |                            | 74.0000                   |                               |                                      | 9.0000                         | 666.0000 (32c)   |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               | (28)...(30) + (32) + (32a)...(32e) = |                                | 47667.3000 (34)  |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |                                      |                                | 817.6209 (35)    |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |                                      |                                | 10.5848 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |                                      | (33) + (36) =                  | 76.4600 (37)     |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 11.4842 | 11.3500 | 11.2159 | 10.5449 | 10.4107 | 9.7397  | 9.7397  | 9.6056  | 10.0081 | 10.4107 | 10.6791 | 10.9475 (38) |
| Heat transfer coeff       | 87.9443 | 87.8101 | 87.6759 | 87.0049 | 86.8707 | 86.1998 | 86.1998 | 86.0656 | 86.4682 | 86.8707 | 87.1391 | 87.4075 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 86.9714 (39) |
| HLP                       | 1.5085  | 1.5062  | 1.5039  | 1.4924  | 1.4901  | 1.4786  | 1.4786  | 1.4763  | 1.4832  | 1.4901  | 1.4947  | 1.4993 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.4918 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 1.9332 (42)  |
| Average daily hot water use (litres/day) | 84.3296 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy conte                                                    | 92.7625  | 89.3893  | 86.0162  | 82.6430  | 79.2698  | 75.8966  | 75.8966  | 79.2698  | 82.6430  | 86.0162             | 89.3893  | 92.7625 (44)   |
| Energy content (annual)                                         | 137.5642 | 120.3145 | 124.1538 | 108.2403 | 103.8591 | 89.6225  | 83.0484  | 95.2993  | 96.4375  | 112.3886            | 122.6809 | 133.2235 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1326.8325 (45) |
|                                                                 | 20.6346  | 18.0472  | 18.6231  | 16.2360  | 15.5789  | 13.4434  | 12.4573  | 14.2949  | 14.4656  | 16.8583             | 18.4021  | 19.9835 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |                     |          |                |
| Solar input                                                     | 183.7666 | 162.0457 | 170.3562 | 152.9523 | 150.0615 | 134.3345 | 129.2508 | 141.5017 | 141.1495 | 158.5910            | 167.3929 | 179.4259 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum (63)m =                       |          |          |          |          |          |          |          |          |          |                     |          | 0.0000 (63)    |
| Output from w/h                                                 | 183.7666 | 162.0457 | 170.3562 | 152.9523 | 150.0615 | 134.3345 | 129.2508 | 141.5017 | 141.1495 | 158.5910            | 167.3929 | 179.4259 (64)  |
| Heat gains from water heating, kWh/month                        | 82.7020  | 73.3895  | 78.2430  | 71.7595  | 71.4951  | 65.5691  | 64.5755  | 68.6489  | 67.8351  | 74.3311             | 76.5610  | 81.2587 (65)   |
|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 15.0344  | 13.3534  | 10.8597  | 8.2215   | 6.1457   | 5.1884   | 5.6063   | 7.2873   | 9.7810   | 12.4192  | 14.4950  | 15.4522 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 168.6400 | 170.3900 | 165.9802 | 156.5922 | 144.7415 | 133.6035 | 126.1627 | 124.4127 | 128.8225 | 138.2105 | 150.0612 | 161.1992 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 111.1586 | 109.2106 | 105.1654 | 99.6660  | 96.0955  | 91.0682  | 86.7951  | 92.2701  | 94.2154  | 99.9074  | 106.3347 | 109.2187 (72) |
| Total internal gains                                                                | 346.8308 | 344.9517 | 334.0030 | 316.4774 | 298.9804 | 281.8579 | 270.5618 | 275.9678 | 284.8166 | 302.5349 | 322.8887 | 337.8679 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          |          | Gains<br>W    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|----------|---------------|
| West        |          |          |          |          | 8.4000     | 19.6403                        | 0.3700                            | 0.8900                             | 0.7700                       |          |          | 37.6488 (80)  |
| West        |          |          |          |          | 3.8000     | 19.6403                        | 0.3700                            | 0.6800                             | 0.7700                       |          |          | 13.0129 (80)  |
| -----       |          |          |          |          |            |                                |                                   |                                    |                              |          |          |               |
| Solar gains | 50.6618  | 99.1051  | 163.2121 | 238.0351 | 291.7209   | 298.6282                       | 284.3063                          | 244.2149                           | 189.8224                     | 117.5966 | 63.1693  | 41.6618 (83)  |
| Total gains | 397.4925 | 444.0569 | 497.2151 | 554.5124 | 590.7013   | 580.4861                       | 554.8680                          | 520.1827                           | 474.6390                     | 420.1315 | 386.0580 | 379.5297 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |          |          |          |          |          |          |          |          |                           |          |          |              |
|-----------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|----------|----------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |          |          |          |          |          |          |          |          |                           |          |          | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |          |          |          |          |          |          |          |          |                           |          |          |              |
|                                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep                       | Oct      | Nov      | Dec          |
| tau                                                                         | 150.5603 | 150.7904 | 151.0212 | 152.1858 | 152.4209 | 153.6073 | 153.6073 | 153.8468 | 153.1305                  | 152.4209 | 151.9514 | 151.4849     |
| alpha                                                                       | 11.0374  | 11.0527  | 11.0681  | 11.1457  | 11.1614  | 11.2405  | 11.2405  | 11.2565  | 11.2087                   | 11.1614  | 11.1301  | 11.0990      |
| util living area                                                            | 1.0000   | 1.0000   | 1.0000   | 0.9996   | 0.9917   | 0.8930   | 0.6805   | 0.7524   | 0.9832                    | 0.9999   | 1.0000   | 1.0000 (86)  |
| MIT                                                                         | 20.3967  | 20.4538  | 20.5639  | 20.7190  | 20.8747  | 20.9812  | 20.9991  | 20.9974  | 20.9267                   | 20.7274  | 20.5348  | 20.3863 (87) |
| Th 2                                                                        | 19.6811  | 19.6829  | 19.6846  | 19.6932  | 19.6950  | 19.7036  | 19.7036  | 19.7054  | 19.7002                   | 19.6950  | 19.6915  | 19.6880 (88) |
| util rest of house                                                          | 1.0000   | 1.0000   | 0.9999   | 0.9988   | 0.9715   | 0.7495   | 0.4821   | 0.5466   | 0.9270                    | 0.9996   | 1.0000   | 1.0000 (89)  |
| MIT 2                                                                       | 18.8932  | 18.9783  | 19.1410  | 19.3752  | 19.5953  | 19.6996  | 19.7036  | 19.7052  | 19.6636                   | 19.3893  | 19.1043  | 18.8839 (90) |
| Living area fraction                                                        |          |          |          |          |          |          |          |          | fLA = Living area / (4) = |          |          | 0.4837 (91)  |
| MIT                                                                         | 19.6204  | 19.6920  | 19.8293  | 20.0252  | 20.2142  | 20.3195  | 20.3302  | 20.3303  | 20.2746                   | 20.0366  | 19.7963  | 19.6106 (92) |
| Temperature adjustment                                                      |          |          |          |          |          |          |          |          |                           |          |          | 0.0000       |
| adjusted MIT                                                                | 19.6204  | 19.6920  | 19.8293  | 20.0252  | 20.2142  | 20.3195  | 20.3302  | 20.3303  | 20.2746                   | 20.0366  | 19.7963  | 19.6106 (93) |

#### 8. Space heating requirement

|                   |           |           |           |          |          |          |          |          |          |          |           |                |
|-------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Utilisation       | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec            |
|                   | 1.0000    | 1.0000    | 1.0000    | 0.9991   | 0.9825   | 0.8257   | 0.5790   | 0.6485   | 0.9611   | 0.9997   | 1.0000    | 1.0000 (94)    |
| Useful gains      | 397.4921  | 444.0548  | 497.1928  | 554.0356 | 580.3593 | 479.3155 | 321.2495 | 337.3259 | 456.1525 | 420.0136 | 386.0559  | 379.5295 (95)  |
| Ext temp.         | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000 (96)    |
| Heat loss rate W  | 1347.3458 | 1298.8850 | 1168.6547 | 967.9444 | 739.6329 | 493.0203 | 321.5434 | 338.2620 | 533.9024 | 819.7606 | 1106.3429 | 1347.0062 (97) |
| Month fracti      | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000 (97a)   |
| Space heating kWh | 706.6911  | 574.4459  | 499.5677  | 298.0144 | 118.4995 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 297.4117 | 518.6066  | 719.8027 (98)  |
| Space heating     |           |           |           |          |          |          |          |          |          |          |           | 3733.0396 (98) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 64.0316 (99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 3733.0396 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 4106.3436 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1870.8285 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 2057.9114 (310a) |
| Electricity used for heat distribution                                                  | 61.6425 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 113.0903 (330a)  |
| Total electricity for the above, kWh/year                                               | 113.0903 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 265.5119 (332)   |
| Total delivered energy for all uses                                                     | 6542.8572 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 6564.7018          | 0.2160                        | 1417.9756 (367)          |
| Electrical energy for heat distribution                                                    | 61.6425            | 0.5190                        | 31.9925 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 1449.9681 (373)          |
| Space and water heating                                                                    |                    |                               | 1449.9681 (376)          |
| Pumps and fans                                                                             | 113.0903           | 0.5190                        | 58.6939 (378)            |
| Energy for lighting                                                                        | 265.5119           | 0.5190                        | 137.8007 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1646.4626 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 28.2400 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 28.2400 ZC1 |
| Total Floor Area                                                                | 58.3000     |
| Assumed number of occupants                                                     | N 1.9332    |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF 0.5190   |
| CO2 emissions from appliances, equation (L14)                                   | 17.1411 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.8370 ZC3  |
| Total CO2 emissions                                                             | 48.2181 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 48.2181 ZC8 |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.3000 (1b)              | x 2.4000 (2b)                   | = 139.9200 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.3000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 139.9200 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour    |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|----------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                          |                              |                      |       |       | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | Air changes per hour       |
| Pressure test                                        |                              |                      |       |       | 20.0000 / (5) = 0.1429 (8) |
| Measured/design AP50                                 |                              |                      |       |       | Yes                        |
| Infiltration rate                                    |                              |                      |       |       | 5.0000                     |
| Number of sides sheltered                            |                              |                      |       |       | 0.3929 (18)                |
|                                                      |                              |                      |       |       | 3 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.3045 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.3883 | 0.3807 | 0.3730 | 0.3350 | 0.3274 | 0.2893 | 0.2893 | 0.2817 | 0.3045 | 0.3274 | 0.3426 | 0.3578 (22b) |
| Effective ac    | 0.5754 | 0.5725 | 0.5696 | 0.5561 | 0.5536 | 0.5418 | 0.5418 | 0.5397 | 0.5464 | 0.5536 | 0.5587 | 0.5640 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 12.2000                   | 1.3258                        | 16.1742      |                                | (27)          |
| External Wall 1                                                | 41.0000                 | 12.2000                    | 28.8000                   | 0.1800                        | 5.1840       |                                | (29a)         |
| Corridor Wall                                                  | 277.0000                | 2.1000                     | 274.9000                  | 0.1800                        | 49.4820      |                                | (29a)         |
| Exposed ceiling                                                | 6.7000                  |                            | 6.7000                    | 0.1300                        | 0.8710       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 324.7000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 74.2312      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 9.3348 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 83.5660 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| (38)m                     | 26.5673  | 26.4321  | 26.2996  | 25.6774  | 25.5610  | 25.0191  | 25.0191  | 24.9187  | 25.2278  | 25.5610  | 25.7965  | 26.0427 (38)  |
| Heat transfer coeff       | 110.1333 | 109.9982 | 109.8657 | 109.2435 | 109.1270 | 108.5851 | 108.5851 | 108.4847 | 108.7938 | 109.1270 | 109.3625 | 109.6088 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 109.2429 (39) |
| HLP                       | 1.8891   | 1.8868   | 1.8845   | 1.8738   | 1.8718   | 1.8625   | 1.8625   | 1.8608   | 1.8661   | 1.8718   | 1.8759   | 1.8801 (40)   |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.8738 (40)   |
| Days in month             | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31 (41)       |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |                    |          | 1.9332 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |                    |          | 80.1131 (43)   |
| Daily hot water use                                         | 88.1244  | 84.9199  | 81.7154  | 78.5108  | 75.3063 | 72.1018 | 72.1018 | 75.3063 | 78.5108 | 81.7154            | 84.9199  | 88.1244 (44)   |
| Energy conte                                                | 130.6859 | 114.2988 | 117.9461 | 102.8283 | 98.6662 | 85.1414 | 78.8960 | 90.5343 | 91.6156 | 106.7691           | 116.5469 | 126.5624 (45)  |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         | Total = Sum(45)m = |          | 1260.4909 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 19.6029  | 17.1448  | 17.6919  | 15.4242  | 14.7999 | 12.7712 | 11.8344 | 13.5801 | 13.7423 | 16.0154            | 17.4820  | 18.9844 (46)   |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |                    |          | 2.0000 (47)    |
| Store volume                                                |          |          |          |          |         |         |         |         |         |                    |          | 0.2388 (48)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |                    |          | 0.1290 (55)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 157.9461 | 138.9208 | 145.2062 | 129.2090 | 125.9263 | 111.5222 | 106.1562 | 117.7945 | 117.9964 | 134.0293 | 142.9277 | 153.8225 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 157.9461 | 138.9208 | 145.2062 | 129.2090 | 125.9263 | 111.5222 | 106.1562 | 117.7945 | 117.9964 | 134.0293 | 142.9277 | 153.8225 (64) |
| Heat gains from water heating, kWh/month                        | 65.2612  | 57.7020  | 61.0252  | 55.2950  | 54.6146  | 49.4141  | 48.0410  | 51.9108  | 51.5668  | 57.3089  | 59.8565  | 63.8901 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.0794  | 13.3934  | 10.8922  | 8.2461   | 6.1641   | 5.2040   | 5.6231   | 7.3091   | 9.8102   | 12.4564  | 14.5384  | 15.4985  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 168.6400 | 170.3900 | 165.9802 | 156.5922 | 144.7415 | 133.6035 | 126.1627 | 124.4127 | 128.8225 | 138.2105 | 150.0612 | 161.1992 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | (71) |
| Water heating gains (Table 5)                                                       | 87.7167  | 85.8661  | 82.0231  | 76.7986  | 73.4067  | 68.6308  | 64.5713  | 69.7726  | 71.6206  | 77.0280  | 83.1340  | 85.8738  | (72) |
| Total internal gains                                                                | 326.4338 | 324.6472 | 313.8933 | 296.6347 | 279.3100 | 262.4360 | 251.3548 | 256.4921 | 265.2511 | 282.6927 | 302.7314 | 317.5692 | (73) |

#### 6. Solar gains

| [Jan]       |            |          |          |          |                                |          |                                   |          |                                    |          |                              |          |              |  |
|-------------|------------|----------|----------|----------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|--------------|--|
|             | Area<br>m2 |          |          |          | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W   |  |
| West        | 12.2000    |          |          |          | 19.6403                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 73.2283 (80) |  |
| Solar gains | 73.2283    | 143.2501 | 235.9125 | 344.0643 | 421.6637                       | 431.6479 | 410.9464                          | 352.9969 | 274.3760                           | 169.9783 | 91.3071                      | 60.2194  | (83)         |  |
| Total gains | 399.6622   | 467.8973 | 549.8058 | 640.6990 | 700.9738                       | 694.0838 | 662.3011                          | 609.4890 | 539.6271                           | 452.6710 | 394.0384                     | 377.7886 | (84)         |  |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 36.7610 | 36.8062 | 36.8506 | 37.0604 | 37.1000 | 37.2851 | 37.2851 | 37.3196 | 37.2136 | 37.1000 | 37.0201 | 36.9369 |              |
| alpha                                                                       | 3.4507  | 3.4537  | 3.4567  | 3.4707  | 3.4733  | 3.4857  | 3.4857  | 3.4880  | 3.4809  | 3.4733  | 3.4680  | 3.4625  |              |
| util living area                                                            | 0.9960  | 0.9926  | 0.9833  | 0.9566  | 0.8943  | 0.7775  | 0.6376  | 0.6941  | 0.8846  | 0.9749  | 0.9931  | 0.9967  | (86)         |
| MIT                                                                         | 18.9538 | 19.1443 | 19.5047 | 19.9909 | 20.4476 | 20.7786 | 20.9209 | 20.8916 | 20.6105 | 20.0125 | 19.3939 | 18.9172 | (87)         |
| Th 2                                                                        | 19.4083 | 19.4099 | 19.4115 | 19.4188 | 19.4202 | 19.4266 | 19.4266 | 19.4277 | 19.4241 | 19.4202 | 19.4174 | 19.4145 | (88)         |
| util rest of house                                                          | 0.9945  | 0.9898  | 0.9765  | 0.9371  | 0.8418  | 0.6581  | 0.4458  | 0.5082  | 0.8035  | 0.9601  | 0.9900  | 0.9955  | (89)         |
| MIT 2                                                                       | 16.7747 | 17.0530 | 17.5768 | 18.2750 | 18.8939 | 19.2860 | 19.4022 | 19.3887 | 19.1201 | 18.3193 | 17.4232 | 16.7248 | (90)         |
| Living area fraction                                                        | 17.8287 | 18.0646 | 18.5093 | 19.1050 | 19.6454 | 20.0080 | 20.1368 | 20.1156 | 19.8410 | 19.1383 | 18.3764 | 17.7853 | (92)         |
| Temperature adjustment                                                      | 17.8287 | 18.0646 | 18.5093 | 19.1050 | 19.6454 | 20.0080 | 20.1368 | 20.1156 | 19.8410 | 19.1383 | 18.3764 | 17.7853 | (93)         |
| adjusted MIT                                                                | 17.8287 | 18.0646 | 18.5093 | 19.1050 | 19.6454 | 20.0080 | 20.1368 | 20.1156 | 19.8410 | 19.1383 | 18.3764 | 17.7853 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |          |           |           |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec       |       |
| Useful gains         | 0.9922    | 0.9862    | 0.9711    | 0.9321    | 0.8509   | 0.7082   | 0.5399   | 0.5986   | 0.8299   | 0.9564   | 0.9869    | 0.9935    | (94)  |
| Ext temp.            | 396.5341  | 461.4562  | 533.9265  | 597.1897  | 596.4385 | 491.5489 | 357.6087 | 364.8372 | 447.8242 | 432.9254 | 388.8789  | 375.3416  | (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000    | (96)  |
| Month fracti         | 1489.9660 | 1448.0808 | 1319.4110 | 1114.8299 | 867.0583 | 587.2276 | 384.0469 | 403.0911 | 624.5879 | 931.7603 | 1233.2190 | 1489.0642 | (97)  |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000    | (97a) |
| Space heating        | 813.5133  | 663.0117  | 584.4004  | 372.7009  | 201.3411 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 371.1332 | 607.9249  | 828.6096  | (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |          |           | 4442.6351 | (98)  |
|                      |           |           |           |           |          |          |          |          |          |          |           | 76.2030   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 4751.4814 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 813.5133 | 663.0117 | 584.4004 | 372.7009 | 201.3411 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 371.1332 | 607.9249 | 828.6096  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 870.0677 | 709.1034 | 625.0272 | 398.6106 | 215.3381 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 396.9339 | 650.1870 | 886.2135  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 157.9461 | 138.9208 | 145.2062 | 129.2090 | 125.9263 | 111.5222 | 106.1562 | 117.7945 | 117.9964 | 134.0293 | 142.9277 | 153.8225  | (64)            |
| Efficiency of water heater (217)m                                     | 88.5692  | 88.4456  | 88.1477  | 87.4803  | 86.0599  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 87.3910  | 88.2476  | 88.6391   | (216)           |
| Fuel for water heating, kWh/month                                     | 178.3308 | 157.0692 | 164.7305 | 147.7007 | 146.3241 | 139.7521 | 133.0278 | 147.6121 | 147.8651 | 153.3673 | 161.9621 | 173.5380  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1851.2799 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 4751.4814 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 266.3071  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 6944.0683 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 4751.4814          | 0.2160                        | 1026.3200 (261)          |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1851.2799          | 0.2160                        | 399.8765 (264)           |
| Space and water heating                                                                           |                    |                               | 1426.1964 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 266.3071           | 0.5190                        | 138.2134 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1603.3348 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 24.4631 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3707 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6677 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (24.4631 * 1.00) + 2.3707 + 0.6677, rounded to 2 d.p. |                    |                               | 27.5000 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-3-05                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - be lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 83 B                                                                    | DER           | 17.25   | TER            | 17.36      |
| Environmental                      | 88 B                                                                    | % DER<TER     | 0.62    |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.97                                                                    | DFEE          | 45.21   | TFEE           | 48.34      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 6.46    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 68 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 17.36 kgCO<sub>2</sub>/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 17.25 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)48.3 kWh/m<sup>2</sup>/yr

Dwelling Fabric Energy Efficiency (DFEE)45.2 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.18 (max. 0.20) | 0.18 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls: No cylinderstat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail

Based on:

Overshading: Average  
Windows facing South East: 7.61 m<sup>2</sup>, No overhang  
Windows facing South: 3.80 m<sup>2</sup>, No overhang  
Windows facing West: 8.40 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 68.1000 (1b)              | x 2.4000 (2b)                   | = 163.4400 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.1000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 163.4400 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour                           |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|---------------------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)                              |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)                              |
| Number of intermittent fans                                               |                 |                      |       |                             | 0 * 10 = 0.0000 (7a)                              |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)                              |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)                              |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour<br>0.0000 / (5) = 0.0000 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                                               |
| Measured/design AP50                                                      |                 |                      |       |                             | 3.0000                                            |
| Infiltration rate                                                         |                 |                      |       |                             | 0.1500 (18)                                       |
| Number of sides sheltered                                                 |                 |                      |       |                             | 1 (19)                                            |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.9250 (20)                                       |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.1388 (21)                                       |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1769 | 0.1734 | 0.1700 | 0.1526 | 0.1492 | 0.1318 | 0.1318 | 0.1283 | 0.1388 | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 79.9000 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2774 | 0.2739 | 0.2705 | 0.2531 | 0.2497 | 0.2323 | 0.2323 | 0.2288 | 0.2393 | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364      |                                | (27)                                                 |
| W02 (Uw = 1.40)                                                |                         |                            | 11.4100                   | 1.3258                        | 15.1269      |                                | (27)                                                 |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                | (26a)                                                |
| External Wall 1                                                | 62.2000                 | 19.8100                    | 42.3900                   | 0.1500                        | 6.3585       | 140.0000                       | 5934.6000 (29a)                                      |
| Corridor wall                                                  | 4.1500                  | 2.1000                     | 2.0500                    | 0.1409                        | 0.2889       | 110.0000                       | 225.5000 (29a)                                       |
| Exposed ceiling                                                | 9.6000                  |                            | 9.6000                    | 0.1800                        | 1.7280       | 9.0000                         | 86.4000 (30)                                         |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 75.9500                   |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 37.5786      |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 31.9000                   | 0.0000                        | 0.0000       | 140.0000                       | 4466.0000 (32)                                       |
| Party Floor                                                    |                         |                            | 68.1000                   |                               |              | 80.0000                        | 5448.0000 (32d)                                      |
| Party Ceilings                                                 |                         |                            | 58.5000                   |                               |              | 80.0000                        | 4680.0000 (32b)                                      |
| Internal Wall                                                  |                         |                            | 109.6000                  |                               |              | 9.0000                         | 986.4000 (32c)                                       |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 21826.9000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 320.5125 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 18.3210 (36)                                         |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 55.8996 (37)                           |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 14.9620 | 14.7749 | 14.5878 | 13.6523 | 13.4653 | 12.5298 | 12.5298 | 12.3427 | 12.9040 | 13.4653 | 13.8394 | 14.2136 (38) |
| Heat transfer coeff       | 70.8616 | 70.6745 | 70.4874 | 69.5520 | 69.3649 | 68.4294 | 68.4294 | 68.2424 | 68.8036 | 69.3649 | 69.7391 | 70.1132 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 69.5052 (39) |
| HLP                       | 1.0406  | 1.0378  | 1.0351  | 1.0213  | 1.0186  | 1.0048  | 1.0048  | 1.0021  | 1.0103  | 1.0186  | 1.0241  | 1.0296 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.0206 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 2.1991 (42)  |
| Average daily hot water use (litres/day) | 90.9782 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy conte                                                    | 100.0760 | 96.4369  | 92.7978  | 89.1586  | 85.5195  | 81.8804  | 81.8804  | 85.5195  | 89.1586  | 92.7978             | 96.4369  | 100.0760 (44)  |
| Energy content (annual)                                         | 148.4098 | 129.8002 | 133.9422 | 116.7740 | 112.0475 | 96.6884  | 89.5960  | 102.8128 | 104.0407 | 121.2494            | 132.3532 | 143.7270 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1431.4411 (45) |
|                                                                 | 22.2615  | 19.4700  | 20.0913  | 17.5161  | 16.8071  | 14.5033  | 13.4394  | 15.4219  | 15.6061  | 18.1874             | 19.8530  | 21.5590 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |                     |          |                |
| Solar input                                                     | 194.6122 | 171.5314 | 180.1446 | 161.4860 | 158.2499 | 141.4004 | 135.7984 | 149.0152 | 148.7527 | 167.4518            | 177.0652 | 189.9294 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |                     |          | 0.0000 (63)    |
| Output from w/h                                                 | 194.6122 | 171.5314 | 180.1446 | 161.4860 | 158.2499 | 141.4004 | 135.7984 | 149.0152 | 148.7527 | 167.4518            | 177.0652 | 189.9294 (64)  |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 86.3082  | 76.5435  | 81.4977  | 74.5970  | 74.2177  | 67.9185  | 66.7526  | 71.1472  | 70.3631  | 77.2773             | 79.7770  | 84.7511 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 17.1903  | 15.2682  | 12.4170  | 9.4004   | 7.0269   | 5.9324   | 6.4102   | 8.3322   | 11.1835  | 14.2000  | 16.5735  | 17.6680 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 192.8226 | 194.8235 | 189.7813 | 179.0470 | 165.4970 | 152.7619 | 144.2540 | 142.2532 | 147.2953 | 158.0296 | 171.5796 | 184.3147 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 116.0056 | 113.9040 | 109.5399 | 103.6069 | 99.7550  | 94.3313  | 89.7212  | 95.6279  | 97.7266  | 103.8674 | 110.8014 | 113.9128 (72) |
| Total internal gains                                                                |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 382.0054 | 379.9827 | 367.7251 | 348.0413 | 328.2658 | 309.0125 | 296.3724 | 302.2002 | 312.1923 | 332.0839 | 354.9415 | 371.8825 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| West        |          |          |          | 8.4000     | 19.6403                        | 0.3700                            | 0.8900                             | 0.7700                       | 37.6488 (80) |          |          |               |
| Southeast   |          |          |          | 7.6100     | 36.7938                        | 0.5600                            | 0.6800                             | 0.7700                       | 73.8907 (77) |          |          |               |
| South       |          |          |          | 3.8000     | 46.7521                        | 0.5600                            | 0.6800                             | 0.7700                       | 46.8829 (78) |          |          |               |
| Solar gains | 158.4225 | 276.2945 | 391.3080 | 500.8150   | 570.9840                       | 570.0534                          | 548.3507                           | 496.3150                     | 429.7043     | 309.3133 | 191.0200 | 134.7068 (83) |
| Total gains | 540.4278 | 656.2771 | 759.0330 | 848.8563   | 899.2499                       | 879.0659                          | 844.7231                           | 798.5152                     | 741.8966     | 641.3972 | 545.9614 | 506.5893 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 85.5616 | 85.7881 | 86.0158 | 87.1726 | 87.4077 | 88.6026 | 88.6026 | 88.8455 | 88.1208 | 87.4077 | 86.9388 | 86.4748      |
| alpha                                                                       | 6.7041  | 6.7192  | 6.7344  | 6.8115  | 6.8272  | 6.9068  | 6.9068  | 6.9230  | 6.8747  | 6.8272  | 6.7959  | 6.7650       |
| util living area                                                            | 0.9972  | 0.9894  | 0.9614  | 0.8682  | 0.6947  | 0.4962  | 0.3563  | 0.3928  | 0.6289  | 0.9174  | 0.9911  | 0.9981 (86)  |
| MIT                                                                         | 20.2612 | 20.4397 | 20.6646 | 20.8797 | 20.9765 | 20.9979 | 20.9998 | 20.9997 | 20.9906 | 20.8470 | 20.5078 | 20.2281 (87) |
| Th 2                                                                        | 20.0497 | 20.0519 | 20.0542 | 20.0656 | 20.0679 | 20.0793 | 20.0793 | 20.0816 | 20.0747 | 20.0679 | 20.0633 | 20.0588 (88) |
| util rest of house                                                          | 0.9960  | 0.9852  | 0.9475  | 0.8301  | 0.6336  | 0.4258  | 0.2818  | 0.3146  | 0.5498  | 0.8823  | 0.9869  | 0.9973 (89)  |
| MIT 2                                                                       | 19.0796 | 19.3393 | 19.6573 | 19.9444 | 20.0498 | 20.0783 | 20.0793 | 20.0815 | 20.0693 | 19.9149 | 19.4485 | 19.0385 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 19.6209 | 19.8435 | 20.1188 | 20.3729 | 20.4744 | 20.4996 | 20.5010 | 20.5022 | 20.4914 | 20.3419 | 19.9338 | 19.5835 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.6209 | 19.8435 | 20.1188 | 20.3729 | 20.4744 | 20.4996 | 20.5010 | 20.5022 | 20.4914 | 20.3419 | 19.9338 | 19.5835 (93) |

#### 8. Space heating requirement

|                   |           |           |          |          |          |          |          |          |          |          |          |                |
|-------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation       | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Useful gains      | 537.8893  | 645.8521  | 720.0142 | 715.9934 | 594.2683 | 402.6947 | 266.8802 | 279.8121 | 434.7547 | 573.2870 | 538.3992 | 504.9669 (95)  |
| Ext temp.         | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Heat loss rate W  | 1085.6659 | 1056.1215 | 959.9541 | 797.9637 | 608.6360 | 403.7081 | 266.9442 | 279.9404 | 439.7517 | 675.7485 | 895.0202 | 1078.5859 (97) |
| Month fracti      | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating kWh | 407.5457  | 275.7010  | 178.5153 | 59.0186  | 10.6896  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 76.2314  | 256.7671 | 426.7725 (98)  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                                                           |                    |                               |                          |                  |
|-----------------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|------------------|
| Space heating                                                                                             |                    |                               |                          | 1691.2413 (98)   |
| Space heating per m2                                                                                      |                    |                               | (98) / (4) =             | 24.8347 (99)     |
| -----                                                                                                     |                    |                               |                          |                  |
| 8c. Space cooling requirement                                                                             |                    |                               |                          |                  |
| -----                                                                                                     |                    |                               |                          |                  |
| Not applicable                                                                                            |                    |                               |                          |                  |
| -----                                                                                                     |                    |                               |                          |                  |
| 9b. Energy requirements                                                                                   |                    |                               |                          |                  |
| -----                                                                                                     |                    |                               |                          |                  |
| Fraction of space heat from secondary/supplementary system (Table 11)                                     |                    |                               |                          | 0.0000 (301)     |
| Fraction of space heat from community system                                                              |                    |                               |                          | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                                   |                    |                               |                          | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                                       |                    |                               |                          | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating                          |                    |                               |                          | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating                          |                    |                               |                          | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                                         |                    |                               |                          | 1.1000 (306)     |
| Space heating:                                                                                            |                    |                               |                          |                  |
| Annual space heating requirement                                                                          |                    |                               |                          | 1691.2413 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                                       |                    |                               |                          | 1860.3655 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)                   |                    |                               |                          | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                                     |                    |                               |                          | 0.0000 (309)     |
| Water heating                                                                                             |                    |                               |                          |                  |
| Annual water heating requirement                                                                          |                    |                               |                          | 1975.4371 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                                       |                    |                               |                          | 2172.9808 (310a) |
| Electricity used for heat distribution                                                                    |                    |                               |                          | 40.3335 (313)    |
| Annual totals kWh/year                                                                                    |                    |                               |                          |                  |
| Electricity for pumps and fans:                                                                           |                    |                               |                          |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)                               |                    |                               |                          |                  |
| mechanical ventilation fans (SFP = 0.6625)                                                                |                    |                               |                          | 132.1004 (330a)  |
| Total electricity for the above, kWh/year                                                                 |                    |                               |                          | 132.1004 (331)   |
| Electricity for lighting (calculated in Appendix L)                                                       |                    |                               |                          | 303.5856 (332)   |
| Total delivered energy for all uses                                                                       |                    |                               |                          | 4469.0323 (338)  |
| -----                                                                                                     |                    |                               |                          |                  |
| 12b. Carbon dioxide emissions - Community heating scheme                                                  |                    |                               |                          |                  |
| -----                                                                                                     |                    |                               |                          |                  |
|                                                                                                           | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |                  |
| Efficiency of heat source Boilers                                                                         |                    |                               | 93.9000                  | (367a)           |
| Space heating from Boilers                                                                                | 4295.3635          | 0.2160                        | 927.7985                 | (367)            |
| Electrical energy for heat distribution                                                                   | 40.3335            | 0.5190                        | 20.9331                  | (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE)                |                    |                               | 948.7316                 | (373)            |
| Space and water heating                                                                                   |                    |                               | 948.7316                 | (376)            |
| Pumps and fans                                                                                            | 132.1004           | 0.5190                        | 68.5601                  | (378)            |
| Energy for lighting                                                                                       | 303.5856           | 0.5190                        | 157.5609                 | (379)            |
| Total CO2, kg/year                                                                                        |                    |                               | 1174.8526                | (383)            |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                               |                    |                               | 17.2500                  | (384)            |
| -----                                                                                                     |                    |                               |                          |                  |
| 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES |                    |                               |                          |                  |
| DER                                                                                                       |                    |                               | 17.2500                  | ZC1              |
| Total Floor Area                                                                                          |                    | TFA                           | 68.1000                  |                  |
| Assumed number of occupants                                                                               |                    | N                             | 2.1991                   |                  |
| CO2 emission factor in Table 12 for electricity displaced from grid                                       |                    | EF                            | 0.5190                   |                  |
| CO2 emissions from appliances, equation (L14)                                                             |                    |                               | 16.7786                  | ZC2              |
| CO2 emissions from cooking, equation (L16)                                                                |                    |                               | 2.5225                   | ZC3              |
| Total CO2 emissions                                                                                       |                    |                               | 36.5511                  | ZC4              |
| Residual CO2 emissions offset from biofuel CHP                                                            |                    |                               | 0.0000                   | ZC5              |
| Additional allowable electricity generation, kWh/m²/year                                                  |                    |                               | 0.0000                   | ZC6              |
| Resulting CO2 emissions offset from additional allowable electricity generation                           |                    |                               | 0.0000                   | ZC7              |
| Net CO2 emissions                                                                                         |                    |                               | 36.5511                  | ZC8              |
| -----                                                                                                     |                    |                               |                          |                  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 68.1000 (1b)              | x 2.4000 (2b)                   | = 163.4400 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.1000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 163.4400 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour    |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|----------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                          |                              |                      |       |       | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | Air changes per hour       |
| Pressure test                                        |                              |                      |       |       | 20.0000 / (5) = 0.1224 (8) |
| Measured/design AP50                                 |                              |                      |       |       | Yes                        |
| Infiltration rate                                    |                              |                      |       |       | 5.0000                     |
| Number of sides sheltered                            |                              |                      |       |       | 0.3724 (18)                |
|                                                      |                              |                      |       |       | 1 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.9250 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.3444 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4392 | 0.4306 | 0.4219 | 0.3789 | 0.3703 | 0.3272 | 0.3272 | 0.3186 | 0.3444 | 0.3703 | 0.3875 | 0.4047 (22b) |
|                 | 0.5964 | 0.5927 | 0.5890 | 0.5718 | 0.5686 | 0.5535 | 0.5535 | 0.5508 | 0.5593 | 0.5686 | 0.5751 | 0.5819 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 14.9200                   | 1.3258                        | 19.7803      |                                | (27)          |
| External Wall 1                                                | 62.2000                 | 14.9200                    | 47.2800                   | 0.1800                        | 8.5104       |                                | (29a)         |
| Corridor wall                                                  | 4.1500                  | 2.1000                     | 2.0500                    | 0.1800                        | 0.3690       |                                | (29a)         |
| Exposed ceiling                                                | 9.6000                  |                            | 9.6000                    | 0.1300                        | 1.2480       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 75.9500                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 32.4277      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 16.0085 (36)  |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 48.4362 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 32.1687 | 31.9667 | 31.7687 | 30.8389 | 30.6649 | 29.8551 | 29.8551 | 29.7051 | 30.1670 | 30.6649 | 31.0169 | 31.3848 (38) |
| Heat transfer coeff       | 80.6049 | 80.4029 | 80.2050 | 79.2751 | 79.1011 | 78.2913 | 78.2913 | 78.1413 | 78.6032 | 79.1011 | 79.4531 | 79.8210 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 79.2743 (39) |
| HLP                       | 1.1836  | 1.1807  | 1.1778  | 1.1641  | 1.1615  | 1.1497  | 1.1497  | 1.1474  | 1.1542  | 1.1615  | 1.1667  | 1.1721 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.1641 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |         |                    |          | 2.1991 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |         |                    |          | 86.4293 (43)   |
| Daily hot water use                                         | 95.0722  | 91.6150  | 88.1579  | 84.7007  | 81.2435  | 77.7863 | 77.7863 | 81.2435 | 84.7007 | 88.1579            | 91.6150  | 95.0722 (44)   |
| Energy conte                                                | 140.9893 | 123.3102 | 127.2451 | 110.9353 | 106.4451 | 91.8540 | 85.1162 | 97.6721 | 98.8386 | 115.1869           | 125.7355 | 136.5406 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |         | Total = Sum(45)m = |          | 1359.8691 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 21.1484  | 18.4965  | 19.0868  | 16.6403  | 15.9668  | 13.7781 | 12.7674 | 14.6508 | 14.8258 | 17.2780            | 18.8603  | 20.4811 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |         |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |                    |          | 0.1290 (55)    |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 168.2495 | 147.9322 | 154.5052 | 137.3161 | 133.7052 | 118.2348 | 112.3764 | 124.9323 | 125.2194 | 142.4471 | 152.1163 | 163.8008 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 168.2495 | 147.9322 | 154.5052 | 137.3161 | 133.7052 | 118.2348 | 112.3764 | 124.9323 | 125.2194 | 142.4471 | 152.1163 | 163.8008 (64) |
| Heat gains from water heating, kWh/month                        | 68.6871  | 60.6983  | 64.1171  | 57.9906  | 57.2011  | 51.6461  | 50.1093  | 54.2841  | 53.9685  | 60.1078  | 62.9117  | 67.2079 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.1986  | 15.2756  | 12.4230  | 9.4050   | 7.0303   | 5.9353   | 6.4133   | 8.3363   | 11.1889  | 14.2069  | 16.5816  | 17.6766 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 192.8226 | 194.8235 | 189.7813 | 179.0470 | 165.4970 | 152.7619 | 144.2540 | 142.2532 | 147.2953 | 158.0296 | 171.5796 | 184.3147 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 (71) |
| Water heating gains (Table 5)                                                       | 92.3213  | 90.3248  | 86.1789  | 80.5425  | 76.8832  | 71.7307  | 67.3512  | 72.9625  | 74.9562  | 80.7900  | 87.3773  | 90.3332 (72)  |
| Total internal gains                                                                | 361.3294 | 359.4108 | 347.3701 | 327.9815 | 308.3975 | 289.4148 | 277.0054 | 282.5388 | 292.4274 | 312.0134 | 334.5254 | 351.3114 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| Southeast   |          |          |          | 5.7300     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       | 64.4320 (77) |          |          |               |
| South       |          |          |          | 2.8600     | 46.7521                        | 0.6300                            | 0.7000                             | 0.7700                       | 40.8638 (78) |          |          |               |
| West        |          |          |          | 6.3300     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       | 37.9947 (80) |          |          |               |
|             |          |          |          |            |                                |                                   |                                    |                              |              |          |          |               |
| Solar gains | 143.2905 | 251.0015 | 357.8203 | 460.9333   | 527.5918                       | 527.4862                          | 507.1024                           | 457.6414                     | 394.0130     | 281.6767 | 172.9871 | 121.6954 (83) |
| Total gains | 504.6199 | 610.4124 | 705.1904 | 788.9148   | 835.9893                       | 816.9010                          | 784.1078                           | 740.1802                     | 686.4404     | 593.6901 | 507.5125 | 473.0068 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |              |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|--------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) | 21.0000 (85) |         |         |         |         |         |         |         |         |         |         |              |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan          | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 58.6710      | 58.8183 | 58.9635 | 59.6551 | 59.7863 | 60.4048 | 60.4048 | 60.5207 | 60.1650 | 59.7863 | 59.5215 | 59.2471      |
| alpha                                                                       | 4.9114       | 4.9212  | 4.9309  | 4.9770  | 4.9858  | 5.0270  | 5.0270  | 5.0347  | 5.0110  | 4.9858  | 4.9681  | 4.9498       |
| util living area                                                            | 0.9949       | 0.9868  | 0.9648  | 0.9026  | 0.7756  | 0.5919  | 0.4354  | 0.4790  | 0.7229  | 0.9362  | 0.9885  | 0.9963 (86)  |
| MIT                                                                         | 19.8431      | 20.0508 | 20.3378 | 20.6600 | 20.8799 | 20.9758 | 20.9957 | 20.9932 | 20.9364 | 20.6328 | 20.1713 | 19.8053 (87) |
| Th 2                                                                        | 19.9331      | 19.9355 | 19.9378 | 19.9488 | 19.9509 | 19.9605 | 19.9605 | 19.9623 | 19.9568 | 19.9509 | 19.9467 | 19.9424 (88) |
| util rest of house                                                          | 0.9933       | 0.9825  | 0.9536  | 0.8731  | 0.7162  | 0.5048  | 0.3346  | 0.3744  | 0.6378  | 0.9099  | 0.9841  | 0.9950 (89)  |
| MIT 2                                                                       | 18.4096      | 18.7119 | 19.1232 | 19.5718 | 19.8422 | 19.9457 | 19.9590 | 19.9597 | 19.9113 | 19.5488 | 18.8971 | 18.3613 (90) |
| Living area fraction                                                        | 19.0664      | 19.3253 | 19.6797 | 20.0704 | 20.3176 | 20.4177 | 20.4340 | 20.4332 | 20.3810 | 20.0454 | 19.4809 | 19.0229 (92) |
| Temperature adjustment                                                      | 19.0664      | 19.3253 | 19.6797 | 20.0704 | 20.3176 | 20.4177 | 20.4340 | 20.4332 | 20.3810 | 20.0454 | 19.4809 | 19.0229 (93) |
| adjusted MIT                                                                | 19.0664      | 19.3253 | 19.6797 | 20.0704 | 20.3176 | 20.4177 | 20.4340 | 20.4332 | 20.3810 | 20.0454 | 19.4809 | 19.0229 (93) |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |          |          |                |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Useful gains         | 0.9914    | 0.9794    | 0.9503    | 0.8769   | 0.7382   | 0.5441   | 0.3809   | 0.4224   | 0.6743   | 0.9127   | 0.9816   | 0.9936 (94)    |
| Ext temp.            | 500.2966  | 597.8508  | 670.1137  | 691.7893 | 617.1611 | 444.4586 | 298.6788 | 312.6867 | 462.8706 | 541.8395 | 498.1606 | 469.9581 (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Month fracti         | 1190.2402 | 1159.8384 | 1057.0747 | 885.5330 | 681.6656 | 455.4733 | 300.1674 | 315.1596 | 493.7039 | 747.1442 | 983.6980 | 1183.1778 (97) |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating per m2 | 513.3180  | 377.6556  | 287.8990  | 139.4955 | 47.9913  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 152.7467 | 349.5869 | 530.6354 (98)  |
|                      |           |           |           |          |          |          |          |          |          |          |          | 2399.3285 (98) |
|                      |           |           |           |          |          |          |          |          |          |          |          | 35.2324 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |          | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |          | 2566.1267 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |                 |
| Space heating requirement                                             | 513.3180 | 377.6556 | 287.8990 | 139.4955 | 47.9913  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 152.7467 | 349.5869 | 530.6354 | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000  | (210)           |
| Space heating fuel (main heating system)                              | 549.0032 | 403.9098 | 307.9134 | 149.1930 | 51.3276  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 163.3654 | 373.8897 | 567.5245 | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (215)           |
| Water heating requirement                                             | 168.2495 | 147.9322 | 154.5052 | 137.3161 | 133.7052 | 118.2348 | 112.3764 | 124.9323 | 125.2194 | 142.4471 | 152.1163 | 163.8008 | (64)            |
| Efficiency of water heater (217)m                                     | 87.6004  | 87.2088  | 86.4517  | 84.8558  | 82.3724  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.0002  | 86.9645  | 87.7255  | (216)           |
| Fuel for water heating, kWh/month                                     | 192.0646 | 169.6300 | 178.7186 | 161.8228 | 162.3181 | 148.1639 | 140.8225 | 156.5567 | 156.9166 | 167.5844 | 174.9177 | 186.7198 | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          |          | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          |          | 2566.1267 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |          |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          |          | 30.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          |          | 75.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          |          | 303.7325 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          |          | 4941.0950 (238) |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2566.1267          | 0.2160                        | 554.2834 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1996.2358          | 0.2160                        | 431.1869 (264)           |
| Space and water heating                                                                           |                    |                               | 985.4703 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 303.7325           | 0.5190                        | 157.6372 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1182.0325 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 14.4709 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3148 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5716 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (14.4709 * 1.00) + 2.3148 + 0.5716, rounded to 2 d.p. |                    |                               | 17.3600 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-3-06                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - be lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 83 B                                                                    | DER           | 17.25   | TER            | 17.36      |
| Environmental                      | 88 B                                                                    | % DER<TER     | 0.62    |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.97                                                                    | DFEE          | 45.21   | TFEE           | 48.34      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 6.46    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 68 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 17.36 kgCO<sub>2</sub>/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 17.25 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)48.3 kWh/m<sup>2</sup>/yr

Dwelling Fabric Energy Efficiency (DFEE)45.2 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.18 (max. 0.20) | 0.18 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system: None

#### 5 Cylinder insulation

|                             |                                      |
|-----------------------------|--------------------------------------|
| Hot water storage           | Measured cylinder loss: 0.74 kWh/day |
| Permitted by DBSCG 0.32     | Fail                                 |
| Primary pipework insulated: | No primary pipework                  |

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls: No cylinderstat

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.53   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 94%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |                                   |      |
|-----------------------------------|-----------------------------------|------|
| Overheating risk (Thames Valley): | High                              | Fail |
| Based on:                         |                                   |      |
| Overshading:                      | Average                           |      |
| Windows facing South East:        | 7.61 m <sup>2</sup> , No overhang |      |
| Windows facing South:             | 3.80 m <sup>2</sup> , No overhang |      |
| Windows facing West:              | 8.40 m <sup>2</sup> , No overhang |      |
| Air change rate:                  | 0.50 ach                          |      |
| Blinds/curtains:                  | None                              |      |

#### 10 Key features

|                    |                                      |
|--------------------|--------------------------------------|
| Party wall U-value | 0.00 W/m <sup>2</sup> K              |
| Air permeability   | 3.0 m <sup>3</sup> /m <sup>2</sup> h |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 68.1000 (1b)              | x 2.4000 (2b)                   | = 163.4400 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.1000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 163.4400 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour   |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|---------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                                               |                 |                      |       |                             | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour      |
| Pressure test                                                             |                 |                      |       |                             | 0.0000 / (5) = 0.0000 (8) |
| Measured/design AP50                                                      |                 |                      |       |                             | Yes                       |
| Infiltration rate                                                         |                 |                      |       |                             | 3.0000                    |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0.1500 (18)               |
|                                                                           |                 |                      |       |                             | 1 (19)                    |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.9250 (20)               |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.1388 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1769 | 0.1734 | 0.1700 | 0.1526 | 0.1492 | 0.1318 | 0.1318 | 0.1283 | 0.1388 | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        |               |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2774 | 0.2739 | 0.2705 | 0.2531 | 0.2497 | 0.2323 | 0.2323 | 0.2288 | 0.2393 | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364      |                                | (27)                                                 |
| W02 (Uw = 1.40)                                                |                         |                            | 11.4100                   | 1.3258                        | 15.1269      |                                | (27)                                                 |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                | (26a)                                                |
| External Wall 1                                                | 62.2000                 | 19.8100                    | 42.3900                   | 0.1500                        | 6.3585       | 140.0000                       | 5934.6000 (29a)                                      |
| Corridor wall                                                  | 4.1500                  | 2.1000                     | 2.0500                    | 0.1409                        | 0.2889       | 110.0000                       | 225.5000 (29a)                                       |
| Exposed ceiling                                                | 9.6000                  |                            | 9.6000                    | 0.1800                        | 1.7280       | 9.0000                         | 86.4000 (30)                                         |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 75.9500                   |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 37.5786      |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 31.9000                   | 0.0000                        | 0.0000       | 140.0000                       | 4466.0000 (32)                                       |
| Party Floor                                                    |                         |                            | 68.1000                   |                               |              | 80.0000                        | 5448.0000 (32d)                                      |
| Party Ceilings                                                 |                         |                            | 58.5000                   |                               |              | 80.0000                        | 4680.0000 (32b)                                      |
| Internal Wall                                                  |                         |                            | 109.6000                  |                               |              | 9.0000                         | 986.4000 (32c)                                       |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 21826.9000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 320.5125 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 18.3210 (36)                                         |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 55.8996 (37)                           |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 14.9620 | 14.7749 | 14.5878 | 13.6523 | 13.4653 | 12.5298 | 12.5298 | 12.3427 | 12.9040 | 13.4653 | 13.8394 | 14.2136 (38) |
| Heat transfer coeff       | 70.8616 | 70.6745 | 70.4874 | 69.5520 | 69.3649 | 68.4294 | 68.4294 | 68.2424 | 68.8036 | 69.3649 | 69.7391 | 70.1132 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 69.5052 (39) |
| HLP                       | 1.0406  | 1.0378  | 1.0351  | 1.0213  | 1.0186  | 1.0048  | 1.0048  | 1.0021  | 1.0103  | 1.0186  | 1.0241  | 1.0296 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.0206 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 2.1991 (42)  |
| Average daily hot water use (litres/day) | 90.9782 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy conte                                                    | 100.0760 | 96.4369  | 92.7978  | 89.1586  | 85.5195  | 81.8804  | 81.8804  | 85.5195  | 89.1586  | 92.7978             | 96.4369  | 100.0760 (44)  |
| Energy content (annual)                                         | 148.4098 | 129.8002 | 133.9422 | 116.7740 | 112.0475 | 96.6884  | 89.5960  | 102.8128 | 104.0407 | 121.2494            | 132.3532 | 143.7270 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1431.4411 (45) |
|                                                                 | 22.2615  | 19.4700  | 20.0913  | 17.5161  | 16.8071  | 14.5033  | 13.4394  | 15.4219  | 15.6061  | 18.1874             | 19.8530  | 21.5590 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |                     |          |                |
| Solar input                                                     | 194.6122 | 171.5314 | 180.1446 | 161.4860 | 158.2499 | 141.4004 | 135.7984 | 149.0152 | 148.7527 | 167.4518            | 177.0652 | 189.9294 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |                     |          | 0.0000 (63)    |
| Output from w/h                                                 | 194.6122 | 171.5314 | 180.1446 | 161.4860 | 158.2499 | 141.4004 | 135.7984 | 149.0152 | 148.7527 | 167.4518            | 177.0652 | 189.9294 (64)  |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 86.3082  | 76.5435  | 81.4977  | 74.5970  | 74.2177  | 67.9185  | 66.7526  | 71.1472  | 70.3631  | 77.2773             | 79.7770  | 84.7511 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 17.1903  | 15.2682  | 12.4170  | 9.4004   | 7.0269   | 5.9324   | 6.4102   | 8.3322   | 11.1835  | 14.2000  | 16.5735  | 17.6680 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 192.8226 | 194.8235 | 189.7813 | 179.0470 | 165.4970 | 152.7619 | 144.2540 | 142.2532 | 147.2953 | 158.0296 | 171.5796 | 184.3147 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 116.0056 | 113.9040 | 109.5399 | 103.6069 | 99.7550  | 94.3313  | 89.7212  | 95.6279  | 97.7266  | 103.8674 | 110.8014 | 113.9128 (72) |
| Total internal gains                                                                |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 382.0054 | 379.9827 | 367.7251 | 348.0413 | 328.2658 | 309.0125 | 296.3724 | 302.2002 | 312.1923 | 332.0839 | 354.9415 | 371.8825 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| West        |          |          |          | 8.4000     | 19.6403                        | 0.3700                            | 0.8900                             | 0.7700                       | 37.6488 (80) |          |          |               |
| Southeast   |          |          |          | 7.6100     | 36.7938                        | 0.5600                            | 0.6800                             | 0.7700                       | 73.8907 (77) |          |          |               |
| South       |          |          |          | 3.8000     | 46.7521                        | 0.5600                            | 0.6800                             | 0.7700                       | 46.8829 (78) |          |          |               |
| Solar gains | 158.4225 | 276.2945 | 391.3080 | 500.8150   | 570.9840                       | 570.0534                          | 548.3507                           | 496.3150                     | 429.7043     | 309.3133 | 191.0200 | 134.7068 (83) |
| Total gains | 540.4278 | 656.2771 | 759.0330 | 848.8563   | 899.2499                       | 879.0659                          | 844.7231                           | 798.5152                     | 741.8966     | 641.3972 | 545.9614 | 506.5893 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 85.5616 | 85.7881 | 86.0158 | 87.1726 | 87.4077 | 88.6026 | 88.6026 | 88.8455 | 88.1208 | 87.4077 | 86.9388 | 86.4748      |
| alpha                                                                       | 6.7041  | 6.7192  | 6.7344  | 6.8115  | 6.8272  | 6.9068  | 6.9068  | 6.9230  | 6.8747  | 6.8272  | 6.7959  | 6.7650       |
| util living area                                                            | 0.9972  | 0.9894  | 0.9614  | 0.8682  | 0.6947  | 0.4962  | 0.3563  | 0.3928  | 0.6289  | 0.9174  | 0.9911  | 0.9981 (86)  |
| MIT                                                                         | 20.2612 | 20.4397 | 20.6646 | 20.8797 | 20.9765 | 20.9979 | 20.9998 | 20.9997 | 20.9906 | 20.8470 | 20.5078 | 20.2281 (87) |
| Th 2                                                                        | 20.0497 | 20.0519 | 20.0542 | 20.0656 | 20.0679 | 20.0793 | 20.0793 | 20.0816 | 20.0747 | 20.0679 | 20.0633 | 20.0588 (88) |
| util rest of house                                                          | 0.9960  | 0.9852  | 0.9475  | 0.8301  | 0.6336  | 0.4258  | 0.2818  | 0.3146  | 0.5498  | 0.8823  | 0.9869  | 0.9973 (89)  |
| MIT 2                                                                       | 19.0796 | 19.3393 | 19.6573 | 19.9444 | 20.0498 | 20.0783 | 20.0793 | 20.0815 | 20.0693 | 19.9149 | 19.4485 | 19.0385 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 19.6209 | 19.8435 | 20.1188 | 20.3729 | 20.4744 | 20.4996 | 20.5010 | 20.5022 | 20.4914 | 20.3419 | 19.9338 | 19.5835 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.6209 | 19.8435 | 20.1188 | 20.3729 | 20.4744 | 20.4996 | 20.5010 | 20.5022 | 20.4914 | 20.3419 | 19.9338 | 19.5835 (93) |

#### 8. Space heating requirement

|                   |           |           |          |          |          |          |          |          |          |          |          |                |
|-------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation       | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
|                   | 0.9953    | 0.9841    | 0.9486   | 0.8435   | 0.6608   | 0.4581   | 0.3159   | 0.3504   | 0.5860   | 0.8938   | 0.9861   | 0.9968 (94)    |
| Useful gains      | 537.8893  | 645.8521  | 720.0142 | 715.9934 | 594.2683 | 402.6947 | 266.8802 | 279.8121 | 434.7547 | 573.2870 | 538.3992 | 504.9669 (95)  |
| Ext temp.         | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Heat loss rate W  | 1085.6659 | 1056.1215 | 959.9541 | 797.9637 | 608.6360 | 403.7081 | 266.9442 | 279.9404 | 439.7517 | 675.7485 | 895.0202 | 1078.5859 (97) |
| Month fracti      | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating kWh | 407.5457  | 275.7010  | 178.5153 | 59.0186  | 10.6896  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 76.2314  | 256.7671 | 426.7725 (98)  |

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|                                                                                                           |                    |                               |                          |                  |
|-----------------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|------------------|
| Space heating                                                                                             |                    |                               |                          | 1691.2413 (98)   |
| Space heating per m2                                                                                      |                    |                               | (98) / (4) =             | 24.8347 (99)     |
| -----                                                                                                     |                    |                               |                          |                  |
| 8c. Space cooling requirement                                                                             |                    |                               |                          |                  |
| -----                                                                                                     |                    |                               |                          |                  |
| Not applicable                                                                                            |                    |                               |                          |                  |
| -----                                                                                                     |                    |                               |                          |                  |
| 9b. Energy requirements                                                                                   |                    |                               |                          |                  |
| -----                                                                                                     |                    |                               |                          |                  |
| Fraction of space heat from secondary/supplementary system (Table 11)                                     |                    |                               |                          | 0.0000 (301)     |
| Fraction of space heat from community system                                                              |                    |                               |                          | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                                   |                    |                               |                          | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                                       |                    |                               |                          | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating                          |                    |                               |                          | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating                          |                    |                               |                          | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                                         |                    |                               |                          | 1.1000 (306)     |
| Space heating:                                                                                            |                    |                               |                          |                  |
| Annual space heating requirement                                                                          |                    |                               |                          | 1691.2413 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                                       |                    |                               |                          | 1860.3655 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)                   |                    |                               |                          | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                                     |                    |                               |                          | 0.0000 (309)     |
| Water heating                                                                                             |                    |                               |                          |                  |
| Annual water heating requirement                                                                          |                    |                               |                          | 1975.4371 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                                       |                    |                               |                          | 2172.9808 (310a) |
| Electricity used for heat distribution                                                                    |                    |                               |                          | 40.3335 (313)    |
| Annual totals kWh/year                                                                                    |                    |                               |                          |                  |
| Electricity for pumps and fans:                                                                           |                    |                               |                          |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)                               |                    |                               |                          |                  |
| mechanical ventilation fans (SFP = 0.6625)                                                                |                    |                               |                          | 132.1004 (330a)  |
| Total electricity for the above, kWh/year                                                                 |                    |                               |                          | 132.1004 (331)   |
| Electricity for lighting (calculated in Appendix L)                                                       |                    |                               |                          | 303.5856 (332)   |
| Total delivered energy for all uses                                                                       |                    |                               |                          | 4469.0323 (338)  |
| -----                                                                                                     |                    |                               |                          |                  |
| 12b. Carbon dioxide emissions - Community heating scheme                                                  |                    |                               |                          |                  |
| -----                                                                                                     |                    |                               |                          |                  |
|                                                                                                           | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |                  |
| Efficiency of heat source Boilers                                                                         |                    |                               | 93.9000                  | (367a)           |
| Space heating from Boilers                                                                                | 4295.3635          | 0.2160                        | 927.7985                 | (367)            |
| Electrical energy for heat distribution                                                                   | 40.3335            | 0.5190                        | 20.9331                  | (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE)                |                    |                               | 948.7316                 | (373)            |
| Space and water heating                                                                                   |                    |                               | 948.7316                 | (376)            |
| Pumps and fans                                                                                            | 132.1004           | 0.5190                        | 68.5601                  | (378)            |
| Energy for lighting                                                                                       | 303.5856           | 0.5190                        | 157.5609                 | (379)            |
| Total CO2, kg/year                                                                                        |                    |                               | 1174.8526                | (383)            |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                               |                    |                               | 17.2500                  | (384)            |
| -----                                                                                                     |                    |                               |                          |                  |
| 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES |                    |                               |                          |                  |
| DER                                                                                                       |                    |                               | 17.2500                  | ZC1              |
| Total Floor Area                                                                                          |                    | TFA                           | 68.1000                  |                  |
| Assumed number of occupants                                                                               |                    | N                             | 2.1991                   |                  |
| CO2 emission factor in Table 12 for electricity displaced from grid                                       |                    | EF                            | 0.5190                   |                  |
| CO2 emissions from appliances, equation (L14)                                                             |                    |                               | 16.7786                  | ZC2              |
| CO2 emissions from cooking, equation (L16)                                                                |                    |                               | 2.5225                   | ZC3              |
| Total CO2 emissions                                                                                       |                    |                               | 36.5511                  | ZC4              |
| Residual CO2 emissions offset from biofuel CHP                                                            |                    |                               | 0.0000                   | ZC5              |
| Additional allowable electricity generation, kWh/m²/year                                                  |                    |                               | 0.0000                   | ZC6              |
| Resulting CO2 emissions offset from additional allowable electricity generation                           |                    |                               | 0.0000                   | ZC7              |
| Net CO2 emissions                                                                                         |                    |                               | 36.5511                  | ZC8              |
| -----                                                                                                     |                    |                               |                          |                  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 68.1000 (1b)              | x 2.4000 (2b)                   | = 163.4400 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.1000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 163.4400 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour       |
| Pressure test                                                             |                 |                      |       |                             | 20.0000 / (5) = 0.1224 (8) |
| Measured/design AP50                                                      |                 |                      |       |                             | Yes                        |
| Infiltration rate                                                         |                 |                      |       |                             | 5.0000                     |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0.3724 (18)                |
|                                                                           |                 |                      |       |                             | 1 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.9250 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3444 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4392 | 0.4306 | 0.4219 | 0.3789 | 0.3703 | 0.3272 | 0.3272 | 0.3186 | 0.3444 | 0.3703 | 0.3875 | 0.4047 (22b) |
|                 | 0.5964 | 0.5927 | 0.5890 | 0.5718 | 0.5686 | 0.5535 | 0.5535 | 0.5508 | 0.5593 | 0.5686 | 0.5751 | 0.5819 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 14.9200                   | 1.3258                        | 19.7803      |                                | (27)          |
| External Wall 1                                                | 62.2000                 | 14.9200                    | 47.2800                   | 0.1800                        | 8.5104       |                                | (29a)         |
| Corridor wall                                                  | 4.1500                  | 2.1000                     | 2.0500                    | 0.1800                        | 0.3690       |                                | (29a)         |
| Exposed ceiling                                                | 9.6000                  |                            | 9.6000                    | 0.1300                        | 1.2480       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 75.9500                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 32.4277      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 16.0085 (36)  |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 48.4362 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 32.1687 | 31.9667 | 31.7687 | 30.8389 | 30.6649 | 29.8551 | 29.8551 | 29.7051 | 30.1670 | 30.6649 | 31.0169 | 31.3848 (38) |
| Heat transfer coeff       | 80.6049 | 80.4029 | 80.2050 | 79.2751 | 79.1011 | 78.2913 | 78.2913 | 78.1413 | 78.6032 | 79.1011 | 79.4531 | 79.8210 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 79.2743 (39) |
| HLP                       | 1.1836  | 1.1807  | 1.1778  | 1.1641  | 1.1615  | 1.1497  | 1.1497  | 1.1474  | 1.1542  | 1.1615  | 1.1667  | 1.1721 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.1641 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |         |                    |          | 2.1991 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |         |                    |          | 86.4293 (43)   |
| Daily hot water use                                         | 95.0722  | 91.6150  | 88.1579  | 84.7007  | 81.2435  | 77.7863 | 77.7863 | 81.2435 | 84.7007 | 88.1579            | 91.6150  | 95.0722 (44)   |
| Energy conte                                                | 140.9893 | 123.3102 | 127.2451 | 110.9353 | 106.4451 | 91.8540 | 85.1162 | 97.6721 | 98.8386 | 115.1869           | 125.7355 | 136.5406 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |         | Total = Sum(45)m = |          | 1359.8691 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 21.1484  | 18.4965  | 19.0868  | 16.6403  | 15.9668  | 13.7781 | 12.7674 | 14.6508 | 14.8258 | 17.2780            | 18.8603  | 20.4811 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |         |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |                    |          | 0.1290 (55)    |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 168.2495 | 147.9322 | 154.5052 | 137.3161 | 133.7052 | 118.2348 | 112.3764 | 124.9323 | 125.2194 | 142.4471 | 152.1163 | 163.8008 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 168.2495 | 147.9322 | 154.5052 | 137.3161 | 133.7052 | 118.2348 | 112.3764 | 124.9323 | 125.2194 | 142.4471 | 152.1163 | 163.8008 (64) |
| Heat gains from water heating, kWh/month                        | 68.6871  | 60.6983  | 64.1171  | 57.9906  | 57.2011  | 51.6461  | 50.1093  | 54.2841  | 53.9685  | 60.1078  | 62.9117  | 67.2079 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.1986  | 15.2756  | 12.4230  | 9.4050   | 7.0303   | 5.9353   | 6.4133   | 8.3363   | 11.1889  | 14.2069  | 16.5816  | 17.6766 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 192.8226 | 194.8235 | 189.7813 | 179.0470 | 165.4970 | 152.7619 | 144.2540 | 142.2532 | 147.2953 | 158.0296 | 171.5796 | 184.3147 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 (71) |
| Water heating gains (Table 5)                                                       | 92.3213  | 90.3248  | 86.1789  | 80.5425  | 76.8832  | 71.7307  | 67.3512  | 72.9625  | 74.9562  | 80.7900  | 87.3773  | 90.3332 (72)  |
| Total internal gains                                                                | 361.3294 | 359.4108 | 347.3701 | 327.9815 | 308.3975 | 289.4148 | 277.0054 | 282.5388 | 292.4274 | 312.0134 | 334.5254 | 351.3114 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| Southeast   |          |          |          | 5.7300     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       | 64.4320 (77) |          |          |               |
| South       |          |          |          | 2.8600     | 46.7521                        | 0.6300                            | 0.7000                             | 0.7700                       | 40.8638 (78) |          |          |               |
| West        |          |          |          | 6.3300     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       | 37.9947 (80) |          |          |               |
|             |          |          |          |            |                                |                                   |                                    |                              |              |          |          |               |
| Solar gains | 143.2905 | 251.0015 | 357.8203 | 460.9333   | 527.5918                       | 527.4862                          | 507.1024                           | 457.6414                     | 394.0130     | 281.6767 | 172.9871 | 121.6954 (83) |
| Total gains | 504.6199 | 610.4124 | 705.1904 | 788.9148   | 835.9893                       | 816.9010                          | 784.1078                           | 740.1802                     | 686.4404     | 593.6901 | 507.5125 | 473.0068 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |              |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|--------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) | 21.0000 (85) |         |         |         |         |         |         |         |         |         |         |              |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan          | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 58.6710      | 58.8183 | 58.9635 | 59.6551 | 59.7863 | 60.4048 | 60.4048 | 60.5207 | 60.1650 | 59.7863 | 59.5215 | 59.2471      |
| alpha                                                                       | 4.9114       | 4.9212  | 4.9309  | 4.9770  | 4.9858  | 5.0270  | 5.0270  | 5.0347  | 5.0110  | 4.9858  | 4.9681  | 4.9498       |
| util living area                                                            | 0.9949       | 0.9868  | 0.9648  | 0.9026  | 0.7756  | 0.5919  | 0.4354  | 0.4790  | 0.7229  | 0.9362  | 0.9885  | 0.9963 (86)  |
| MIT                                                                         | 19.8431      | 20.0508 | 20.3378 | 20.6600 | 20.8799 | 20.9758 | 20.9957 | 20.9932 | 20.9364 | 20.6328 | 20.1713 | 19.8053 (87) |
| Th 2                                                                        | 19.9331      | 19.9355 | 19.9378 | 19.9488 | 19.9509 | 19.9605 | 19.9605 | 19.9623 | 19.9568 | 19.9509 | 19.9467 | 19.9424 (88) |
| util rest of house                                                          | 0.9933       | 0.9825  | 0.9536  | 0.8731  | 0.7162  | 0.5048  | 0.3346  | 0.3744  | 0.6378  | 0.9099  | 0.9841  | 0.9950 (89)  |
| MIT 2                                                                       | 18.4096      | 18.7119 | 19.1232 | 19.5718 | 19.8422 | 19.9457 | 19.9590 | 19.9597 | 19.9113 | 19.5488 | 18.8971 | 18.3613 (90) |
| Living area fraction                                                        | 19.0664      | 19.3253 | 19.6797 | 20.0704 | 20.3176 | 20.4177 | 20.4340 | 20.4332 | 20.3810 | 20.0454 | 19.4809 | 19.0229 (92) |
| Temperature adjustment                                                      | 19.0664      | 19.3253 | 19.6797 | 20.0704 | 20.3176 | 20.4177 | 20.4340 | 20.4332 | 20.3810 | 20.0454 | 19.4809 | 19.0229 (93) |
| adjusted MIT                                                                | 19.0664      | 19.3253 | 19.6797 | 20.0704 | 20.3176 | 20.4177 | 20.4340 | 20.4332 | 20.3810 | 20.0454 | 19.4809 | 19.0229 (93) |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 0.9914    | 0.9794    | 0.9503    | 0.8769   | 0.7382   | 0.5441   | 0.3809   | 0.4224   | 0.6743   | 0.9127       | 0.9816   | 0.9936 (94)    |
| Ext temp.            | 500.2966  | 597.8508  | 670.1137  | 691.7893 | 617.1611 | 444.4586 | 298.6788 | 312.6867 | 462.8706 | 541.8395     | 498.1606 | 469.9581 (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Month fracti         | 1190.2402 | 1159.8384 | 1057.0747 | 885.5330 | 681.6656 | 455.4733 | 300.1674 | 315.1596 | 493.7039 | 747.1442     | 983.6980 | 1183.1778 (97) |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating        | 513.3180  | 377.6556  | 287.8990  | 139.4955 | 47.9913  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 152.7467     | 349.5869 | 530.6354 (98)  |
| Space heating per m2 |           |           |           |          |          |          |          |          |          |              |          | 2399.3285 (98) |
|                      |           |           |           |          |          |          |          |          |          | (98) / (4) = |          | 35.2324 (99)   |

#### 8c. Space cooling requirement

Not applicable

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |          | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |          | 2566.1267 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |                 |
| Space heating requirement                                             | 513.3180 | 377.6556 | 287.8990 | 139.4955 | 47.9913  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 152.7467 | 349.5869 | 530.6354 | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000  | (210)           |
| Space heating fuel (main heating system)                              | 549.0032 | 403.9098 | 307.9134 | 149.1930 | 51.3276  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 163.3654 | 373.8897 | 567.5245 | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (215)           |
| Water heating requirement                                             | 168.2495 | 147.9322 | 154.5052 | 137.3161 | 133.7052 | 118.2348 | 112.3764 | 124.9323 | 125.2194 | 142.4471 | 152.1163 | 163.8008 | (64)            |
| Efficiency of water heater (217)m                                     | 87.6004  | 87.2088  | 86.4517  | 84.8558  | 82.3724  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.0002  | 86.9645  | 87.7255  | (216)           |
| Fuel for water heating, kWh/month                                     | 192.0646 | 169.6300 | 178.7186 | 161.8228 | 162.3181 | 148.1639 | 140.8225 | 156.5567 | 156.9166 | 167.5844 | 174.9177 | 186.7198 | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          |          | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          |          | 2566.1267 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |          |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          |          | 30.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          |          | 75.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          |          | 303.7325 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          |          | 4941.0950 (238) |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2566.1267          | 0.2160                        | 554.2834 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1996.2358          | 0.2160                        | 431.1869 (264)           |
| Space and water heating                                                                           |                    |                               | 985.4703 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 303.7325           | 0.5190                        | 157.6372 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1182.0325 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 14.4709 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3148 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5716 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (14.4709 * 1.00) + 2.3148 + 0.5716, rounded to 2 d.p. |                    |                               | 17.3600 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-4-01                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be Lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 84 B                                                                    | DER           | 15.50   | TER            | 16.29      |
| Environmental                      | 88 B                                                                    | % DER<TER     | 4.87    |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.16                                                                    | DFEE          | 46.01   | TFEE           | 49.65      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 7.32    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Top-floor flat, total floor area 92 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 16.29 kgCO<sub>2</sub>/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 15.50 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)49.6 kWh/m<sup>2</sup>/yr

Dwelling Fabric Energy Efficiency (DFEE)46.0 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.11 (max. 0.20) | 0.11 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system: None

#### 5 Cylinder insulation

|                             |                                     |
|-----------------------------|-------------------------------------|
| Hot water storage           | Nominal cylinder loss: 0.09 kWh/day |
| Permitted by DBSCG 0.32     | OK                                  |
| Primary pipework insulated: | No primary pipework                 |

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and TRVsOK

Hot water controls: No cylinderstat

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.53   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 94%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |                                    |      |
|-----------------------------------|------------------------------------|------|
| Overheating risk (Thames Valley): | High                               | Fail |
| Based on:                         |                                    |      |
| Overshading:                      | Average                            |      |
| Windows facing North East:        | 12.22 m <sup>2</sup> , No overhang |      |
| Windows facing North West:        | 16.76 m <sup>2</sup> , No overhang |      |
| Air change rate:                  | 0.50 ach                           |      |
| Blinds/curtains:                  | None                               |      |

#### 10 Key features

|                    |                                      |
|--------------------|--------------------------------------|
| Party wall U-value | 0.00 W/m <sup>2</sup> K              |
| Roof U-value       | 0.11 W/m <sup>2</sup> K              |
| Air permeability   | 3.0 m <sup>3</sup> /m <sup>2</sup> h |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 91.9000 (1b)              | x 2.5000 (2b)                   | = 229.7500 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 91.9000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 229.7500 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000      | (6a)   |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000      | (6b)   |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000      | (7a)   |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000      | (7b)   |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000      | (7c)   |        |        |               |
|                                                                                              |                              |        |           |        |        |        | Air changes per hour        |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000      | (8)    |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes         |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000      |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500      | (18)   |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 2           | (19)   |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500      | (20)   |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275      | (21)   |        |        |               |
|                                                                                              |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2631                       | 0.2599 | 0.2567    | 0.2408 | 0.2376 | 0.2216 | 0.2216                      | 0.2184      | 0.2280 | 0.2376 | 0.2439 | 0.2503 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364      |                                      | (27)            |
| W02 (Uw = 1.40)                                                |                         |                            | 16.7600                   | 1.3258                        | 22.2197      |                                      | (27)            |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                      | (26a)           |
| W31 (Uw = 1.40)                                                |                         |                            | 3.8200                    | 1.3258                        | 5.0644       |                                      | (27)            |
| External Wall 1                                                | 54.9000                 | 28.9800                    | 25.9200                   | 0.1500                        | 3.8880       | 140.0000                             | 3628.8000 (29a) |
| Corridor wall                                                  | 7.6000                  | 2.1000                     | 5.5000                    | 0.1409                        | 0.7750       | 110.0000                             | 605.0000 (29a)  |
| roof                                                           | 91.9000                 |                            | 91.9000                   | 0.1100                        | 10.1090      | 9.0000                               | 827.1000 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 154.4000                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 56.1325      |                                      | (33)            |
| Party Wall 1                                                   |                         |                            | 38.9000                   | 0.0000                        | 0.0000       | 140.0000                             | 5446.0000 (32)  |
| Party Floor                                                    |                         |                            | 91.9000                   |                               |              | 80.0000                              | 7352.0000 (32d) |
| Internal Wall                                                  |                         |                            | 163.4000                  |                               |              | 9.0000                               | 1470.6000 (32c) |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 19329.5000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 210.3319 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 6.4040 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 62.5365 (37)    |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 19.9447 | 19.7031 | 19.4614 | 18.2531 | 18.0114 | 16.8031 | 16.8031 | 16.5614 | 17.2864 | 18.0114 | 18.4947 | 18.9781 (38) |
| Heat transfer coeff       | 82.4812 | 82.2395 | 81.9979 | 80.7895 | 80.5479 | 79.3395 | 79.3395 | 79.0979 | 79.8229 | 80.5479 | 81.0312 | 81.5145 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 80.7291 (39) |
| HLP                       | 0.8975  | 0.8949  | 0.8923  | 0.8791  | 0.8765  | 0.8633  | 0.8633  | 0.8607  | 0.8686  | 0.8765  | 0.8817  | 0.8870 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.8784 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |               |
|------------------------------------------|---------------|
| Assumed occupancy                        | 2.6508 (42)   |
| Average daily hot water use (litres/day) | 102.2711 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy conte                                                    | 112.4982 | 108.4074 | 104.3165 | 100.2257 | 96.1348  | 92.0440  | 92.0440  | 96.1348  | 100.2257 | 104.3165            | 108.4074 | 112.4982 (44)  |
| Energy content (annual)                                         | 166.8316 | 145.9120 | 150.5681 | 131.2689 | 125.9556 | 108.6901 | 100.7174 | 115.5747 | 116.9550 | 136.2998            | 148.7819 | 161.5675 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1609.1225 (45) |
|                                                                 | 25.0247  | 21.8868  | 22.5852  | 19.6903  | 18.8933  | 16.3035  | 15.1076  | 17.3362  | 17.5433  | 20.4450             | 22.3173  | 24.2351 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |          |          |                     |          |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |          |          |                     |          | 0.0115 (51)    |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |          |          |                     |          | 3.9149 (52)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (53)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.0904 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 2.8029   | 2.5316   | 2.8029   | 2.7124   | 2.8029   | 2.7124   | 2.8029   | 2.8029   | 2.7124   | 2.8029              | 2.7124   | 2.8029 (56)    |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 2.8029   | 2.5316   | 2.8029   | 2.7124   | 2.8029   | 2.7124   | 2.8029   | 2.8029   | 2.7124   | 2.8029              | 2.7124   | 2.8029 (57)    |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 192.8968 | 169.4548 | 176.6333 | 156.4933 | 152.0209 | 133.9146 | 126.7826 | 141.6399 | 142.1794 | 162.3650            | 174.0063 | 187.6327 (62)  |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 192.8968 | 169.4548 | 176.6333 | 156.4933 | 152.0209 | 133.9146 | 126.7826 | 141.6399 | 142.1794 | 162.3650            | 174.0063 | 187.6327 (64)  |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 76.3237  | 67.3500  | 70.9161  | 63.8265  | 62.7325  | 56.3190  | 54.3407  | 59.2808  | 59.0671  | 66.1719             | 69.6495  | 74.5734 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |                |
| (66)m                                                                               | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 21.6217   | 19.2042   | 15.6179   | 11.8238   | 8.8384    | 7.4618    | 8.0627    | 10.4802   | 14.0665   | 17.8607   | 20.8460   | 22.2227 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 242.5301  | 245.0468  | 238.7048  | 225.2034  | 208.1603  | 192.1422  | 181.4412  | 178.9245  | 185.2665  | 198.7679  | 215.8110  | 231.8290 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542 (69)   |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 (71) |
| Water heating gains (Table 5)                                                       |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 102.5856  | 100.2232  | 95.3173   | 88.6479   | 84.3178   | 78.2209   | 73.0386   | 79.6785   | 82.0376   | 88.9407   | 96.7355   | 100.2331 (72)  |
| Total internal gains                                                                |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 429.5001  | 427.2369  | 412.4027  | 388.4377  | 364.0792  | 340.5875  | 325.3051  | 331.8458  | 344.1333  | 368.3319  | 396.1551  | 417.0474 (73)  |

#### 6. Solar gains

|             |          |          |            |               |               |           |              |          |          |          |          |               |
|-------------|----------|----------|------------|---------------|---------------|-----------|--------------|----------|----------|----------|----------|---------------|
| [Jan]       |          |          |            |               |               |           |              |          |          |          |          |               |
|             |          | Area     | Solar flux | g             | FF            | Access    | Gains        |          |          |          |          |               |
|             |          | m2       | Table 6a   | Specific data | Specific data | factor    | W            |          |          |          |          |               |
|             |          |          | W/m2       | or Table 6b   | or Table 6c   | Table 6d  |              |          |          |          |          |               |
| Northeast   |          | 8.4000   | 11.2829    | 0.3700        | 0.8900        | 0.7700    | 21.6285 (75) |          |          |          |          |               |
| Northwest   |          | 16.7600  | 11.2829    | 0.5600        | 0.6800        | 0.7700    | 49.9030 (81) |          |          |          |          |               |
| Northeast   |          | 3.8200   | 11.2829    | 0.3700        | 0.8800        | 0.7700    | 9.7253 (75)  |          |          |          |          |               |
| Solar gains | 81.2568  | 165.4006 | 297.9992   | 489.4003      | 657.8501      | 701.3378  | 656.0871     | 523.0403 | 363.1167 | 202.1326 | 102.2421 | 66.3584 (83)  |
| Total gains | 510.7569 | 592.6375 | 710.4019   | 877.8380      | 1021.9293     | 1041.9253 | 981.3923     | 854.8861 | 707.2500 | 570.4645 | 498.3972 | 483.4058 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 65.0973 | 65.2886 | 65.4810 | 66.4604 | 66.6598 | 67.6750 | 67.6750 | 67.8818 | 67.2653                   | 66.6598 | 66.2622 | 65.8693      |
| alpha                                                                       | 5.3398  | 5.3526  | 5.3654  | 5.4307  | 5.4440  | 5.5117  | 5.5117  | 5.5255  | 5.4844                    | 5.4440  | 5.4175  | 5.3913       |
| util living area                                                            | 0.9968  | 0.9925  | 0.9736  | 0.8861  | 0.6913  | 0.4825  | 0.3549  | 0.4234  | 0.7243                    | 0.9570  | 0.9932  | 0.9976 (86)  |
| MIT                                                                         | 19.9291 | 20.0919 | 20.3859 | 20.7527 | 20.9472 | 20.9938 | 20.9991 | 20.9977 | 20.9522                   | 20.6385 | 20.2187 | 19.9032 (87) |
| Th 2                                                                        | 20.1696 | 20.1719 | 20.1741 | 20.1853 | 20.1875 | 20.1988 | 20.1988 | 20.2010 | 20.1943                   | 20.1875 | 20.1831 | 20.1786 (88) |
| util rest of house                                                          | 0.9960  | 0.9904  | 0.9665  | 0.8600  | 0.6421  | 0.4241  | 0.2907  | 0.3510  | 0.6576                    | 0.9414  | 0.9910  | 0.9970 (89)  |
| MIT 2                                                                       | 18.7240 | 18.9627 | 19.3880 | 19.9010 | 20.1378 | 20.1945 | 20.1984 | 20.1999 | 20.1554                   | 19.7607 | 19.1567 | 18.6929 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3297 (91)  |
| MIT                                                                         | 19.1213 | 19.3350 | 19.7170 | 20.1818 | 20.4046 | 20.4581 | 20.4624 | 20.4630 | 20.4181                   | 20.0501 | 19.5068 | 19.0919 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.1213 | 19.3350 | 19.7170 | 20.1818 | 20.4046 | 20.4581 | 20.4624 | 20.4630 | 20.4181                   | 20.0501 | 19.5068 | 19.0919 (93) |

#### 8. Space heating requirement

|                  |           |           |           |          |          |          |          |          |          |          |           |                |
|------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Utilisation      | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec            |
|                  | 0.9945    | 0.9877    | 0.9617    | 0.8599   | 0.6557   | 0.4432   | 0.3119   | 0.3749   | 0.6770   | 0.9383   | 0.9886    | 0.9958 (94)    |
| Useful gains     | 507.9317  | 585.3460  | 683.1694  | 754.8636 | 670.0946 | 461.7515 | 306.0934 | 320.4689 | 478.8344 | 535.2426 | 492.7198  | 481.3682 (95)  |
| Ext temp.        | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000 (96)    |
| Heat loss rate W |           |           |           |          |          |          |          |          |          |          |           |                |
|                  | 1222.4820 | 1187.1261 | 1083.7689 | 911.4508 | 701.1401 | 464.7757 | 306.4384 | 321.3709 | 504.3283 | 761.1856 | 1005.3398 | 1213.9101 (97) |
| Month fracti     | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000 (97a)   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                      |          |          |          |          |         |        |        |        |        |          |          |                           |
|----------------------|----------|----------|----------|----------|---------|--------|--------|--------|--------|----------|----------|---------------------------|
| Space heating kWh    | 531.6254 | 404.3963 | 298.0461 | 112.7428 | 23.0979 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 168.1016 | 369.0864 | 545.0111 (98)             |
| Space heating        |          |          |          |          |         |        |        |        |        |          |          | 2452.1076 (98)            |
| Space heating per m2 |          |          |          |          |         |        |        |        |        |          |          | (98) / (4) = 26.6823 (99) |

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 2452.1076 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 2697.3183 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1916.0199 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 2107.6219 (310a) |
| Electricity used for heat distribution                                                  | 48.0494 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 185.6954 (330a)  |
| Total electricity for the above, kWh/year                                               | 185.6954 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 381.8466 (332)   |
| Total delivered energy for all uses                                                     | 5372.4823 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |        |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|--------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000                  | (367a) |
| Space heating from Boilers                                                                 | 5117.0823          | 0.2160                        | 1105.2898                | (367)  |
| Electrical energy for heat distribution                                                    | 48.0494            | 0.5190                        | 24.9376                  | (372)  |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 1130.2274                | (373)  |
| Space and water heating                                                                    |                    |                               | 1130.2274                | (376)  |
| Pumps and fans                                                                             | 185.6954           | 0.5190                        | 96.3759                  | (378)  |
| Energy for lighting                                                                        | 381.8466           | 0.5190                        | 198.1784                 | (379)  |
| Total CO2, kg/year                                                                         |                    |                               | 1424.7817                | (383)  |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 15.5000                  | (384)  |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |         |     |
|---------------------------------------------------------------------------------|-----|---------|-----|
| DER                                                                             |     | 15.5000 | ZC1 |
| Total Floor Area                                                                | TFA | 91.9000 |     |
| Assumed number of occupants                                                     | N   | 2.6508  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |     | 15.6385 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 1.9872  | ZC3 |
| Total CO2 emissions                                                             |     | 33.1257 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |     | 33.1257 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 91.9000 (1b)              | x 2.5000 (2b)                   | = 229.7500 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 91.9000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 229.7500 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total    | m <sup>3</sup> per hour    |
|------------------------------------------------------|------------------------------|----------------------|-------|----------|----------------------------|
| Number of chimneys                                   | 0                            | 0                    | 0     | 0 * 40 = | 0.0000 (6a)                |
| Number of open flues                                 | 0                            | 0                    | 0     | 0 * 20 = | 0.0000 (6b)                |
| Number of intermittent fans                          |                              |                      |       | 3 * 10 = | 30.0000 (7a)               |
| Number of passive vents                              |                              |                      |       | 0 * 10 = | 0.0000 (7b)                |
| Number of flueless gas fires                         |                              |                      |       | 0 * 40 = | 0.0000 (7c)                |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |          | 30.0000 / (5) = 0.1306 (8) |
| Pressure test                                        |                              |                      |       |          | Yes                        |
| Measured/design AP50                                 |                              |                      |       |          | 5.0000                     |
| Infiltration rate                                    |                              |                      |       |          | 0.3806 (18)                |
| Number of sides sheltered                            |                              |                      |       |          | 2 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |          | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |          | 0.3235 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4125 | 0.4044 | 0.3963 | 0.3558 | 0.3478 | 0.3073 | 0.3073 | 0.2992 | 0.3235 | 0.3478 | 0.3639 | 0.3801 (22b) |
| Effective ac    | 0.5851 | 0.5818 | 0.5785 | 0.5633 | 0.5605 | 0.5472 | 0.5472 | 0.5448 | 0.5523 | 0.5605 | 0.5662 | 0.5722 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 20.8700                   | 1.3258                        | 27.6686      |                                | (27)          |
| External Wall 1                                                | 54.9000                 | 20.8700                    | 34.0300                   | 0.1800                        | 6.1254       |                                | (29a)         |
| Corridor wall                                                  | 7.6000                  | 2.1000                     | 5.5000                    | 0.1800                        | 0.9900       |                                | (29a)         |
| roof                                                           | 91.9000                 |                            | 91.9000                   | 0.1300                        | 11.9470      |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 154.4000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 49.2510      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 4.1715 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 53.4225 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 44.3576 | 44.1072 | 43.8617 | 42.7088 | 42.4931 | 41.4890 | 41.4890 | 41.3030 | 41.8757 | 42.4931 | 42.9295 | 43.3857 (38) |
| Heat transfer coeff       | 97.7801 | 97.5296 | 97.2842 | 96.1313 | 95.9156 | 94.9114 | 94.9114 | 94.7255 | 95.2982 | 95.9156 | 96.3519 | 96.8081 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 96.1302 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.0640 | 1.0613 | 1.0586 | 1.0460 | 1.0437 | 1.0328 | 1.0328 | 1.0307 | 1.0370 | 1.0437 | 1.0484 | 1.0534 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.0460 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

| Assumed occupancy                                           |          |          |          |          |          |          |         |          |          |          |          | 2.6508 (42)                       |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|----------|-----------------------------------|
| Average daily hot water use (litres/day)                    |          |          |          |          |          |          |         |          |          |          |          | 97.1575 (43)                      |
|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov      | Dec                               |
| Daily hot water use                                         | 106.8733 | 102.9870 | 99.1007  | 95.2144  | 91.3281  | 87.4418  | 87.4418 | 91.3281  | 95.2144  | 99.1007  | 102.9870 | 106.8733 (44)                     |
| Energy conte                                                | 158.4900 | 138.6164 | 143.0397 | 124.7055 | 119.6579 | 103.2556 | 95.6815 | 109.7959 | 111.1073 | 129.4848 | 141.3428 | 153.4891 (45)                     |
| Energy content (annual)                                     |          |          |          |          |          |          |         |          |          |          |          | Total = Sum(45)m = 1528.6664 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 23.7735  | 20.7925  | 21.4560  | 18.7058  | 17.9487  | 15.4883  | 14.3522 | 16.4694  | 16.6661  | 19.4227  | 21.2014  | 23.0234 (46)                      |
| Water storage loss:                                         |          |          |          |          |          |          |         |          |          |          |          | 2.0000 (47)                       |
| Store volume                                                |          |          |          |          |          |          |         |          |          |          |          | 0.2388 (48)                       |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |          |         |          |          |          |          | 0.5400 (49)                       |
| Temperature factor from Table 2b                            |          |          |          |          |          |          |         |          |          |          |          | 0.1290 (55)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |          |         |          |          |          |          |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 185.7501 | 163.2384 | 170.2998 | 151.0862 | 146.9180 | 129.6364 | 122.9417 | 137.0561 | 137.4880 | 156.7449 | 167.7236 | 180.7492 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 185.7501 | 163.2384 | 170.2998 | 151.0862 | 146.9180 | 129.6364 | 122.9417 | 137.0561 | 137.4880 | 156.7449 | 167.7236 | 180.7492 (64) |
| Heat gains from water heating, kWh/month                        | 74.5060  | 65.7876  | 69.3688  | 62.5692  | 61.5944  | 55.4371  | 53.6222  | 58.3153  | 58.0478  | 64.8618  | 68.1011  | 72.8432 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 21.6173   | 19.2003   | 15.6148   | 11.8214   | 8.8366    | 7.4602    | 8.0611    | 10.4781   | 14.0636   | 17.8570   | 20.8418   | 22.2182 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 242.5301  | 245.0468  | 238.7048  | 225.2034  | 208.1603  | 192.1422  | 181.4412  | 178.9245  | 185.2665  | 198.7679  | 215.8110  | 231.8290 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542 (69)   |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 (71) |
| Water heating gains (Table 5)                                                       | 100.1425  | 97.8982   | 93.2376   | 86.9017   | 82.7881   | 76.9960   | 72.0729   | 78.3807   | 80.6219   | 87.1799   | 94.5849   | 97.9076 (72)   |
| Total internal gains                                                                | 430.0526  | 427.9080  | 413.3199  | 389.6891  | 365.5477  | 342.3611  | 327.3378  | 333.5459  | 345.7147  | 369.5674  | 397.0003  | 417.7174 (73)  |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| Northeast   |          |          |          | 8.8000     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 30.3443 (75) |          |          |               |
| Northwest   |          |          |          | 12.0700    | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 41.6199 (81) |          |          |               |
|             |          |          |          |            |                                |                                   |                                    |                              |              |          |          |               |
| Solar gains | 71.9642  | 146.4852 | 263.9198 | 433.4322   | 582.6179                       | 621.1323                          | 581.0565                           | 463.2250                     | 321.5904     | 179.0166 | 90.5496  | 58.7696 (83)  |
| Total gains | 502.0169 | 574.3933 | 677.2397 | 823.1213   | 948.1656                       | 963.4935                          | 908.3943                           | 796.7709                     | 667.3051     | 548.5840 | 487.5499 | 476.4870 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 65.2684 | 65.4359 | 65.6010 | 66.3878 | 66.5371 | 67.2411 | 67.2411 | 67.3731 | 66.9681                   | 66.5371 | 66.2358 | 65.9236      |
| alpha                                                                       | 5.3512  | 5.3624  | 5.3734  | 5.4259  | 5.4358  | 5.4827  | 5.4827  | 5.4915  | 5.4645                    | 5.4358  | 5.4157  | 5.3949       |
| util living area                                                            | 0.9987  | 0.9971  | 0.9898  | 0.9498  | 0.8177  | 0.6109  | 0.4562  | 0.5377  | 0.8390                    | 0.9822  | 0.9973  | 0.9991 (86)  |
| MIT                                                                         | 19.8252 | 19.9639 | 20.2307 | 20.6027 | 20.8784 | 20.9803 | 20.9967 | 20.9923 | 20.8981                   | 20.5220 | 20.1118 | 19.8034 (87) |
| Th 2                                                                        | 20.0304 | 20.0326 | 20.0348 | 20.0451 | 20.0471 | 20.0561 | 20.0561 | 20.0578 | 20.0526                   | 20.0471 | 20.0432 | 20.0391 (88) |
| util rest of house                                                          | 0.9983  | 0.9961  | 0.9862  | 0.9321  | 0.7654  | 0.5291  | 0.3602  | 0.4323  | 0.7694                    | 0.9731  | 0.9962  | 0.9987 (89)  |
| MIT 2                                                                       | 18.4536 | 18.6577 | 19.0472 | 19.5811 | 19.9328 | 20.0437 | 20.0549 | 20.0547 | 19.9703                   | 19.4789 | 18.8821 | 18.4279 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3297 (91)  |
| MIT                                                                         | 18.9058 | 19.0884 | 19.4374 | 19.9179 | 20.2446 | 20.3525 | 20.3654 | 20.3638 | 20.2762                   | 19.8228 | 19.2875 | 18.8814 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.9058 | 19.0884 | 19.4374 | 19.9179 | 20.2446 | 20.3525 | 20.3654 | 20.3638 | 20.2762                   | 19.8228 | 19.2875 | 18.8814 (93) |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |              |           |                |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|--------------|-----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov       | Dec            |
| Useful gains         | 500.8051  | 571.3717  | 665.8236  | 764.8955  | 736.8584 | 535.1999 | 356.0749 | 372.2644 | 525.6682 | 532.3126     | 485.1003  | 475.6150 (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000    | 4.2000 (96)    |
| Heat loss rate W     | 1428.1580 | 1383.7862 | 1258.6020 | 1059.1653 | 819.5555 | 545.9803 | 357.3803 | 375.4764 | 588.5820 | 884.6090     | 1174.2904 | 1421.2815 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000    | 1.0000 (97a)   |
| Space heating kWh    | 689.9505  | 545.9426  | 441.0271  | 211.8743  | 61.5266  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 262.1085     | 496.2169  | 703.5758 (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |              |           | 3412.2225 (98) |
| Space heating per m2 |           |           |           |           |          |          |          |          |          | (98) / (4) = |           | 37.1297 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 3649.4358 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 689.9505 | 545.9426 | 441.0271 | 211.8743 | 61.5266  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 262.1085 | 496.2169 | 703.5758  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 737.9150 | 583.8958 | 471.6868 | 226.6035 | 65.8039  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 280.3300 | 530.7133 | 752.4875  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 185.7501 | 163.2384 | 170.2998 | 151.0862 | 146.9180 | 129.6364 | 122.9417 | 137.0561 | 137.4880 | 156.7449 | 167.7236 | 180.7492  | (64)            |
| Efficiency of water heater (217)m                                     | 87.9972  | 87.7905  | 87.2413  | 85.7158  | 82.6856  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 86.1759  | 87.5350  | 79.8000   | (216)           |
| Fuel for water heating, kWh/month                                     | 211.0864 | 185.9409 | 195.2055 | 176.2641 | 177.6827 | 162.4516 | 154.0622 | 171.7495 | 172.2908 | 181.8896 | 191.6075 | 205.1965  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2185.4273 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3649.4358 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 381.7691  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 6291.6322 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 3649.4358          | 0.2160                        | 788.2781 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2185.4273          | 0.2160                        | 472.0523 (264)           |
| Space and water heating                                                                           |                    |                               | 1260.3304 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 381.7691           | 0.5190                        | 198.1382 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1497.3936 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 13.7142 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.1560 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.4236 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (13.7142 * 1.00) + 2.1560 + 0.4236, rounded to 2 d.p. |                    |                               | 16.2900 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-4-02                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be Lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 86 B                                                                    | DER           | 12.20   | TER            | 14.37      |
| Environmental                      | 90 B                                                                    | % DER<TER     | 15.12   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.92                                                                    | DFEE          | 32.08   | TFEE           | 39.37      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 18.52   |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Top-floor flat, total floor area 92 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 14.37 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.20 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)39.4 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)32.1 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.11 (max. 0.20) | 0.11 (max. 0.35) | OK |
| Openings      | 1.25 (max. 2.00) | 1.25 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Nominal cylinder loss: 0.09 kWh/day  
Permitted by DBSCG 0.32 OK  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK  
Hot water controls: No cylinderstat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing South East: 16.76 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Roof U-value 0.11 W/m<sup>2</sup>K  
Thermal bridging y-value 0.039 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 91.9000 (1b)              | x 2.5000 (2b)                   | = 229.7500 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 91.9000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 229.7500 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m3 per hour               |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 2 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.8500 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1275 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1626 | 0.1594 | 0.1562 | 0.1403 | 0.1371 | 0.1211 | 0.1211 | 0.1179 | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 79.9000 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2631 | 0.2599 | 0.2567 | 0.2408 | 0.2376 | 0.2216 | 0.2216 | 0.2184 | 0.2280 | 0.2376 | 0.2439 | 0.2503 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W02 (Uw = 1.25)                                                |                         |                            | 16.7600                   | 1.1905                        | 19.9524      |                                | (27)                                                 |
| door                                                           |                         |                            | 2.1000                    | 1.2500                        | 2.6250       |                                | (26a)                                                |
| External Wall 1                                                | 63.4000                 | 16.7600                    | 46.6400                   | 0.1500                        | 6.9960       | 140.0000                       | 6529.6000 (29a)                                      |
| Corridor wall                                                  | 3.5000                  | 2.1000                     | 1.4000                    | 0.1409                        | 0.1973       | 110.0000                       | 154.0000 (29a)                                       |
| roof                                                           | 91.9000                 |                            | 91.9000                   | 0.1100                        | 10.1090      | 9.0000                         | 827.1000 (30)                                        |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 158.8000                  |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      | 39.8797                       |              |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 52.3000                   | 0.0000                        | 0.0000       | 140.0000                       | 7322.0000 (32)                                       |
| Party Floor                                                    |                         |                            | 91.9000                   |                               |              | 80.0000                        | 7352.0000 (32d)                                      |
| Internal Wall                                                  |                         |                            | 163.4000                  |                               |              | 9.0000                         | 1470.6000 (32c)                                      |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 23655.3000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 257.4026 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 6.1640 (36)                                          |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 46.0437 (37)                           |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 19.9447 | 19.7031 | 19.4614 | 18.2531 | 18.0114 | 16.8031 | 16.8031 | 16.5614 | 17.2864 | 18.0114 | 18.4947 | 18.9781 (38) |
| Heat transfer coeff       | 65.9884 | 65.7467 | 65.5051 | 64.2967 | 64.0551 | 62.8467 | 62.8467 | 62.6050 | 63.3300 | 64.0551 | 64.5384 | 65.0217 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 64.2363 (39) |
| HLP                       | 0.7180  | 0.7154  | 0.7128  | 0.6996  | 0.6970  | 0.6839  | 0.6839  | 0.6812  | 0.6891  | 0.6970  | 0.7023  | 0.7075 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.6990 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |          |          |          |          |          |          |          |          |               |
|------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Assumed occupancy                        |          |          |          |          |          |          |          |          |          |          |          | 2.6508 (42)   |
| Average daily hot water use (litres/day) |          |          |          |          |          |          |          |          |          |          |          | 102.2711 (43) |
| Daily hot water use                      | 112.4982 | 108.4074 | 104.3165 | 100.2257 | 96.1348  | 92.0440  | 92.0440  | 96.1348  | 100.2257 | 104.3165 | 108.4074 | 112.4982 (44) |
| Energy conte                             | 166.8316 | 145.9120 | 150.5681 | 131.2689 | 125.9556 | 108.6901 | 100.7174 | 115.5747 | 116.9550 | 136.2998 | 148.7819 | 161.5675 (45) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |               |                                          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|------------------------------------------|----------------|
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          |          |               | Total = Sum(45)m =                       | 1609.1225 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |               |                                          |                |
| 25.0247                                                         | 21.8868  | 22.5852  | 19.6903  | 18.8933  | 16.3035  | 15.1076  | 17.3362  | 17.5433  | 20.4450  | 22.3173  | 24.2351 (46)  |                                          |                |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |               |                                          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |               | 2.0000 (47)                              |                |
| b) If manufacturer declared loss factor is not known :          |          |          |          |          |          |          |          |          |          |          |               |                                          |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |          |          |          |          |          |          |          |          |          |          |               | 0.0115 (51)                              |                |
| Volume factor from Table 2a                                     |          |          |          |          |          |          |          |          |          |          |               | 3.9149 (52)                              |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |               | 1.0000 (53)                              |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |               | 0.0904 (55)                              |                |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |               |                                          |                |
| 2.8029                                                          | 2.5316   | 2.8029   | 2.7124   | 2.8029   | 2.7124   | 2.8029   | 2.8029   | 2.7124   | 2.8029   | 2.7124   | 2.8029 (56)   |                                          |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |               |                                          |                |
| 2.8029                                                          | 2.5316   | 2.8029   | 2.7124   | 2.8029   | 2.7124   | 2.8029   | 2.8029   | 2.7124   | 2.8029   | 2.7124   | 2.8029 (57)   |                                          |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |                                          |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |               |                                          |                |
| 192.8968                                                        | 169.4548 | 176.6333 | 156.4933 | 152.0209 | 133.9146 | 126.7826 | 141.6399 | 142.1794 | 162.3650 | 174.0063 | 187.6327 (62) |                                          |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |                                          |                |
|                                                                 |          |          |          |          |          |          |          |          |          |          |               | Solar input (sum of months) = Sum(63)m = | 0.0000 (63)    |
| Output from w/h                                                 | 192.8968 | 169.4548 | 176.6333 | 156.4933 | 152.0209 | 133.9146 | 126.7826 | 141.6399 | 142.1794 | 162.3650 | 174.0063      | 187.6327 (64)                            |                |
|                                                                 |          |          |          |          |          |          |          |          |          |          |               | Total per year (kWh/year) = Sum(64)m =   | 1916.0199 (64) |
| Heat gains from water heating, kWh/month                        | 76.3237  | 67.3500  | 70.9161  | 63.8265  | 62.7325  | 56.3190  | 54.3407  | 59.2808  | 59.0671  | 66.1719  | 69.6495       | 74.5734 (65)                             |                |

#### 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
|                                                                                     | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 22.1407   | 19.6652   | 15.9928   | 12.1076   | 9.0506    | 7.6409    | 8.2562    | 10.7318   | 14.4042   | 18.2894   | 21.3464   | 22.7561 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 242.5301  | 245.0468  | 238.7048  | 225.2034  | 208.1603  | 192.1422  | 181.4412  | 178.9245  | 185.2665  | 198.7679  | 215.8110  | 231.8290 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542 (69)   |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 (71) |
| Water heating gains (Table 5)                                                       | 102.5856  | 100.2232  | 95.3173   | 88.6479   | 84.3178   | 78.2209   | 73.0386   | 79.6785   | 82.0376   | 88.9407   | 96.7355   | 100.2331 (72)  |
| Total internal gains                                                                | 430.0191  | 427.6979  | 412.7776  | 388.7215  | 364.2914  | 340.7666  | 325.4987  | 332.0974  | 344.4709  | 368.7606  | 396.6555  | 417.5809 (73)  |

#### 6. Solar gains

| [Jan]       |          |          | Area     | Solar flux | g           | FF            | Access   | Gains         |          |          |          |               |
|-------------|----------|----------|----------|------------|-------------|---------------|----------|---------------|----------|----------|----------|---------------|
|             |          |          | m2       | Table 6a   | or Table 6b | Specific data | factor   | W             |          |          |          |               |
|             |          |          |          | W/m2       |             | or Table 6c   | Table 6d |               |          |          |          |               |
| Southeast   |          |          | 16.7600  | 36.7938    | 0.5600      | 0.6800        | 0.7700   | 162.7343 (77) |          |          |          |               |
| Solar gains | 162.7343 | 277.1968 | 379.2727 | 469.9373   | 526.3690    | 522.5625      | 503.8060 | 461.7055      | 410.6722 | 306.3615 | 194.9182 | 139.2667 (83) |
| Total gains | 592.7535 | 704.8947 | 792.0504 | 858.6589   | 890.6603    | 863.3292      | 829.3047 | 793.8029      | 755.1431 | 675.1221 | 591.5737 | 556.8476 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |          |          |          |          |          |          |          |          |          |              |
|-----------------------------------------------------------------------------|---------|---------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |          |          |          |          |          |          |          |          |          | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |          |          |          |          |          |          |          |          |          |              |
|                                                                             | Jan     | Feb     | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec          |
| tau                                                                         | 99.5768 | 99.9429 | 100.3116 | 102.1968 | 102.5823 | 104.5547 | 104.5547 | 104.9583 | 103.7567 | 102.5823 | 101.8141 | 101.0572     |
| alpha                                                                       | 7.6385  | 7.6629  | 7.6874   | 7.8131   | 7.8388   | 7.9703   | 7.9703   | 7.9972   | 7.9171   | 7.8388   | 7.7876   | 7.7371       |
| util living area                                                            | 0.9959  | 0.9847  | 0.9482   | 0.8383   | 0.6591   | 0.4653   | 0.3334   | 0.3627   | 0.5754   | 0.8809   | 0.9863   | 0.9973 (86)  |
| MIT                                                                         | 20.4465 | 20.6056 | 20.7847  | 20.9368  | 20.9906  | 20.9995  | 21.0000  | 20.9999  | 20.9973  | 20.9224  | 20.6597  | 20.4179 (87) |
| Th 2                                                                        | 20.3249 | 20.3272 | 20.3296  | 20.3412  | 20.3435  | 20.3551  | 20.3551  | 20.3574  | 20.3505  | 20.3435  | 20.3388  | 20.3342 (88) |
| util rest of house                                                          | 0.9947  | 0.9804  | 0.9350   | 0.8074   | 0.6159   | 0.4187   | 0.2846   | 0.3121   | 0.5227   | 0.8491   | 0.9817   | 0.9965 (89)  |
| MIT 2                                                                       | 19.5837 | 19.8149 | 20.0673  | 20.2739  | 20.3353  | 20.3548  | 20.3551  | 20.3574  | 20.3486  | 20.2625  | 19.9039  | 19.5497 (90) |
| Living area fraction                                                        | 19.8475 | 20.0567 | 20.2867  | 20.4766  | 20.5357  | 20.5519  | 20.5523  | 20.5539  | 20.5470  | 20.4643  | 20.1350  | 19.8151 (91) |
| MIT                                                                         | 19.8475 | 20.0567 | 20.2867  | 20.4766  | 20.5357  | 20.5519  | 20.5523  | 20.5539  | 20.5470  | 20.4643  | 20.1350  | 19.8151 (92) |
| Temperature adjustment                                                      |         |         |          |          |          |          |          |          |          |          |          | 0.0000       |
| adjusted MIT                                                                | 19.8475 | 20.0567 | 20.2867  | 20.4766  | 20.5357  | 20.5519  | 20.5523  | 20.5539  | 20.5470  | 20.4643  | 20.1350  | 19.8151 (93) |

#### 8. Space heating requirement

|                      | Jan                       | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
|----------------------|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation          | 0.9936                    | 0.9783   | 0.9341   | 0.8141   | 0.6287   | 0.4330   | 0.2995   | 0.3276   | 0.5388   | 0.8554   | 0.9800   | 0.9956 (94)    |
| Useful gains         | 588.9309                  | 689.6013 | 739.8243 | 699.0172 | 559.9598 | 373.7878 | 248.3761 | 260.0306 | 406.8413 | 577.4840 | 579.7237 | 554.4245 (95)  |
| Ext temp.            | 4.3000                    | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 1025.9550                 | 996.5020 | 903.0985 | 744.3359 | 565.9702 | 374.0579 | 248.3878 | 260.0538 | 408.2885 | 631.8572 | 841.2606 | 1015.3235 (97) |
| Month fracti         | 1.0000                    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 325.1459                  | 206.2372 | 121.4760 | 32.6295  | 4.4718   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 40.4536  | 188.3065 | 342.9089 (98)  |
| Space heating        |                           |          |          |          |          |          |          |          |          |          |          |                |
| Space heating per m2 | (98) / (4) = 13.7283 (99) |          |          |          |          |          |          |          |          |          |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

-----  
8c. Space cooling requirement  
-----

Not applicable

-----  
9b. Energy requirements  
-----

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1261.6294 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 1387.7923 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1916.0199 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 2107.6219 (310a) |
| Electricity used for heat distribution                                                  | 34.9541 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 185.6954 (330a)  |
| Total electricity for the above, kWh/year                                               | 185.6954 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 391.0125 (332)   |
| Total delivered energy for all uses                                                     | 4072.1221 (338)  |

-----  
12b. Carbon dioxide emissions - Community heating scheme  
-----

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 3722.4859          | 0.2160                        | 804.0570 (367)           |
| Electrical energy for heat distribution                                                    | 34.9541            | 0.5190                        | 18.1412 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 822.1982 (373)           |
| Space and water heating                                                                    |                    |                               | 822.1982 (376)           |
| Pumps and fans                                                                             | 185.6954           | 0.5190                        | 96.3759 (378)            |
| Energy for lighting                                                                        | 391.0125           | 0.5190                        | 202.9355 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1121.5095 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.2000 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 12.2000 ZC1 |
| Total Floor Area                                                                | TFA | 91.9000     |
| Assumed number of occupants                                                     | N   | 2.6508      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 15.6385 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 1.9872 ZC3  |
| Total CO2 emissions                                                             |     | 29.8257 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 29.8257 ZC8 |

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 91.9000 (1b)              | x 2.5000 (2b)                   | = 229.7500 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 91.9000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 229.7500 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total    | m3 per hour                |
|------------------------------------------------------|------------------------------|----------------------|-------|----------|----------------------------|
| Number of chimneys                                   | 0                            | 0                    | 0     | 0 * 40 = | 0.0000 (6a)                |
| Number of open flues                                 | 0                            | 0                    | 0     | 0 * 20 = | 0.0000 (6b)                |
| Number of intermittent fans                          |                              |                      |       | 3 * 10 = | 30.0000 (7a)               |
| Number of passive vents                              |                              |                      |       | 0 * 10 = | 0.0000 (7b)                |
| Number of flueless gas fires                         |                              |                      |       | 0 * 40 = | 0.0000 (7c)                |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |          | 30.0000 / (5) = 0.1306 (8) |
| Pressure test                                        |                              |                      |       |          | Yes                        |
| Measured/design AP50                                 |                              |                      |       |          | 5.0000                     |
| Infiltration rate                                    |                              |                      |       |          | 0.3806 (18)                |
| Number of sides sheltered                            |                              |                      |       |          | 2 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |          | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |          | 0.3235 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4125 | 0.4044 | 0.3963 | 0.3558 | 0.3478 | 0.3073 | 0.3073 | 0.2992 | 0.3235 | 0.3478 | 0.3639 | 0.3801 (22b) |
| Effective ac    | 0.5851 | 0.5818 | 0.5785 | 0.5633 | 0.5605 | 0.5472 | 0.5472 | 0.5448 | 0.5523 | 0.5605 | 0.5662 | 0.5722 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 16.7600                   | 1.3258                        | 22.2197      |                                | (27)          |
| External Wall 1                                                | 63.4000                 | 16.7600                    | 46.6400                   | 0.1800                        | 8.3952       |                                | (29a)         |
| Corridor wall                                                  | 3.5000                  | 2.1000                     | 1.4000                    | 0.1800                        | 0.2520       |                                | (29a)         |
| roof                                                           | 91.9000                 |                            | 91.9000                   | 0.1300                        | 11.9470      |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 158.8000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 45.3339      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 3.9315 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 49.2654 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 44.3576 | 44.1072 | 43.8617 | 42.7088 | 42.4931 | 41.4890 | 41.4890 | 41.3030 | 41.8757 | 42.4931 | 42.9295 | 43.3857 (38) |
| Heat transfer coeff       | 93.6230 | 93.3726 | 93.1271 | 91.9742 | 91.7585 | 90.7544 | 90.7544 | 90.5684 | 91.1411 | 91.7585 | 92.1949 | 92.6511 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 91.9732 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.0187 | 1.0160 | 1.0134 | 1.0008 | 0.9985 | 0.9875 | 0.9875 | 0.9855 | 0.9917 | 0.9985 | 1.0032 | 1.0082 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.0008 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

| Assumed occupancy                                           |          |          |          |          |          |          |         |          |          |          |          | 2.6508 (42)                       |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|----------|-----------------------------------|
| Average daily hot water use (litres/day)                    |          |          |          |          |          |          |         |          |          |          |          | 97.1575 (43)                      |
|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov      | Dec                               |
| Daily hot water use                                         | 106.8733 | 102.9870 | 99.1007  | 95.2144  | 91.3281  | 87.4418  | 87.4418 | 91.3281  | 95.2144  | 99.1007  | 102.9870 | 106.8733 (44)                     |
| Energy conte                                                | 158.4900 | 138.6164 | 143.0397 | 124.7055 | 119.6579 | 103.2556 | 95.6815 | 109.7959 | 111.1073 | 129.4848 | 141.3428 | 153.4891 (45)                     |
| Energy content (annual)                                     |          |          |          |          |          |          |         |          |          |          |          | Total = Sum(45)m = 1528.6664 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 23.7735  | 20.7925  | 21.4560  | 18.7058  | 17.9487  | 15.4883  | 14.3522 | 16.4694  | 16.6661  | 19.4227  | 21.2014  | 23.0234 (46)                      |
| Water storage loss:                                         |          |          |          |          |          |          |         |          |          |          |          | 2.0000 (47)                       |
| Store volume                                                |          |          |          |          |          |          |         |          |          |          |          | 0.2388 (48)                       |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |          |         |          |          |          |          | 0.5400 (49)                       |
| Temperature factor from Table 2b                            |          |          |          |          |          |          |         |          |          |          |          | 0.1290 (55)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |          |         |          |          |          |          |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 185.7501 | 163.2384 | 170.2998 | 151.0862 | 146.9180 | 129.6364 | 122.9417 | 137.0561 | 137.4880 | 156.7449 | 167.7236 | 180.7492 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 185.7501 | 163.2384 | 170.2998 | 151.0862 | 146.9180 | 129.6364 | 122.9417 | 137.0561 | 137.4880 | 156.7449 | 167.7236 | 180.7492 (64) |
| Heat gains from water heating, kWh/month                        | 74.5060  | 65.7876  | 69.3688  | 62.5692  | 61.5944  | 55.4371  | 53.6222  | 58.3153  | 58.0478  | 64.8618  | 68.1011  | 72.8432 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       |      |
| (66)m                                                                               | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 22.0382   | 19.5741   | 15.9187   | 12.0515   | 9.0086    | 7.6055    | 8.2180    | 10.6821   | 14.3374   | 18.2047   | 21.2475   | 22.6507   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 242.5301  | 245.0468  | 238.7048  | 225.2034  | 208.1603  | 192.1422  | 181.4412  | 178.9245  | 185.2665  | 198.7679  | 215.8110  | 231.8290  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | (69) |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | (71) |
| Water heating gains (Table 5)                                                       | 100.1425  | 97.8982   | 93.2376   | 86.9017   | 82.7881   | 76.9960   | 72.0729   | 78.3807   | 80.6219   | 87.1799   | 94.5849   | 97.9076   | (72) |
| Total internal gains                                                                | 430.4735  | 428.2818  | 413.6239  | 389.9192  | 365.7197  | 342.5064  | 327.4947  | 333.7499  | 345.9885  | 369.9150  | 397.4060  | 418.1500  | (73) |

#### 6. Solar gains

| [Jan]       |            |          |          |          |                                |          |                                   |          |                                    |          |                              |          |               |
|-------------|------------|----------|----------|----------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|---------------|
|             | Area<br>m2 |          |          |          | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W    |
| Southeast   | 16.7600    |          |          |          | 36.7938                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 188.4607 (77) |
| Solar gains | 188.4607   | 321.0183 | 439.2313 | 544.2289 | 609.5817                       | 605.1735 | 583.4519                          | 534.6957 | 475.5946                           | 354.7937 | 225.7325                     | 161.2831 | (83)          |
| Total gains | 618.9342   | 749.3002 | 852.8551 | 934.1481 | 975.3014                       | 947.6799 | 910.9465                          | 868.4456 | 821.5831                           | 724.7087 | 623.1385                     | 579.4331 | (84)          |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 68.1664 | 68.3492 | 68.5294 | 69.3884 | 69.5515 | 70.3211 | 70.3211 | 70.4655 | 70.0227 | 69.5515 | 69.2223 | 68.8815 |              |
| alpha                                                                       | 5.5444  | 5.5566  | 5.5686  | 5.6259  | 5.6368  | 5.6881  | 5.6881  | 5.6977  | 5.6682  | 5.6368  | 5.6148  | 5.5921  |              |
| util living area                                                            | 0.9964  | 0.9894  | 0.9700  | 0.9126  | 0.7873  | 0.5977  | 0.4361  | 0.4759  | 0.7180  | 0.9392  | 0.9910  | 0.9975  | (86)         |
| MIT                                                                         | 20.0088 | 20.2019 | 20.4518 | 20.7265 | 20.9102 | 20.9848 | 20.9978 | 20.9965 | 20.9590 | 20.7124 | 20.3028 | 19.9735 | (87)         |
| Th 2                                                                        | 20.0677 | 20.0700 | 20.0722 | 20.0827 | 20.0846 | 20.0937 | 20.0937 | 20.0954 | 20.0902 | 20.0846 | 20.0807 | 20.0765 | (88)         |
| util rest of house                                                          | 0.9953  | 0.9861  | 0.9607  | 0.8868  | 0.7337  | 0.5196  | 0.3475  | 0.3844  | 0.6410  | 0.9152  | 0.9876  | 0.9967  | (89)         |
| MIT 2                                                                       | 18.7487 | 19.0305 | 19.3897 | 19.7747 | 20.0018 | 20.0842 | 20.0929 | 20.0940 | 20.0604 | 19.7660 | 19.1866 | 18.7037 | (90)         |
| Living area fraction                                                        | 19.1340 | 19.3886 | 19.7145 | 20.0657 | 20.2795 | 20.3595 | 20.3696 | 20.3700 | 20.3352 | 20.0554 | 19.5279 | 19.0920 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.1340 | 19.3886 | 19.7145 | 20.0657 | 20.2795 | 20.3595 | 20.3696 | 20.3700 | 20.3352 | 20.0554 | 19.5279 | 19.0920 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |          |           |           |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec       |       |
| Useful gains         | 615.0299  | 736.4929  | 815.5216  | 827.8535  | 727.4292 | 514.6072 | 341.2955 | 358.1656 | 544.5672 | 662.6235 | 613.6705  | 576.7980  | (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000    | (96)  |
| Heat loss rate W     | 1388.8008 | 1352.8412 | 1230.6254 | 1026.9594 | 787.2451 | 522.7042 | 342.1102 | 359.5547 | 568.2814 | 867.6103 | 1145.7866 | 1379.7583 | (97)  |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000    | (97a) |
| Space heating kWh    | 575.6856  | 414.1861  | 308.8372  | 143.3562  | 44.5030  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 152.5102 | 383.1236  | 597.4024  | (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |          |           | 2619.6043 | (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |          |           | 28.5049   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2801.7159 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 575.6856 | 414.1861 | 308.8372 | 143.3562 | 44.5030  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 152.5102 | 383.1236 | 597.4024  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 615.7065 | 442.9798 | 330.3071 | 153.3222 | 47.5968  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 163.1125 | 409.7579 | 638.9331  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 185.7501 | 163.2384 | 170.2998 | 151.0862 | 146.9180 | 129.6364 | 122.9417 | 137.0561 | 137.4880 | 156.7449 | 167.7236 | 180.7492  | (64)            |
| Efficiency of water heater (217)m                                     | 87.6335  | 87.1948  | 86.3832  | 84.6742  | 82.0555  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.7409  | 86.9501  | 87.7665   | (216)           |
| Fuel for water heating, kWh/month                                     | 211.9624 | 187.2112 | 197.1447 | 178.4325 | 179.0471 | 162.4516 | 154.0622 | 171.7495 | 172.2908 | 184.9695 | 192.8963 | 205.9434  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2198.1613 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2801.7159 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 389.2012  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5464.0783 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2801.7159          | 0.2160                        | 605.1706 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2198.1613          | 0.2160                        | 474.8028 (264)           |
| Space and water heating                                                                           |                    |                               | 1079.9735 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 389.2012           | 0.5190                        | 201.9954 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1320.8939 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.7516 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.1980 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.4236 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.7516 * 1.00) + 2.1980 + 0.4236, rounded to 2 d.p. |                    |                               | 14.3700 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-4-04                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be Lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 83 B                                                                    | DER           | 17.95   | TER            | 19.24      |
| Environmental                      | 88 B                                                                    | % DER<TER     | 6.70    |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.85                                                                    | DFEE          | 47.59   | TFEE           | 53.54      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 11.12   |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Top-floor flat, total floor area 57 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 19.24 kgCO<sub>2</sub>/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 17.95 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)53.5 kWh/m<sup>2</sup>/yr

Dwelling Fabric Energy Efficiency (DFEE)47.6 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.11 (max. 0.20) | 0.11 (max. 0.35) | OK |
| Openings      | 1.38 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)

Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Nominal cylinder loss: 0.09 kWh/day

Permitted by DBSCG 0.32 OK

Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls:

No cylinderstat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%

Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system

Specific fan power: 0.53

Maximum 1.5 OK

MVHR efficiency: 94% OK

Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail

Based on:

Overshading: Average

Windows facing South: 7.61 m<sup>2</sup>, No overhang

Windows facing South West: 8.40 m<sup>2</sup>, No overhang

Air change rate: 0.50 ach

Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K

Roof U-value 0.11 W/m<sup>2</sup>K

Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 57.0000 (1b)              | x 2.5000 (2b)                   | = 142.5000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 142.5000 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |        |             |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |        |             |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)   |             |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 1                           | (19)   |             |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.9250 | (20)        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1388 | (21)        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1769                       | 0.1734 | 0.1700    | 0.1526 | 0.1492 | 0.1318 | 0.1318                      | 0.1283 | 0.1388      | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2774                       | 0.2739 | 0.2705    | 0.2531 | 0.2497 | 0.2323 | 0.2323                      | 0.2288 | 0.2393      | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                    | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K     | A x U<br>W/K | K-value<br>kJ/m2K                    | A x K<br>kJ/K   |
|------------------------------------------------------------|-------------|----------------|---------------|----------------------|--------------|--------------------------------------|-----------------|
| W03 (Uw = 1.40)                                            |             |                | 8.4000        | 1.3258               | 11.1364      |                                      | (27)            |
| W02 (Uw = 1.40)                                            |             |                | 7.6100        | 1.3258               | 10.0890      |                                      | (27)            |
| door                                                       |             |                | 2.1000        | 1.2500               | 2.6250       |                                      | (26a)           |
| External Wall 1                                            | 49.0000     | 16.0100        | 32.9900       | 0.1500               | 4.9485       | 140.0000                             | 4618.6000 (29a) |
| Corridor wall                                              | 3.5000      | 2.1000         | 1.4000        | 0.1409               | 0.1973       | 110.0000                             | 154.0000 (29a)  |
| roof                                                       | 57.0000     |                | 57.0000       | 0.1100               | 6.2700       | 9.0000                               | 513.0000 (30)   |
| Total net area of external elements Aum(A, m2)             |             |                | 109.5000      |                      |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                        |             |                |               | (26)...(30) + (32) = | 35.2662      |                                      | (33)            |
| Party Wall 1                                               |             |                | 22.2000       | 0.0000               | 0.0000       | 140.0000                             | 3108.0000 (32)  |
| Party Floor                                                |             |                | 57.0000       |                      |              | 80.0000                              | 4560.0000 (32d) |
| Internal Wall                                              |             |                | 84.5000       |                      |              | 9.0000                               | 760.5000 (32c)  |
| Heat capacity Cm = Sum(A x k)                              |             |                |               |                      |              | (28)...(30) + (32) + (32a)...(32e) = | 13714.1000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K          |             |                |               |                      |              |                                      | 240.5982 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) |             |                |               |                      |              |                                      | 15.3980 (36)    |
| Total fabric heat loss                                     |             |                |               |                      |              | (33) + (36) =                        | 50.6642 (37)    |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                  |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.8957 (42)      |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 83.3918 (43)     |
| Daily hot water use                      | Jan 91.7310 | Feb 88.3953 | Mar 85.0596 | Apr 81.7240 | May 78.3883 | Jun 75.0526 | Jul 75.0526 | Aug 78.3883 | Sep 81.7240 | Oct 85.0596 | Nov 88.3953 | Dec 91.7310 (44) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                                     |          |          |          |          |            |          |               |                               |               |          |            |                |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|------------|----------|---------------|-------------------------------|---------------|----------|------------|----------------|
| Energy conte                                                                        | 136.0344 | 118.9765 | 122.7731 | 107.0366 | 102.7042   | 88.6259  | 82.1249       | 94.2395                       | 95.3650       | 111.1388 | 121.3167   | 131.7420 (45)  |
| Energy content (annual)                                                             |          |          |          |          |            |          |               |                               |               | Total =  | Sum(45)m = | 1312.0776 (45) |
| Distribution loss (46)m = 0.15 x (45)m                                              |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | 20.4052  | 17.8465  | 18.4160  | 16.0555  | 15.4056    | 13.2939  | 12.3187       | 14.1359                       | 14.3048       | 16.6708  | 18.1975    | 19.7613 (46)   |
| Water storage loss:                                                                 |          |          |          |          |            |          |               |                               |               |          |            |                |
| Store volume                                                                        |          |          |          |          |            |          |               |                               |               |          |            | 2.0000 (47)    |
| b) If manufacturer declared loss factor is not known :                              |          |          |          |          |            |          |               |                               |               |          |            |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)                          |          |          |          |          |            |          |               |                               |               |          |            | 0.0115 (51)    |
| Volume factor from Table 2a                                                         |          |          |          |          |            |          |               |                               |               |          |            | 3.9149 (52)    |
| Temperature factor from Table 2b                                                    |          |          |          |          |            |          |               |                               |               |          |            | 1.0000 (53)    |
| Enter (49) or (54) in (55)                                                          |          |          |          |          |            |          |               |                               |               |          |            | 0.0904 (55)    |
| Total storage loss                                                                  |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | 2.8029   | 2.5316   | 2.8029   | 2.7124   | 2.8029     | 2.7124   | 2.8029        | 2.8029                        | 2.7124        | 2.8029   | 2.7124     | 2.8029 (56)    |
| If cylinder contains dedicated solar storage                                        |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | 2.8029   | 2.5316   | 2.8029   | 2.7124   | 2.8029     | 2.7124   | 2.8029        | 2.8029                        | 2.7124        | 2.8029   | 2.7124     | 2.8029 (57)    |
| Primary loss                                                                        | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624    | 22.5120  | 23.2624       | 23.2624                       | 22.5120       | 23.2624  | 22.5120    | 23.2624 (59)   |
| Total heat required for water heating calculated for each month                     |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | 162.0996 | 142.5193 | 148.8384 | 132.2610 | 128.7694   | 113.8503 | 108.1902      | 120.3048                      | 120.5895      | 137.2040 | 146.5411   | 157.8073 (62)  |
| Solar input                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000     | 0.0000   | 0.0000        | 0.0000                        | 0.0000        | 0.0000   | 0.0000     | 0.0000 (63)    |
|                                                                                     |          |          |          |          |            |          |               | Solar input (sum of months) = | Sum(63)m =    |          |            | 0.0000 (63)    |
| Output from w/h                                                                     |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | 162.0996 | 142.5193 | 148.8384 | 132.2610 | 128.7694   | 113.8503 | 108.1902      | 120.3048                      | 120.5895      | 137.2040 | 146.5411   | 157.8073 (64)  |
| Heat gains from water heating, kWh/month                                            |          |          |          |          |            |          |               | Total per year (kWh/year) =   | Sum(64)m =    |          |            | 1618.9750 (64) |
|                                                                                     | 66.0836  | 58.3939  | 61.6743  | 55.7692  | 55.0013    | 49.6477  | 48.1587       | 52.1868                       | 51.8884       | 57.8058  | 60.5173    | 64.6564 (65)   |
| -----                                                                               |          |          |          |          |            |          |               |                               |               |          |            |                |
| 5. Internal gains (see Table 5 and 5a)                                              |          |          |          |          |            |          |               |                               |               |          |            |                |
| -----                                                                               |          |          |          |          |            |          |               |                               |               |          |            |                |
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May        | Jun      | Jul           | Aug                           | Sep           | Oct      | Nov        | Dec            |
| (66)m                                                                               | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836    | 94.7836  | 94.7836       | 94.7836                       | 94.7836       | 94.7836  | 94.7836    | 94.7836 (66)   |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | 14.7386  | 13.0907  | 10.6461  | 8.0598   | 6.0248     | 5.0864   | 5.4960        | 7.1439                        | 9.5885        | 12.1749  | 14.2099    | 15.1483 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | 165.3227 | 167.0382 | 162.7151 | 153.5118 | 141.8942   | 130.9753 | 123.6809      | 121.9653                      | 126.2884      | 135.4918 | 147.1093   | 158.0282 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784    | 32.4784  | 32.4784       | 32.4784                       | 32.4784       | 32.4784  | 32.4784    | 32.4784 (69)   |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000     | 0.0000   | 0.0000        | 0.0000                        | 0.0000        | 0.0000   | 0.0000     | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269   | -75.8269 | -75.8269      | -75.8269                      | -75.8269      | -75.8269 | -75.8269   | -75.8269 (71)  |
| Water heating gains (Table 5)                                                       |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | 88.8221  | 86.8958  | 82.8955  | 77.4572  | 73.9265    | 68.9551  | 64.7295       | 70.1436                       | 72.0673       | 77.6960  | 84.0519    | 86.9038 (72)   |
| Total internal gains                                                                |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | 320.3185 | 318.4598 | 307.6918 | 290.4639 | 273.2806   | 256.4519 | 245.3414      | 250.6879                      | 259.3793      | 276.7977 | 296.8061   | 311.5153 (73)  |
| -----                                                                               |          |          |          |          |            |          |               |                               |               |          |            |                |
| 6. Solar gains                                                                      |          |          |          |          |            |          |               |                               |               |          |            |                |
| -----                                                                               |          |          |          |          |            |          |               |                               |               |          |            |                |
| [Jan]                                                                               |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     |          |          | Area     |          | Solar flux |          | g             |                               | FF            |          | Access     | Gains          |
|                                                                                     |          |          | m2       |          | Table 6a   |          | Specific data |                               | Specific data |          | factor     | W              |
|                                                                                     |          |          |          |          | W/m2       |          | or Table 6b   |                               | or Table 6c   |          | Table 6d   |                |
| Southwest                                                                           |          |          | 8.4000   |          | 36.7938    |          | 0.3700        |                               | 0.8900        |          | 0.7700     | 70.5309 (79)   |
| South                                                                               |          |          | 7.6100   |          | 46.7521    |          | 0.5600        |                               | 0.6800        |          | 0.7700     | 93.8892 (78)   |
| -----                                                                               |          |          |          |          |            |          |               |                               |               |          |            |                |
| Solar gains                                                                         | 164.4201 | 273.9065 | 360.2520 | 425.0528 | 458.8224   | 448.4905 | 435.2686      | 410.7613                      | 382.6003      | 298.6319 | 195.7705   | 141.4886 (83)  |
| Total gains                                                                         | 484.7385 | 592.3662 | 667.9438 | 715.5167 | 732.1030   | 704.9424 | 680.6100      | 661.4493                      | 641.9796      | 575.4296 | 492.5766   | 453.0040 (84)  |
| -----                                                                               |          |          |          |          |            |          |               |                               |               |          |            |                |
| 7. Mean internal temperature (heating season)                                       |          |          |          |          |            |          |               |                               |               |          |            |                |
| -----                                                                               |          |          |          |          |            |          |               |                               |               |          |            |                |
| Temperature during heating periods in the living area from Table 9, Th1 (C)         |          |          |          |          |            |          |               |                               |               |          |            | 21.0000 (85)   |
| Utilisation factor for gains for living area, nil,m (see Table 9a)                  |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May        | Jun      | Jul           | Aug                           | Sep           | Oct      | Nov        | Dec            |
| tau                                                                                 | 59.7947  | 59.9482  | 60.1025  | 60.8859  | 61.0451    | 61.8535  | 61.8535       | 62.0177                       | 61.5276       | 61.0451  | 60.7276    | 60.4134        |
| alpha                                                                               | 4.9863   | 4.9965   | 5.0068   | 5.0591   | 5.0697     | 5.1236   | 5.1236        | 5.1345                        | 5.1018        | 5.0697   | 5.0485     | 5.0276         |
| util living area                                                                    |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | 0.9891   | 0.9715   | 0.9352   | 0.8576   | 0.7258     | 0.5462   | 0.3960        | 0.4241                        | 0.6351        | 0.8811   | 0.9749     | 0.9920 (86)    |
| MIT                                                                                 | 20.0014  | 20.2348  | 20.4965  | 20.7540  | 20.9159    | 20.9843  | 20.9975       | 20.9964                       | 20.9665       | 20.7564  | 20.3285    | 19.9556 (87)   |
| Th 2                                                                                | 19.9864  | 19.9887  | 19.9911  | 20.0027  | 20.0051    | 20.0168  | 20.0168       | 20.0191                       | 20.0121       | 20.0051  | 20.0004    | 19.9957 (88)   |
| util rest of house                                                                  |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | 0.9859   | 0.9635   | 0.9178   | 0.8224   | 0.6670     | 0.4678   | 0.3087        | 0.3353                        | 0.5558        | 0.8434   | 0.9664     | 0.9895 (89)    |
| MIT 2                                                                               | 18.6815  | 19.0171  | 19.3847  | 19.7359  | 19.9298    | 20.0071  | 20.0159       | 20.0178                       | 19.9888       | 19.7497  | 19.1639    | 18.6221 (90)   |
| Living area fraction                                                                |          |          |          |          |            |          |               |                               |               |          |            |                |
| MIT                                                                                 | 19.3484  | 19.6324  | 19.9464  | 20.2503  | 20.4280    | 20.5009  | 20.5119       | 20.5123                       | 20.4828       | 20.2584  | 19.7523    | 19.2958 (92)   |
| Temperature adjustment                                                              |          |          |          |          |            |          |               |                               |               |          |            | 0.0000         |
| adjusted MIT                                                                        | 19.3484  | 19.6324  | 19.9464  | 20.2503  | 20.4280    | 20.5009  | 20.5119       | 20.5123                       | 20.4828       | 20.2584  | 19.7523    | 19.2958 (93)   |
| -----                                                                               |          |          |          |          |            |          |               |                               |               |          |            |                |
| 8. Space heating requirement                                                        |          |          |          |          |            |          |               |                               |               |          |            |                |
| -----                                                                               |          |          |          |          |            |          |               |                               |               |          |            |                |
| Utilisation                                                                         | Jan      | Feb      | Mar      | Apr      | May        | Jun      | Jul           | Aug                           | Sep           | Oct      | Nov        | Dec            |
|                                                                                     | 0.9832   | 0.9601   | 0.9169   | 0.8318   | 0.6930     | 0.5070   | 0.3529        | 0.3802                        | 0.5946        | 0.8540   | 0.9639     | 0.9873 (94)    |
| Useful gains                                                                        | 476.6084 | 568.7483 | 612.4687 | 595.1692 | 507.3281   | 357.4146 | 240.1636      | 251.4801                      | 381.7093      | 491.4021 | 474.7701   | 447.2606 (95)  |
| Ext temp.                                                                           | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000    | 14.6000  | 16.6000       | 16.4000                       | 14.1000       | 10.6000  | 7.1000     | 4.2000 (96)    |
| Heat loss rate W                                                                    |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | 958.7200 | 936.1845 | 852.2754 | 710.1574 | 544.6657   | 363.4265 | 240.9259      | 252.5972                      | 395.1886      | 602.7222 | 793.6857   | 951.8938 (97)  |
| Month fracti                                                                        | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000     | 0.0000   | 0.0000        | 0.0000                        | 0.0000        | 1.0000   | 1.0000     | 1.0000 (97a)   |
| Space heating kWh                                                                   |          |          |          |          |            |          |               |                               |               |          |            |                |
|                                                                                     | 358.6910 | 246.9171 | 178.4162 | 82.7915  | 27.7791    | 0.0000   | 0.0000        | 0.0000                        | 0.0000        | 82.8222  | 229.6192   | 375.4471 (98)  |

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Space heating  
Space heating per m2  
(98) / (4) = 1582.4834 (98)  
27.7629 (99)

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1582.4834 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 1740.7318 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1618.9750 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 1780.8725 (310a) |
| Electricity used for heat distribution                                                  | 35.2160 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 115.1756 (330a)  |
| Total electricity for the above, kWh/year                                               | 115.1756 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 260.2889 (332)   |
| Total delivered energy for all uses                                                     | 3897.0688 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 3750.3773          | 0.2160                        | 810.0815 (367)           |
| Electrical energy for heat distribution                                                    | 35.2160            | 0.5190                        | 18.2771 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 828.3586 (373)           |
| Space and water heating                                                                    |                    |                               | 828.3586 (376)           |
| Pumps and fans                                                                             | 115.1756           | 0.5190                        | 59.7761 (378)            |
| Energy for lighting                                                                        | 260.2889           | 0.5190                        | 135.0899 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1023.2247 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 17.9500 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 17.9500 ZC1 |
| Total Floor Area                                                                | TFA | 57.0000     |
| Assumed number of occupants                                                     | N   | 1.8957      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.1871 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.8859 ZC3  |
| Total CO2 emissions                                                             |     | 38.0230 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 38.0230 ZC8 |

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### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 57.0000 (1b)              | x 2.5000 (2b)                   | = 142.5000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 142.5000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1404 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3904 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 1 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3611 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4604 | 0.4513 | 0.4423 | 0.3972 | 0.3882 | 0.3430 | 0.3430 | 0.3340 | 0.3611 | 0.3882 | 0.4062 | 0.4243 (22b) |
| Effective ac    | 0.6060 | 0.6019 | 0.5978 | 0.5789 | 0.5753 | 0.5588 | 0.5588 | 0.5558 | 0.5652 | 0.5753 | 0.5825 | 0.5900 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K              |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|----------------------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)                      |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 12.1500                   | 1.3258                        | 16.1080      |                                | (27)                       |
| External Wall 1                                                | 49.0000                 | 12.1500                    | 36.8500                   | 0.1800                        | 6.6330       |                                | (29a)                      |
| Corridor wall                                                  | 3.5000                  | 2.1000                     | 1.4000                    | 0.1800                        | 0.2520       |                                | (29a)                      |
| roof                                                           | 57.0000                 |                            | 57.0000                   | 0.1300                        | 7.4100       |                                | (30)                       |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 109.5000                  |                               |              |                                | (31)                       |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 32.9230      |                                | (33)                       |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35)              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 13.7230 (36)               |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 46.6460 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 28.4958 | 28.3022 | 28.1126 | 27.2217 | 27.0550 | 26.2791 | 26.2791 | 26.1354 | 26.5779 | 27.0550 | 27.3922 | 27.7447 (38) |
| Heat transfer coeff       |         |         |         |         |         |         |         |         |         |         |         |              |
| Average = Sum(39)m / 12 = | 75.1417 | 74.9482 | 74.7585 | 73.8676 | 73.7010 | 72.9250 | 72.9250 | 72.7813 | 73.2239 | 73.7010 | 74.0382 | 74.3907 (39) |
|                           |         |         |         |         |         |         |         |         |         |         |         | 73.8668 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.3183 | 1.3149 | 1.3116 | 1.2959 | 1.2930 | 1.2794 | 1.2794 | 1.2769 | 1.2846 | 1.2930 | 1.2989 | 1.3051 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.2959 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |          |          | 1.8957 (42)                       |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |          |          | 79.2222 (43)                      |
|                                                             | Jan      | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec                               |
| Daily hot water use                                         | 87.1444  | 83.9755  | 80.8066  | 77.6378  | 74.4689 | 71.3000 | 71.3000 | 74.4689 | 77.6378 | 80.8066  | 83.9755  | 87.1444 (44)                      |
| Energy conte                                                | 129.2327 | 113.0277 | 116.6345 | 101.6848 | 97.5689 | 84.1946 | 78.0187 | 89.5275 | 90.5968 | 105.5818 | 115.2508 | 125.1549 (45)                     |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         |          |          | Total = Sum(45)m = 1246.4737 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 19.3849  | 16.9542  | 17.4952  | 15.2527  | 14.6353 | 12.6292 | 11.7028 | 13.4291 | 13.5895 | 15.8373  | 17.2876  | 18.7732 (46)                      |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |          |          |                                   |
| Store volume                                                |          |          |          |          |         |         |         |         |         |          |          | 2.0000 (47)                       |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |          |          | 0.2388 (48)                       |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |          |          | 0.5400 (49)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |          |          | 0.1290 (55)                       |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 156.4928 | 137.6498 | 143.8946 | 128.0655 | 124.8291 | 110.5754 | 105.2788 | 116.7877 | 116.9776 | 132.8420 | 141.6316 | 152.4151 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 156.4928 | 137.6498 | 143.8946 | 128.0655 | 124.8291 | 110.5754 | 105.2788 | 116.7877 | 116.9776 | 132.8420 | 141.6316 | 152.4151 (64) |
| Heat gains from water heating, kWh/month                        | 64.7780  | 57.2794  | 60.5891  | 54.9148  | 54.2498  | 49.0993  | 47.7493  | 51.5760  | 51.2281  | 56.9141  | 59.4255  | 63.4221 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.7649  | 13.1140  | 10.6650  | 8.0741   | 6.0355   | 5.0954   | 5.5058   | 7.1566   | 9.6056   | 12.1965  | 14.2352  | 15.1752 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 165.3227 | 167.0382 | 162.7151 | 153.5118 | 141.8942 | 130.9753 | 123.6809 | 121.9653 | 126.2884 | 135.4918 | 147.1093 | 158.0282 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 (71) |
| Water heating gains (Table 5)                                                       | 87.0672  | 85.2371  | 81.4369  | 76.2706  | 72.9164  | 68.1935  | 64.1792  | 69.3226  | 71.1501  | 76.4974  | 82.5355  | 85.2448 (72)  |
| Total internal gains                                                                | 321.5898 | 319.8244 | 309.2522 | 292.2915 | 275.2812 | 258.6994 | 247.8009 | 252.8797 | 261.4792 | 278.6208 | 298.3150 | 312.8833 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|
| South       |          |          |          |          | 5.7800     | 46.7521                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 82.5849 (78)  |
| Southwest   |          |          |          |          | 6.3700     | 36.7938                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 71.6286 (79)  |
|             |          |          |          |          |            |                                |                                   |                                    |          |          |                              |               |
| Solar gains | 154.2134 | 257.2627 | 339.2273 | 401.5688 | 434.5979   | 425.2856                       | 412.5504                          | 388.5129                           | 360.7351 | 280.7297 | 183.6857                     | 132.6601 (83) |
| Total gains | 475.8032 | 577.0871 | 648.4795 | 693.8603 | 709.8791   | 683.9850                       | 660.3513                          | 641.3925                           | 622.2143 | 559.3505 | 482.0007                     | 445.5433 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 52.6782 | 52.8143 | 52.9483 | 53.5868 | 53.7080 | 54.2795 | 54.2795 | 54.3867 | 54.0579                   | 53.7080 | 53.4634 | 53.2101      |
| alpha                                                                       | 4.5119  | 4.5210  | 4.5299  | 4.5725  | 4.5805  | 4.6186  | 4.6186  | 4.6258  | 4.6039                    | 4.5805  | 4.5642  | 4.5473       |
| util living area                                                            | 0.9922  | 0.9811  | 0.9584  | 0.9070  | 0.8061  | 0.6404  | 0.4768  | 0.5093  | 0.7270                    | 0.9229  | 0.9831  | 0.9941 (86)  |
| MIT                                                                         | 19.7486 | 19.9755 | 20.2597 | 20.5756 | 20.8183 | 20.9538 | 20.9904 | 20.9869 | 20.9150                   | 20.5981 | 20.1092 | 19.7071 (87) |
| Th 2                                                                        | 19.8265 | 19.8292 | 19.8318 | 19.8440 | 19.8463 | 19.8570 | 19.8570 | 19.8590 | 19.8529                   | 19.8463 | 19.8417 | 19.8368 (88) |
| util rest of house                                                          | 0.9896  | 0.9751  | 0.9450  | 0.8771  | 0.7460  | 0.5428  | 0.3576  | 0.3893  | 0.6361                    | 0.8914  | 0.9766  | 0.9921 (89)  |
| MIT 2                                                                       | 18.1972 | 18.5261 | 18.9320 | 19.3743 | 19.6798 | 19.8285 | 19.8538 | 19.8542 | 19.7930                   | 19.4162 | 18.7312 | 18.1442 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.5053 (91)  |
| MIT                                                                         | 18.9811 | 19.2584 | 19.6029 | 19.9812 | 20.2550 | 20.3971 | 20.4281 | 20.4265 | 20.3599                   | 20.0134 | 19.4275 | 18.9339 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.9811 | 19.2584 | 19.6029 | 19.9812 | 20.2550 | 20.3971 | 20.4281 | 20.4265 | 20.3599                   | 20.0134 | 19.4275 | 18.9339 (93) |

#### 8. Space heating requirement

|                      |           |           |          |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 469.6550  | 560.5607  | 610.7945 | 611.3713 | 545.8978 | 403.9982 | 276.1165 | 288.7548 | 422.3082 | 501.5682     | 469.2967 | 441.1021 (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 1103.1613 | 1076.1363 | 979.5502 | 818.5454 | 630.5148 | 422.7505 | 279.1622 | 293.0560 | 458.3719 | 693.7755     | 912.7043 | 1096.0637 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 471.3286  | 346.4668  | 274.3542 | 149.1654 | 62.9550  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 143.0022     | 319.2534 | 487.2914 (98)  |
| Space heating        |           |           |          |          |          |          |          |          |          |              |          | 2253.8172 (98) |
| Space heating per m2 |           |           |          |          |          |          |          |          |          | (98) / (4) = |          | 39.5407 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2410.4997 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 471.3286 | 346.4668 | 274.3542 | 149.1654 | 62.9550  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 143.0022 | 319.2534 | 487.2914  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 504.0948 | 370.5528 | 293.4270 | 159.5352 | 67.3316  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 152.9435 | 341.4475 | 521.1673  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 156.4928 | 137.6498 | 143.8946 | 128.0655 | 124.8291 | 110.5754 | 105.2788 | 116.7877 | 116.9776 | 132.8420 | 141.6316 | 152.4151  | (64)            |
| Efficiency of water heater (217)m                                     | 87.5731  | 87.1764  | 86.5093  | 85.2214  | 83.0936  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.0106  | 86.9185  | 79.8000   | (216)           |
| Fuel for water heating, kWh/month                                     | 178.6996 | 157.8979 | 166.3343 | 150.2740 | 150.2270 | 138.5656 | 131.9283 | 146.3505 | 146.5884 | 156.2652 | 162.9475 | 173.7948  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1859.8733 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2410.4997 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 260.7522  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4606.1251 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2410.4997          | 0.2160                        | 520.6679 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1859.8733          | 0.2160                        | 401.7326 (264)           |
| Space and water heating                                                                           |                    |                               | 922.4006 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 260.7522           | 0.5190                        | 135.3304 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1096.6559 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 16.1825 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3742 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6829 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (16.1825 * 1.00) + 2.3742 + 0.6829, rounded to 2 d.p. |                    |                               | 19.2400 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                      |                |               |         |                |            |
|----------------------|----------------|---------------|---------|----------------|------------|
| Property Reference   | D-0-01         |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference | ASHP - Be Lean | Prop Type Ref | 2bed 3F |                |            |
| Property             |                |               |         |                |            |

|                                    |      |             |       |      |       |
|------------------------------------|------|-------------|-------|------|-------|
| SAP Rating                         | 81 B | DER         | 22.73 | TER  | 25.52 |
| Environmental                      | 87 B | % DER<TER   | 10.93 |      |       |
| CO <sub>2</sub> Emissions (t/year) | 0.80 | DFEE        | 61.72 | TFEE | 63.73 |
| General Requirements Compliance    | Fail | % DFEE<TFEE | 3.16  |      |       |

|                  |                                                                         |             |           |
|------------------|-------------------------------------------------------------------------|-------------|-----------|
| Assessor Details | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com | Assessor ID | R479-0001 |
| Client           |                                                                         |             |           |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Ground-floor flat, total floor area 43 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 25.52 kgCO<sub>2</sub>/m<sup>2</sup>

Dwelling Carbon Dioxide Emission Rate (DER) 22.73 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)63.7 kWh/m<sup>2</sup>/yr

Dwelling Fabric Energy Efficiency (DFEE)61.7 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.18 (max. 0.30) | 0.18 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | 0.11 (max. 0.25) | 0.11 (max. 0.70) | OK |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day

Permitted by DBSCG 0.32 Fail

Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls:

No cylinderstat

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

Continuous supply and extract system

|                     |      |    |
|---------------------|------|----|
| Specific fan power: | 0.53 |    |
| Maximum             | 1.5  | OK |
| MVHR efficiency:    | 94%  |    |
| Minimum:            | 70%  | OK |

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail

Based on:

|                      |                                   |
|----------------------|-----------------------------------|
| Overshading:         | Average                           |
| Windows facing West: | 6.66 m <sup>2</sup> , No overhang |
| Air change rate:     | 0.50 ach                          |
| Blinds/curtains:     | None                              |

#### 10 Key features

|                    |                                      |
|--------------------|--------------------------------------|
| Party wall U-value | 0.00 W/m <sup>2</sup> K              |
| Floor U-value      | 0.11 W/m <sup>2</sup> K              |
| Air permeability   | 3.0 m <sup>3</sup> /m <sup>2</sup> h |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 43.4000 (1b)              | x 2.8000 (2b)                   | = 121.5200 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 43.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 121.5200 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour   |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|---------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)      |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)      |
| Number of intermittent fans                          |                              |                      |       |       | 0 * 10 = 0.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)      |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)      |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 0.0000 / (5) = 0.0000 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                       |
| Measured/design AP50                                 |                              |                      |       |       | 3.0000                    |
| Infiltration rate                                    |                              |                      |       |       | 0.1500 (18)               |
| Number of sides sheltered                            |                              |                      |       |       | 2 (19)                    |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.8500 (20)               |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.1275 (21)               |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1626 | 0.1594 | 0.1562 | 0.1403 | 0.1371 | 0.1211 | 0.1211 | 0.1179 | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 79.9000 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2631 | 0.2599 | 0.2567 | 0.2408 | 0.2376 | 0.2216 | 0.2216 | 0.2184 | 0.2280 | 0.2376 | 0.2439 | 0.2503 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                     | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K         | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K   |
|-------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|----------------------|--------------------------------|-----------------|
| W01 (Uw = 1.40)                                             |                         |                            | 6.6600                    | 1.3258                        | 8.8295               |                                | (27)            |
| door                                                        |                         |                            | 2.1000                    | 1.4000                        | 2.9400               |                                | (26a)           |
| Heat Loss Floor 1                                           |                         |                            | 43.4000                   | 0.1100                        | 4.7740               | 110.0000                       | 4774.0000 (28a) |
| External Wall 1                                             | 37.5000                 | 8.7600                     | 28.7400                   | 0.1800                        | 5.1732               | 140.0000                       | 4023.6000 (29a) |
| Total net area of external elements Aum(A, m <sup>2</sup> ) |                         |                            | 80.9000                   |                               |                      |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                         |                         |                            |                           |                               | (26)...(30) + (32) = | 21.7167                        | (33)            |
| Party Wall 1                                                |                         |                            | 37.5000                   | 0.0000                        | 0.0000               | 140.0000                       | 5250.0000 (32)  |
| Party Ceilings                                              |                         |                            | 43.4000                   |                               |                      | 80.0000                        | 3472.0000 (32b) |
| Internal Wall                                               |                         |                            | 58.2000                   |                               |                      | 9.0000                         | 523.8000 (32c)  |

Heat capacity Cm = Sum(A x k)  
Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K  
Thermal bridges (Sum(L x Psi) calculated using Appendix K)  
Total fabric heat loss  
(28)...(30) + (32) + (32a)...(32e) = 18043.4000 (34)  
415.7465 (35)  
12.2778 (36)  
(33) + (36) = 33.9945 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 10.5492 | 10.4214 | 10.2936 | 9.6545  | 9.5266  | 8.8875  | 8.8875  | 8.7597  | 9.1432  | 9.5266  | 9.7823  | 10.0379 (38) |
| Heat transfer coeff       | 44.5438 | 44.4159 | 44.2881 | 43.6490 | 43.5212 | 42.8821 | 42.8821 | 42.7542 | 43.1377 | 43.5212 | 43.7768 | 44.0325 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 43.6170 (39) |
| HLP                       | 1.0264  | 1.0234  | 1.0205  | 1.0057  | 1.0028  | 0.9881  | 0.9881  | 0.9851  | 0.9940  | 1.0028  | 1.0087  | 1.0146 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.0050 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |         |         |         |         |         |         |                    |          |                |
|------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                        |          |          |          |         |         |         |         |         |         |                    |          | 1.4993 (42)    |
| Average daily hot water use (litres/day) |          |          |          |         |         |         |         |         |         |                    |          | 73.4837 (43)   |
| Daily hot water use                      | 80.8321  | 77.8927  | 74.9534  | 72.0140 | 69.0747 | 66.1353 | 66.1353 | 69.0747 | 72.0140 | 74.9534            | 77.8927  | 80.8321 (44)   |
| Energy conte                             | 119.8716 | 104.8405 | 108.1860 | 94.3192 | 90.5015 | 78.0959 | 72.3673 | 83.0426 | 84.0344 | 97.9339            | 106.9026 | 116.0893 (45)  |
| Energy content (annual)                  |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1156.1846 (45) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Distribution loss (46)m = 0.15 x (45)m                          | 17.9807  | 15.7261  | 16.2279  | 14.1479  | 13.5752  | 11.7144  | 10.8551  | 12.4564  | 12.6052  | 14.6901  | 16.0354  | 17.4134 (46)  |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |               |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)   |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)   |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |               |
| 22.9400                                                         | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | (56)          |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |               |
| 22.9400                                                         | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | (57)          |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | (59)          |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |               |
| 166.0740                                                        | 146.5717 | 154.3884 | 139.0312 | 136.7039 | 122.8079 | 118.5697 | 129.2450 | 128.7464 | 144.1363 | 151.6146 | 162.2917 | (62)          |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (63)          |
| Output from w/h                                                 | 166.0740 | 146.5717 | 154.3884 | 139.0312 | 136.7039 | 122.8079 | 118.5697 | 129.2450 | 128.7464 | 144.1363 | 151.6146 | 162.2917 (64) |
| Heat gains from water heating, kWh/month                        | 76.8192  | 68.2444  | 72.9338  | 67.1307  | 67.0537  | 61.7365  | 61.0241  | 64.5736  | 63.7110  | 69.5250  | 71.3147  | 75.5616 (65)  |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          |          |               |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |          |          |          |          |          |          |          |               |
| 1700.1806 (64)                                                  |          |          |          |          |          |          |          |          |          |          |          |               |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 12.4438  | 11.0525  | 8.9885   | 6.8049   | 5.0867   | 4.2944   | 4.6403   | 6.0316   | 8.0956   | 10.2792  | 11.9974  | 12.7897 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 130.1693 | 131.5200 | 128.1162 | 120.8698 | 111.7225 | 103.1254 | 97.3820  | 96.0312  | 99.4351  | 106.6815 | 115.8287 | 124.4259 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 (71) |
| Water heating gains (Table 5)                                                       | 103.2517 | 101.5542 | 98.0292  | 93.2371  | 90.1259  | 85.7451  | 82.0216  | 86.7924  | 88.4875  | 93.4475  | 99.0482  | 101.5613 (72) |
| Total internal gains                                                                | 291.3550 | 289.6169 | 280.6241 | 266.4020 | 252.4254 | 238.6552 | 229.5341 | 234.3455 | 241.5085 | 255.8985 | 272.3645 | 284.2671 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| West        |          |          |          |          | 6.6600     | 19.6403                        | 0.3700                            | 0.6400                             | 0.7700                       |          | 21.4653 (80) |               |
| Solar gains | 21.4653  | 41.9906  | 69.1526  | 100.8549 | 123.6015   | 126.5281                       | 120.4599                          | 103.4733                           | 80.4273                      | 49.8254  | 26.7647      | 17.6520 (83)  |
| Total gains | 312.8203 | 331.6076 | 349.7767 | 367.2569 | 376.0269   | 365.1833                       | 349.9940                          | 337.8188                           | 321.9358                     | 305.7239 | 299.1292     | 301.9191 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |          |          |          |          |          |          |          |          |                           |          |          |              |
|-----------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|----------|----------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |          |          |          |          |          |          |          |          |                           |          |          | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep                       | Oct      | Nov      | Dec          |
| tau                                                                         | 112.5198 | 112.8436 | 113.1693 | 114.8263 | 115.1636 | 116.8800 | 116.8800 | 117.2294 | 116.1873                  | 115.1636 | 114.4911 | 113.8263     |
| alpha                                                                       | 8.5013   | 8.5229   | 8.5446   | 8.6551   | 8.6776   | 8.7920   | 8.7920   | 8.8153   | 8.7458                    | 8.6776   | 8.6327   | 8.5884       |
| util living area                                                            | 0.9996   | 0.9992   | 0.9975   | 0.9865   | 0.9265   | 0.7354   | 0.5380   | 0.5801   | 0.8588                    | 0.9890   | 0.9989   | 0.9997 (86)  |
| MIT                                                                         | 20.3786  | 20.4468  | 20.5770  | 20.7604  | 20.9185  | 20.9915  | 20.9994  | 20.9990  | 20.9694                   | 20.7828  | 20.5527  | 20.3680 (87) |
| Th 2                                                                        | 20.0614  | 20.0639  | 20.0663  | 20.0786  | 20.0810  | 20.0933  | 20.0933  | 20.0958  | 20.0884                   | 20.0810  | 20.0761  | 20.0712 (88) |
| util rest of house                                                          | 0.9994   | 0.9988   | 0.9959   | 0.9774   | 0.8825   | 0.6401   | 0.4279   | 0.4674   | 0.7762                    | 0.9797   | 0.9981   | 0.9996 (89)  |
| MIT 2                                                                       | 19.2394  | 19.3411  | 19.5330  | 19.8056  | 20.0113  | 20.0895  | 20.0932  | 20.0955  | 20.0705                   | 19.8416  | 19.5061  | 19.2319 (90) |
| Living area fraction                                                        |          |          |          |          |          |          |          |          | fLA = Living area / (4) = |          |          | 0.8249 (91)  |
| MIT                                                                         | 20.1791  | 20.2532  | 20.3942  | 20.5932  | 20.7597  | 20.8335  | 20.8407  | 20.8408  | 20.8120                   | 20.6180  | 20.3694  | 20.1691 (92) |
| Temperature adjustment                                                      |          |          |          |          |          |          |          |          |                           |          |          | 0.0000       |
| adjusted MIT                                                                | 20.1791  | 20.2532  | 20.3942  | 20.5932  | 20.7597  | 20.8335  | 20.8407  | 20.8408  | 20.8120                   | 20.6180  | 20.3694  | 20.1691 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |                |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|                      | 0.9995   | 0.9989   | 0.9965   | 0.9830   | 0.9166   | 0.7187   | 0.5188   | 0.5605   | 0.8438   | 0.9858       | 0.9984   | 0.9996 (94)    |
| Useful gains         | 312.6505 | 331.2418 | 348.5617 | 361.0314 | 344.6698 | 262.4665 | 181.5752 | 189.3427 | 271.6537 | 301.3862     | 298.6571 | 301.7980 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 707.3168 | 681.9252 | 615.3484 | 510.3958 | 394.2875 | 267.3060 | 181.8520 | 189.8620 | 289.5394 | 435.9952     | 580.8943 | 703.1580 (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 293.6317 | 235.6592 | 198.4893 | 107.5424 | 36.9155  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 100.1491     | 203.2108 | 298.6119 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 1474.2098 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 33.9680 (99)   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 1474.2098 | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 1621.6308 | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 1700.1806 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 1870.1987 | (310a) |
| Electricity used for heat distribution                                                  | 34.9183   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |           |        |
| mechanical ventilation fans (SFP = 0.6625)                                              | 98.2185   | (330a) |
| Total electricity for the above, kWh/year                                               | 98.2185   | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 219.7622  | (332)  |
| Total delivered energy for all uses                                                     | 3809.8102 | (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 3718.6682          | 0.2160                        | 803.2323 (367)           |
| Electrical energy for heat distribution                                                    | 34.9183            | 0.5190                        | 18.1226 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 821.3549 (373)           |
| Space and water heating                                                                    |                    |                               | 821.3549 (376)           |
| Pumps and fans                                                                             | 98.2185            | 0.5190                        | 50.9754 (378)            |
| Energy for lighting                                                                        | 219.7622           | 0.5190                        | 114.0566 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 986.3869 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 22.7300 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |         |     |
|---------------------------------------------------------------------------------|---------|-----|
| DER                                                                             | 22.7300 | ZC1 |
| Total Floor Area                                                                | 43.4000 | TFA |
| Assumed number of occupants                                                     | 1.4993  | N   |
| CO2 emission factor in Table 12 for electricity displaced from grid             | 0.5190  | EF  |
| CO2 emissions from appliances, equation (L14)                                   | 17.7732 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 3.5711  | ZC3 |
| Total CO2 emissions                                                             | 44.0742 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000  | ZC7 |
| Net CO2 emissions                                                               | 44.0742 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 43.4000 (1b)              | x 2.8000 (2b)                   | = 121.5200 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 43.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 121.5200 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour       |
| Pressure test                                                             |                 |                      |       |                             | 20.0000 / (5) = 0.1646 (8) |
| Measured/design AP50                                                      |                 |                      |       |                             | Yes                        |
| Infiltration rate                                                         |                 |                      |       |                             | 5.0000                     |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0.4146 (18)                |
|                                                                           |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3524 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.4493 | 0.4405 | 0.4317 | 0.3876 | 0.3788 | 0.3348 | 0.3348 | 0.3260 | 0.3524 | 0.3788 | 0.3964 | 0.4141 (22b) |
| Effective ac    | 0.6009 | 0.5970 | 0.5932 | 0.5751 | 0.5718 | 0.5560 | 0.5560 | 0.5531 | 0.5621 | 0.5718 | 0.5786 | 0.5857 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2  | U-value<br>W/m2K     | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------|----------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|------|
| TER Semi-glazed door                                                |                |                | 2.1000         | 1.2000               | 2.5200         |                   |                | (26a)          |                |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                | 6.6600         | 1.3258               | 8.8295         |                   |                | (27)           |                |                |                |                |      |
| Heat Loss Floor 1                                                   |                |                | 43.4000        | 0.1300               | 5.6420         |                   |                | (28a)          |                |                |                |                |      |
| External Wall 1                                                     | 37.5000        | 8.7600         | 28.7400        | 0.1800               | 5.1732         |                   |                | (29a)          |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 80.9000        |                      |                |                   |                | (31)           |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                | (26)...(30) + (32) = | 22.1647        |                   |                | (33)           |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                      |                |                   | 250.0000       | (35)           |                |                |                |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                |                      |                |                   | 10.1950        | (36)           |                |                |                |                |      |
| Total fabric heat loss                                              |                |                |                |                      |                | (33) + (36) =     | 32.3597        | (37)           |                |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                      |                |                   |                |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>24.0985 | Feb<br>23.9413 | Mar<br>23.7873 | Apr<br>23.0636       | May<br>22.9282 | Jun<br>22.2980    | Jul<br>22.2980 | Aug<br>22.1813 | Sep<br>22.5407 | Oct<br>22.9282 | Nov<br>23.2021 | Dec<br>23.4885 | (38) |
| Heat transfer coeff                                                 | 56.4583        | 56.3011        | 56.1470        | 55.4234              | 55.2880        | 54.6577           | 54.6577        | 54.5410        | 54.9005        | 55.2880        | 55.5619        | 55.8482        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                |                      |                |                   |                |                |                |                |                | 55.4227        | (39) |
| HLP                                                                 | Jan<br>1.3009  | Feb<br>1.2973  | Mar<br>1.2937  | Apr<br>1.2770        | May<br>1.2739  | Jun<br>1.2594     | Jul<br>1.2594  | Aug<br>1.2567  | Sep<br>1.2650  | Oct<br>1.2739  | Nov<br>1.2802  | Dec<br>1.2868  | (40) |
| HLP (average)                                                       |                |                |                |                      |                |                   |                |                |                |                |                | 1.2770         | (40) |
| Days in month                                                       | 31             | 28             | 31             | 30                   | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |             |             |             |             |             |             |             |             |             |                    |             |                  |
|-------------------------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------------|-------------|------------------|
| Assumed occupancy                                           |             |             |             |             |             |             |             |             |             |                    |             | 1.4993 (42)      |
| Average daily hot water use (litres/day)                    |             |             |             |             |             |             |             |             |             |                    |             | 69.8095 (43)     |
| Daily hot water use                                         | Jan 76.7905 | Feb 73.9981 | Mar 71.2057 | Apr 68.4133 | May 65.6209 | Jun 62.8286 | Jul 62.8286 | Aug 65.6209 | Sep 68.4133 | Oct 71.2057        | Nov 73.9981 | Dec 76.7905 (44) |
| Energy conte                                                | 113.8780    | 99.5985     | 102.7767    | 89.6032     | 85.9764     | 74.1911     | 68.7490     | 78.8904     | 79.8326     | 93.0372            | 101.5574    | 110.2848 (45)    |
| Energy content (annual)                                     |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = |             | 1098.3754 (45)   |
| Distribution loss (46)m = 0.15 x (45)m                      | 17.0817     | 14.9398     | 15.4165     | 13.4405     | 12.8965     | 11.1287     | 10.3123     | 11.8336     | 11.9749     | 13.9556            | 15.2336     | 16.5427 (46)     |
| Water storage loss:                                         |             |             |             |             |             |             |             |             |             |                    |             |                  |
| Store volume                                                |             |             |             |             |             |             |             |             |             |                    |             | 2.0000 (47)      |
| a) If manufacturer declared loss factor is known (kWh/day): |             |             |             |             |             |             |             |             |             |                    |             | 0.2388 (48)      |
| Temperature factor from Table 2b                            |             |             |             |             |             |             |             |             |             |                    |             | 0.5400 (49)      |
| Enter (49) or (54) in (55)                                  |             |             |             |             |             |             |             |             |             |                    |             | 0.1290 (55)      |
| Total storage loss                                          |             |             |             |             |             |             |             |             |             |                    |             |                  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |         |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977  | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (57)  |
| Total heat required for water heating calculated for each month | 141.1382 | 124.2205 | 130.0368 | 115.9840 | 113.2365 | 100.5719 | 96.0091 | 106.1506 | 106.2134 | 120.2974 | 127.9382 | 137.5449 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 141.1382 | 124.2205 | 130.0368 | 115.9840 | 113.2365 | 100.5719 | 96.0091 | 106.1506 | 106.2134 | 120.2974 | 127.9382 | 137.5449 (64) |
| Heat gains from water heating, kWh/month                        | 59.6726  | 52.8141  | 55.9814  | 50.8977  | 50.3953  | 45.7732  | 44.6671 | 48.0392  | 47.6490  | 52.7430  | 54.8725  | 58.4778 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 12.2094  | 10.8442  | 8.8191   | 6.6767   | 4.9909   | 4.2135   | 4.5528   | 5.9180   | 7.9431   | 10.0856  | 11.7713  | 12.5487  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 130.1693 | 131.5200 | 128.1162 | 120.8698 | 111.7225 | 103.1254 | 97.3820  | 96.0312  | 99.4351  | 106.6815 | 115.8287 | 124.4259 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | (71) |
| Water heating gains (Table 5)                                                       | 80.2051  | 78.5925  | 75.2438  | 70.6912  | 67.7356  | 63.5738  | 60.0365  | 64.5688  | 66.1791  | 70.8911  | 76.2118  | 78.5992  | (72) |
| Total internal gains                                                                | 271.0739 | 269.4470 | 260.6693 | 246.7279 | 232.9392 | 219.4030 | 210.4615 | 215.0082 | 222.0475 | 236.1484 | 252.3020 | 264.0640 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area     | Solar flux | g             |          | FF            |          | Access   |          | Gains         |  |
|-------------|----------|----------|----------|----------|------------|---------------|----------|---------------|----------|----------|----------|---------------|--|
|             |          |          |          | m2       | Table 6a   | Specific data |          | Specific data |          | factor   |          | W             |  |
|             |          |          |          |          | W/m2       | or Table 6b   |          | or Table 6c   |          | Table 6d |          |               |  |
| West        |          |          |          | 6.6600   | 19.6403    | 0.6300        |          | 0.7000        |          | 0.7700   |          | 39.9755 (80)  |  |
| Solar gains | 39.9755  | 78.2005  | 128.7850 | 187.8253 | 230.1869   | 235.6373      | 224.3363 | 192.7016      | 149.7823 | 92.7914  | 49.8447  | 32.8739 (83)  |  |
| Total gains | 311.0494 | 347.6474 | 389.4543 | 434.5532 | 463.1261   | 455.0402      | 434.7978 | 407.7098      | 371.8298 | 328.9398 | 302.1467 | 296.9378 (84) |  |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 53.3826 | 53.5316 | 53.6785 | 54.3794 | 54.5125 | 55.1411 | 55.1411 | 55.2591 | 54.8973 | 54.5125 | 54.2438 | 53.9657 |              |
| alpha                                                                       | 4.5588  | 4.5688  | 4.5786  | 4.6253  | 4.6342  | 4.6761  | 4.6761  | 4.6839  | 4.6598  | 4.6342  | 4.6163  | 4.5977  |              |
| util living area                                                            | 0.9957  | 0.9922  | 0.9819  | 0.9482  | 0.8626  | 0.7017  | 0.5371  | 0.5894  | 0.8309  | 0.9664  | 0.9920  | 0.9965  | (86)         |
| MIT                                                                         | 19.6666 | 19.8167 | 20.0896 | 20.4531 | 20.7573 | 20.9353 | 20.9852 | 20.9775 | 20.8519 | 20.4559 | 20.0010 | 19.6438 | (87)         |
| Th 2                                                                        | 20.3496 | 20.3514 | 20.3531 | 20.3615 | 20.3630 | 20.3703 | 20.3703 | 20.3716 | 20.3675 | 20.3630 | 20.3599 | 20.3566 | (88)         |
| util rest of house                                                          | 0.9950  | 0.9909  | 0.9785  | 0.9381  | 0.8361  | 0.6493  | 0.4663  | 0.5181  | 0.7900  | 0.9581  | 0.9903  | 0.9959  | (89)         |
| MIT 2                                                                       | 19.0930 | 19.2440 | 19.5165 | 19.8802 | 20.1688 | 20.3280 | 20.3632 | 20.3602 | 20.2608 | 19.8877 | 19.4350 | 19.0759 | (90)         |
| Living area fraction                                                        | 19.5661 | 19.7164 | 19.9892 | 20.3527 | 20.6543 | 20.8289 | 20.8763 | 20.8694 | 20.7484 | 20.3564 | 19.9019 | 19.5444 | (91)         |
| MIT                                                                         | 19.5661 | 19.7164 | 19.9892 | 20.3527 | 20.6543 | 20.8289 | 20.8763 | 20.8694 | 20.7484 | 20.3564 | 19.9019 | 19.5444 | (92)         |
| Temperature adjustment                                                      | 20.1661 | 20.3164 | 20.5892 | 20.9527 | 21.2543 | 21.4289 | 21.4763 | 21.4694 | 21.3484 | 20.9564 | 20.5019 | 20.1444 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 0.9947   | 0.9908   | 0.9798   | 0.9475   | 0.8720   | 0.7338   | 0.5873   | 0.6384   | 0.8501   | 0.9659   | 0.9907   | 0.9957    | (94)  |
| Ext temp.            | 309.4102 | 344.4402 | 381.5951 | 411.7367 | 403.8454 | 333.9136 | 255.3712 | 260.2768 | 316.0745 | 317.7187 | 299.3373 | 295.6657  | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Month fracti         | 895.7736 | 867.9593 | 791.0680 | 668.0040 | 528.2371 | 373.2542 | 266.5255 | 276.4903 | 397.9407 | 572.5845 | 744.6353 | 890.4638  | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating        | 436.2544 | 351.8048 | 304.6478 | 184.5125 | 92.5474  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 189.6202 | 320.6146 | 442.5298  | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 2322.5314 | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 53.5145   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 88.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 2624.3293 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                             | 436.2544 | 351.8048 | 304.6478 | 184.5125 | 92.5474  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 189.6202 | 320.6146 | 442.5298 (98)   |
| Space heating efficiency (main heating system 1)                      | 88.5000  | 88.5000  | 88.5000  | 88.5000  | 88.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 88.5000  | 88.5000  | 88.5000 (210)   |
| Space heating fuel (main heating system)                              | 492.9428 | 397.5196 | 344.2348 | 208.4887 | 104.5734 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 214.2601 | 362.2764 | 500.0336 (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (215)    |
| Water heating requirement                                             | 141.1382 | 124.2205 | 130.0368 | 115.9840 | 113.2365 | 100.5719 | 96.0091  | 106.1506 | 106.2134 | 120.2974 | 127.9382 | 137.5449 (64)   |
| Efficiency of water heater (217)m                                     | 82.6113  | 82.4232  | 81.9913  | 81.0263  | 79.2610  | 74.8000  | 74.8000  | 74.8000  | 74.8000  | 81.0023  | 82.1483  | 74.8000 (216)   |
| Fuel for water heating, kWh/month                                     | 170.8460 | 150.7106 | 158.5983 | 143.1436 | 142.8654 | 134.4544 | 128.3544 | 141.9125 | 141.9966 | 148.5111 | 155.7406 | 166.3279 (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1783.4613 (219) |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2624.3293 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 39.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 84.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 215.6211 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4707.4117 (238) |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2624.3293          | 0.2160                        | 566.8551 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1783.4613          | 0.2160                        | 385.2276 (264)           |
| Space and water heating                                                                           |                    |                               | 952.0828 (265)           |
| Pumps and fans                                                                                    | 84.0000            | 0.5190                        | 43.5960 (267)            |
| Energy for lighting                                                                               | 215.6211           | 0.5190                        | 111.9073 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1107.5861 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 21.9374 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.5785 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 1.0045 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (21.9374 * 1.00) + 2.5785 + 1.0045, rounded to 2 d.p. |                    |                               | 25.5200 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | D-1/2-01                                                                |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 82 B                                                                    | DER           | 19.62   | TER            | 19.24      |
| Environmental                      | 88 B                                                                    | % DER<TER     | -1.98   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.81                                                                    | DFEE          | 50.37   | TFEE           | 50.38      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 0.02    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 50 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 19.24 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 19.62 kgCO<sub>2</sub>/m<sup>2</sup>Fail  
Excess emissions =0.38 kgCO<sub>2</sub>/m<sup>2</sup> (2.0%)

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)50.4 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)50.4 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.18 (max. 0.30) | 0.18 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                             |                                      |
|-----------------------------|--------------------------------------|
| Hot water storage           | Measured cylinder loss: 0.74 kWh/day |
| Permitted by DBSCG 0.32     | Fail                                 |
| Primary pipework insulated: | No primary pipework                  |

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
|-------------------------|----------------------------------------------------------------------------------------------|

Hot water controls:

No cylinderstat

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.53   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 94%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |           |
|-----------------------------------|-----------|
| Overheating risk (Thames Valley): | High Fail |
|-----------------------------------|-----------|

Based on:

|                      |                                                                         |
|----------------------|-------------------------------------------------------------------------|
| Overshading:         | Average                                                                 |
| Windows facing East: | 7.32 m <sup>2</sup> , Overhang width less than twice window, ratio 1.00 |
| Windows facing West: | 6.66 m <sup>2</sup> , No overhang                                       |
| Air change rate:     | 0.50 ach                                                                |
| Blinds/curtains:     | None                                                                    |

#### 10 Key features

|                    |                                      |
|--------------------|--------------------------------------|
| Party wall U-value | 0.00 W/m <sup>2</sup> K              |
| Air permeability   | 3.0 m <sup>3</sup> /m <sup>2</sup> h |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 49.5000 (1b)              | x 2.5500 (2b)                   | = 126.2250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 49.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 126.2250 (5)              |

#### 2. Ventilation rate

|                                                                                              |                              |        |        |        | main<br>heating | +      | secondary<br>heating | +      | other  | =      | total                       | m3 per hour   |
|----------------------------------------------------------------------------------------------|------------------------------|--------|--------|--------|-----------------|--------|----------------------|--------|--------|--------|-----------------------------|---------------|
| Number of chimneys                                                                           |                              |        |        |        | 0               | +      | 0                    | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a)   |
| Number of open flues                                                                         |                              |        |        |        | 0               | +      | 0                    | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b)   |
| Number of intermittent fans                                                                  |                              |        |        |        |                 |        |                      |        |        |        | 0 * 10 =                    | 0.0000 (7a)   |
| Number of passive vents                                                                      |                              |        |        |        |                 |        |                      |        |        |        | 0 * 10 =                    | 0.0000 (7b)   |
| Number of flueless gas fires                                                                 |                              |        |        |        |                 |        |                      |        |        |        | 0 * 40 =                    | 0.0000 (7c)   |
| Air changes per hour                                                                         |                              |        |        |        |                 |        |                      |        |        |        |                             |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |        |        |                 |        |                      |        |        |        | 0.0000 / (5) =              | 0.0000 (8)    |
| Pressure test                                                                                |                              |        |        |        |                 |        |                      |        |        |        | Yes                         |               |
| Measured/design AP50                                                                         |                              |        |        |        |                 |        |                      |        |        |        | 3.0000                      |               |
| Infiltration rate                                                                            |                              |        |        |        |                 |        |                      |        |        |        | 0.1500                      | (18)          |
| Number of sides sheltered                                                                    |                              |        |        |        |                 |        |                      |        |        |        | 1                           | (19)          |
| Shelter factor                                                                               |                              |        |        |        |                 |        |                      |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.9250 (20)   |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |        |        |                 |        |                      |        |        |        | (21) = (18) x (20) =        | 0.1388 (21)   |
| Wind speed                                                                                   | Jan                          | Feb    | Mar    | Apr    | May             | Jun    | Jul                  | Aug    | Sep    | Oct    | Nov                         | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000 | 4.4000 | 4.3000          | 3.8000 | 3.8000               | 3.7000 | 4.0000 | 4.3000 | 4.5000                      | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250 | 1.1000 | 1.0750          | 0.9500 | 0.9500               | 0.9250 | 1.0000 | 1.0750 | 1.1250                      | 1.1750 (22a)  |
|                                                                                              | 0.1769                       | 0.1734 | 0.1700 | 0.1526 | 0.1492          | 0.1318 | 0.1318               | 0.1283 | 0.1388 | 0.1492 | 0.1561                      | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |        |        |                 |        |                      |        |        |        |                             |               |
| If mechanical ventilation:                                                                   |                              |        |        |        |                 |        |                      |        |        |        |                             | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |        |        |                 |        |                      |        |        |        |                             | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2774                       | 0.2739 | 0.2705 | 0.2531 | 0.2497          | 0.2323 | 0.2323               | 0.2288 | 0.2393 | 0.2497 | 0.2566                      | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| W29 (Uw = 1.40)                                                |                         |                            | 7.3200                    | 1.3258                        | 9.7045       |                                      | (27)            |
| W02 (Uw = 1.40)                                                |                         |                            | 6.6600                    | 1.3258                        | 8.8295       |                                      | (27)            |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                      | (26a)           |
| External Wall 1                                                | 55.6000                 | 13.9800                    | 41.6200                   | 0.1800                        | 7.4916       | 140.0000                             | 5826.8000 (29a) |
| stair wall                                                     | 22.2000                 | 2.1000                     | 20.1000                   | 0.1800                        | 3.6180       | 140.0000                             | 2814.0000 (29a) |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 77.8000                   |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 32.5837      |                                      | (33)            |
| Party Wall 1                                                   |                         |                            | 5.1000                    | 0.0000                        | 0.0000       | 140.0000                             | 714.0000 (32)   |
| Party Floor 1                                                  |                         |                            | 49.5000                   |                               |              | 80.0000                              | 3960.0000 (32d) |
| Party Ceilings                                                 |                         |                            | 49.5000                   |                               |              | 80.0000                              | 3960.0000 (32b) |
| Internal Wall                                                  |                         |                            | 64.4000                   |                               |              | 9.0000                               | 579.6000 (32c)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 17854.4000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 360.6949 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 7.5945 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 40.1782 (37)    |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 11.5551 | 11.4107 | 11.2662 | 10.5437 | 10.3992 | 9.6768  | 9.6768  | 9.5323  | 9.9658  | 10.3992 | 10.6882 | 10.9772 (38) |
| Heat transfer coeff       | 51.7333 | 51.5889 | 51.4444 | 50.7219 | 50.5774 | 49.8550 | 49.8550 | 49.7105 | 50.1440 | 50.5774 | 50.8664 | 51.1554 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 50.6858 (39) |
| HLP                       | 1.0451  | 1.0422  | 1.0393  | 1.0247  | 1.0218  | 1.0072  | 1.0072  | 1.0043  | 1.0130  | 1.0218  | 1.0276  | 1.0334 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.0240 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |         |         |         |         |         |         |         |         |         |         |         |              |
|------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Assumed occupancy                        |         |         |         |         |         |         |         |         |         |         |         | 1.6754 (42)  |
| Average daily hot water use (litres/day) |         |         |         |         |         |         |         |         |         |         |         | 77.8847 (43) |
| Daily hot water use                      | 85.6732 | 82.5578 | 79.4424 | 76.3270 | 73.2117 | 70.0963 | 70.0963 | 73.2117 | 76.3270 | 79.4424 | 82.5578 | 85.6732 (44) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy content (annual)                                         | 127.0509 | 111.1195 | 114.6654 | 99.9681  | 95.9218  | 82.7732  | 76.7015  | 88.0161  | 89.0673  | 103.7994            | 113.3051 | 123.0420 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1225.4303 (45) |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
| If cylinder contains dedicated solar storage                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| Primary loss                                                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 173.2533 | 152.8507 | 160.8678 | 144.6801 | 142.1242 | 127.4852 | 122.9039 | 134.2185 | 133.7793 | 150.0018            | 158.0171 | 169.2444 (62)  |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 79.2063  | 70.3322  | 75.0882  | 69.0090  | 68.8559  | 63.2917  | 62.4652  | 66.2273  | 65.3845  | 71.4752             | 73.4436  | 77.8734 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.0102  | 11.5556  | 9.3976   | 7.1146   | 5.3183   | 4.4899   | 4.8515   | 6.3062   | 8.4641   | 10.7471  | 12.5435  | 13.3718 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 145.9354 | 147.4497 | 143.6336 | 135.5095 | 125.2544 | 115.6159 | 109.1769 | 107.6625 | 111.4787 | 119.6027 | 129.8579 | 139.4963 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 (71) |
| Water heating gains (Table 5)                                                       | 106.4601 | 104.6610 | 100.9250 | 95.8458  | 92.5483  | 87.9051  | 83.9586  | 89.0152  | 90.8118  | 96.0688  | 102.0049 | 104.6685 (72) |
| Total internal gains                                                                | 313.5366 | 311.7972 | 302.0870 | 286.6008 | 271.2517 | 256.1418 | 246.1178 | 251.1147 | 258.8854 | 274.5495 | 292.5372 | 305.6675 (73) |

#### 6. Solar gains

| [Jan]       |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W   |      |
|-------------|----------|----------|------------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|--------------|------|
| East        |          |          | 7.3200     | 19.6403                        |          | 0.3700                            |          | 0.8900                             |          | 0.7700                       |          | 32.8083 (76) |      |
| West        |          |          | 6.6600     | 19.6403                        |          | 0.5600                            |          | 0.6800                             |          | 0.7700                       |          | 34.5185 (80) |      |
| -----       |          |          |            |                                |          |                                   |          |                                    |          |                              |          |              |      |
| Solar gains | 67.3268  | 131.7054 | 216.9001   | 316.3358                       | 387.6814 | 396.8609                          | 377.8278 | 324.5485                           | 252.2638 | 156.2796                     | 83.9486  | 55.3662      | (83) |
| Total gains | 380.8634 | 443.5026 | 518.9871   | 602.9366                       | 658.9331 | 653.0027                          | 623.9456 | 575.6632                           | 511.1491 | 430.8291                     | 376.4857 | 361.0338     | (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 95.8677 | 96.1362 | 96.4062 | 97.7793 | 98.0587 | 99.4796 | 99.4796 | 99.7688 | 98.9063 | 98.0587 | 97.5016 | 96.9508      |
| alpha                                                                       | 7.3912  | 7.4091  | 7.4271  | 7.5186  | 7.5372  | 7.6320  | 7.6320  | 7.6513  | 7.5938  | 7.5372  | 7.5001  | 7.4634       |
| util living area                                                            | 0.9987  | 0.9955  | 0.9784  | 0.8903  | 0.6968  | 0.4876  | 0.3515  | 0.3970  | 0.6652  | 0.9509  | 0.9958  | 0.9991 (86)  |
| MIT                                                                         | 20.3106 | 20.4451 | 20.6602 | 20.8900 | 20.9839 | 20.9990 | 20.9999 | 20.9998 | 20.9914 | 20.8336 | 20.5254 | 20.2879 (87) |
| Th 2                                                                        | 20.0459 | 20.0483 | 20.0507 | 20.0628 | 20.0652 | 20.0774 | 20.0774 | 20.0798 | 20.0725 | 20.0652 | 20.0604 | 20.0556 (88) |
| util rest of house                                                          | 0.9981  | 0.9934  | 0.9689  | 0.8531  | 0.6337  | 0.4179  | 0.2778  | 0.3177  | 0.5817  | 0.9238  | 0.9935  | 0.9987 (89)  |
| MIT 2                                                                       | 19.1388 | 19.3363 | 19.6448 | 19.9542 | 20.0537 | 20.0769 | 20.0773 | 20.0798 | 20.0680 | 19.8962 | 19.4635 | 19.1134 (90) |
| Living area fraction                                                        | 19.6951 | 19.8627 | 20.1268 | 20.3985 | 20.4953 | 20.5147 | 20.5153 | 20.5166 | 20.5064 | 20.3412 | 19.9676 | 19.6710 (91) |
| MIT                                                                         | 19.6951 | 19.8627 | 20.1268 | 20.3985 | 20.4953 | 20.5147 | 20.5153 | 20.5166 | 20.5064 | 20.3412 | 19.9676 | 19.6710 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.6951 | 19.8627 | 20.1268 | 20.3985 | 20.4953 | 20.5147 | 20.5153 | 20.5166 | 20.5064 | 20.3412 | 19.9676 | 19.6710 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |                           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec                       |
| Useful gains         | 0.9978   | 0.9929   | 0.9698   | 0.8674   | 0.6633   | 0.4510   | 0.3128   | 0.3554   | 0.6215   | 0.9330   | 0.9932   | 0.9984 (94)               |
| Ext temp.            | 380.0100 | 440.3640 | 503.2946 | 523.0011 | 437.0954 | 294.5016 | 195.1804 | 204.5879 | 317.6676 | 401.9722 | 373.9359 | 360.4720 (95)             |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)               |
| Month fracti         | 796.4400 | 771.9092 | 701.0245 | 583.2252 | 444.8455 | 294.8766 | 195.1993 | 204.6361 | 321.2415 | 492.6859 | 654.5303 | 791.4247 (97)             |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)              |
| Space heating        | 309.8246 | 222.7984 | 147.1111 | 43.3613  | 5.7661   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 67.4910  | 202.0280 | 320.6288 (98)             |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 1319.0091 (98)            |
|                      |          |          |          |          |          |          |          |          |          |          |          | (98) / (4) = 26.6466 (99) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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8c. Space cooling requirement  
-----

Not applicable

-----  
9b. Energy requirements  
-----

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1319.0091 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 1450.9100 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1769.4263 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 1946.3689 (310a) |
| Electricity used for heat distribution                                                  | 33.9728 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 102.0214 (330a)  |
| Total electricity for the above, kWh/year                                               | 102.0214 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 229.7650 (332)   |
| Total delivered energy for all uses                                                     | 3729.0653 (338)  |

-----  
12b. Carbon dioxide emissions - Community heating scheme  
-----

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 3617.9755          | 0.2160                        | 781.4827 (367)           |
| Electrical energy for heat distribution                                                    | 33.9728            | 0.5190                        | 17.6319 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 799.1146 (373)           |
| Space and water heating                                                                    |                    |                               | 799.1146 (376)           |
| Pumps and fans                                                                             | 102.0214           | 0.5190                        | 52.9491 (378)            |
| Energy for lighting                                                                        | 229.7650           | 0.5190                        | 119.2480 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 971.3117 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 19.6200 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 19.6200 ZC1 |
| Total Floor Area                                                                | TFA | 49.5000     |
| Assumed number of occupants                                                     | N   | 1.6754      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.4704 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 3.2164 ZC3  |
| Total CO2 emissions                                                             |     | 40.3067 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 40.3067 ZC8 |

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 49.5000 (1b)              | x 2.5500 (2b)                   | = 126.2250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 49.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 126.2250 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour    |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|----------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                          |                              |                      |       |       | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 20.0000 / (5) = 0.1584 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                        |
| Measured/design AP50                                 |                              |                      |       |       | 5.0000                     |
| Infiltration rate                                    |                              |                      |       |       | 0.4084 (18)                |
| Number of sides sheltered                            |                              |                      |       |       | 1 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.9250 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.3778 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4817 | 0.4723 | 0.4628 | 0.4156 | 0.4061 | 0.3589 | 0.3589 | 0.3495 | 0.3778 | 0.4061 | 0.4250 | 0.4439 (22b) |
| Effective ac    | 0.6160 | 0.6115 | 0.6071 | 0.5864 | 0.5825 | 0.5644 | 0.5644 | 0.5611 | 0.5714 | 0.5825 | 0.5903 | 0.5985 (25)  |

#### 3. Heat losses and heat loss parameter

|                                                                     |                |                |                |                       |                |                   |                |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------|-----------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|------|
| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2  | U-value<br>W/m2K      | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                |      |
| TER Semi-glazed door                                                |                |                | 2.1000         | 1.2000                | 2.5200         |                   |                | (26a)          |                |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                | 10.2700        | 1.3258                | 13.6155        |                   |                | (27)           |                |                |                |                |      |
| External Wall 1                                                     | 55.6000        | 10.2700        | 45.3300        | 0.1800                | 8.1594         |                   |                | (29a)          |                |                |                |                |      |
| stair wall                                                          | 22.2000        | 2.1000         | 20.1000        | 0.1800                | 3.6180         |                   |                | (29a)          |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 77.8000        |                       |                |                   |                | (31)           |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                | (26)... (30) + (32) = | 27.9129        |                   |                | (33)           |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                       |                |                   |                | 250.0000 (35)  |                |                |                |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                |                       |                |                   |                | 4.3455 (36)    |                |                |                |                |      |
| Total fabric heat loss                                              |                |                |                |                       |                | (33) + (36) =     |                | 32.2584 (37)   |                |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                       |                |                   |                |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>25.6600 | Feb<br>25.4723 | Mar<br>25.2884 | Apr<br>24.4244        | May<br>24.2627 | Jun<br>23.5102    | Jul<br>23.5102 | Aug<br>23.3708 | Sep<br>23.8001 | Oct<br>24.2627 | Nov<br>24.5897 | Dec<br>24.9316 | (38) |
| Heat transfer coeff                                                 | 57.9184        | 57.7308        | 57.5468        | 56.6828               | 56.5211        | 55.7686           | 55.7686        | 55.6293        | 56.0585        | 56.5211        | 56.8482        | 57.1901        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                |                       |                |                   |                |                |                |                |                | 56.6820        | (39) |
| HLP                                                                 | Jan<br>1.1701  | Feb<br>1.1663  | Mar<br>1.1626  | Apr<br>1.1451         | May<br>1.1418  | Jun<br>1.1266     | Jul<br>1.1266  | Aug<br>1.1238  | Sep<br>1.1325  | Oct<br>1.1418  | Nov<br>1.1484  | Dec<br>1.1554  | (40) |
| HLP (average)                                                       |                |                |                |                       |                |                   |                |                |                |                |                | 1.1451         | (40) |
| Days in month                                                       | 31             | 28             | 31             | 30                    | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |         |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |                    |          | 1.6754 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |                    |          | 73.9905 (43)   |
| Daily hot water use                                         | 81.3896  | 78.4299  | 75.4703  | 72.5107 | 69.5511 | 66.5915 | 66.5915 | 69.5511 | 72.5107 | 75.4703            | 78.4299  | 81.3896 (44)   |
| Energy conte                                                | 120.6984 | 105.5636 | 108.9321 | 94.9697 | 91.1257 | 78.6345 | 72.8664 | 83.6153 | 84.6139 | 98.6094            | 107.6399 | 116.8899 (45)  |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1164.1588 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 18.1048  | 15.8345  | 16.3398  | 14.2455 | 13.6688 | 11.7952 | 10.9300 | 12.5423 | 12.6921 | 14.7914            | 16.1460  | 17.5335 (46)   |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |         |         |         |         |         |         |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |                    |          | 0.1290 (55)    |
| Total storage loss                                          |          |          |          |         |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501 (64) |
|                                                                 | 61.9403  | 54.7975  | 58.0280  | 52.6820  | 52.1074  | 47.2506  | 46.0362  | 49.6102  | 49.2388  | 54.5957  | 56.8949  | 60.6740 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.0577  | 11.5978  | 9.4319   | 7.1406   | 5.3377   | 4.5063   | 4.8692   | 6.3292   | 8.4950   | 10.7863  | 12.5893  | 13.4206  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 145.9354 | 147.4497 | 143.6336 | 135.5095 | 125.2544 | 115.6159 | 109.1769 | 107.6625 | 111.4787 | 119.6027 | 129.8579 | 139.4963 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | (71) |
| Water heating gains (Table 5)                                                       | 83.2531  | 81.5440  | 77.9947  | 73.1695  | 70.0368  | 65.6258  | 61.8766  | 66.6804  | 68.3872  | 73.3814  | 79.0207  | 81.5511  | (72) |
| Total internal gains                                                                | 293.3771 | 291.7223 | 282.1911 | 266.9505 | 251.7597 | 236.8789 | 227.0536 | 231.8029 | 239.4917 | 254.9013 | 272.5987 | 285.5989 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| East        |          |          |          |          | 5.3800     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 32.2925      |               |
| West        |          |          |          |          | 4.8900     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 29.3513 (80) |               |
| <hr/>       |          |          |          |          |            |                                |                                   |                                    |                              |          |              |               |
| Solar gains | 61.6438  | 120.5884 | 198.5919 | 289.6345 | 354.9579   | 363.3626                       | 345.9360                          | 297.1539                           | 230.9706                     | 143.0883 | 76.8626      | 50.6929 (83)  |
| Total gains | 355.0209 | 412.3107 | 480.7830 | 556.5849 | 606.7176   | 600.2415                       | 572.9896                          | 528.9568                           | 470.4623                     | 397.9896 | 349.4613     | 336.2918 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 59.3507 | 59.5436 | 59.7340 | 60.6445 | 60.8179 | 61.6386 | 61.6386 | 61.7930 | 61.3199 | 60.8179 | 60.4681 | 60.1066 |              |
| alpha                                                                       | 4.9567  | 4.9696  | 4.9823  | 5.0430  | 5.0545  | 5.1092  | 5.1092  | 5.1195  | 5.0880  | 5.0545  | 5.0312  | 5.0071  |              |
| util living area                                                            | 0.9956  | 0.9901  | 0.9718  | 0.9083  | 0.7698  | 0.5770  | 0.4250  | 0.4776  | 0.7447  | 0.9503  | 0.9907  | 0.9966  | (86)         |
| MIT                                                                         | 19.8397 | 20.0140 | 20.3049 | 20.6576 | 20.8886 | 20.9798 | 20.9965 | 20.9938 | 20.9306 | 20.6017 | 20.1574 | 19.8141 | (87)         |
| Th 2                                                                        | 19.9440 | 19.9471 | 19.9501 | 19.9642 | 19.9668 | 19.9791 | 19.9791 | 19.9814 | 19.9744 | 19.9668 | 19.9615 | 19.9559 | (88)         |
| util rest of house                                                          | 0.9941  | 0.9869  | 0.9625  | 0.8801  | 0.7106  | 0.4924  | 0.3281  | 0.3751  | 0.6614  | 0.9286  | 0.9871  | 0.9955  | (89)         |
| MIT 2                                                                       | 18.4125 | 18.6677 | 19.0871 | 19.5822 | 19.8663 | 19.9669 | 19.9779 | 19.9791 | 19.9238 | 19.5220 | 18.8880 | 18.3837 | (90)         |
| Living area fraction                                                        | 19.0901 | 19.3068 | 19.6652 | 20.0928 | 20.3517 | 20.4477 | 20.4615 | 20.4608 | 20.4017 | 20.0346 | 19.4907 | 19.0628 | (92)         |
| Temperature adjustment                                                      | 19.0901 | 19.3068 | 19.6652 | 20.0928 | 20.3517 | 20.4477 | 20.4615 | 20.4608 | 20.4017 | 20.0346 | 19.4907 | 19.0628 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 0.9925   | 0.9843   | 0.9594   | 0.8840   | 0.7339   | 0.5321   | 0.3743   | 0.4239   | 0.6981   | 0.9303   | 0.9850   | 0.9942    | (94)  |
| Ext temp.            | 352.3662 | 405.8536 | 461.2712 | 492.0255 | 445.2601 | 319.3615 | 214.4415 | 224.2304 | 328.4427 | 370.2658 | 344.2066 | 334.3271  | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Month fracti         | 856.6178 | 831.7178 | 757.6175 | 634.4370 | 489.0012 | 326.1207 | 215.3495 | 225.9004 | 353.2663 | 533.2545 | 704.3860 | 850.0047  | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating per m2 | 375.1631 | 286.1807 | 220.4816 | 102.5363 | 32.5434  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 121.2635 | 259.3292 | 383.6641  | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 1781.1621 | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 35.9831   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1904.9862 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 375.1631 | 286.1807 | 220.4816 | 102.5363 | 32.5434  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 121.2635 | 259.3292 | 383.6641  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 401.2440 | 306.0757 | 235.8092 | 109.6645 | 34.8058  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 129.6936 | 277.3574 | 410.3359  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501  | (64)            |
| Efficiency of water heater (217)m                                     | 87.1933  | 86.8585  | 86.0922  | 84.3684  | 81.8876  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.7147  | 86.5461  | 87.3030   | (216)           |
| Fuel for water heating, kWh/month                                     | 169.6903 | 149.8824 | 158.1936 | 143.8340 | 144.5711 | 131.5981 | 125.4719 | 138.9417 | 139.0911 | 148.5806 | 154.8546 | 165.1147  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1769.8242 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1904.9862 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 230.6035  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3980.4138 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1904.9862          | 0.2160                        | 411.4770 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1769.8242          | 0.2160                        | 382.2820 (264)           |
| Space and water heating                                                                           |                    |                               | 793.7590 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 230.6035           | 0.5190                        | 119.6832 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 952.3672 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 16.0355 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.4178 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7864 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (16.0355 * 1.00) + 2.4178 + 0.7864, rounded to 2 d.p. |                    |                               | 19.2400 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | D-1/2-02                                                                |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 83 B                                                                    | DER           | 17.34   | TER            | 17.51      |
| Environmental                      | 89 B                                                                    | % DER<TER     | 0.96    |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.76                                                                    | DFEE          | 40.68   | TFEE           | 42.07      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 3.29    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Top-floor flat, total floor area 51 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 17.51 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 17.34 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)42.1 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)40.7 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.18 (max. 0.30) | 0.18 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls: No cylinderstat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing East: 3.33 m<sup>2</sup>, No overhang  
Windows facing South: 12.19 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 51.4000 (1b)              | x 2.5500 (2b)                   | = 131.0700 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 131.0700 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |        |             |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |        |             |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)   |             |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 1                           | (19)   |             |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.9250 | (20)        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1388 | (21)        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1769                       | 0.1734 | 0.1700    | 0.1526 | 0.1492 | 0.1318 | 0.1318                      | 0.1283 | 0.1388      | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2774                       | 0.2739 | 0.2705    | 0.2531 | 0.2497 | 0.2323 | 0.2323                      | 0.2288 | 0.2393      | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                    | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2          | U-value<br>W/m2K | A x U<br>W/K                             | K-value<br>kJ/m2K | A x K<br>kJ/K   |
|------------------------------------------------------------|-------------|----------------|------------------------|------------------|------------------------------------------|-------------------|-----------------|
| W03 (Uw = 1.40)                                            |             |                | 8.3900                 | 1.3258           | 11.1231                                  |                   | (27)            |
| W02 (Uw = 1.40)                                            |             |                | 7.1300                 | 1.3258           | 9.4527                                   |                   | (27)            |
| door                                                       |             |                | 2.1000                 | 1.4000           | 2.9400                                   |                   | (26a)           |
| External Wall 1                                            | 57.1000     | 15.5200        | 41.5800                | 0.1800           | 7.4844                                   | 140.0000          | 5821.2000 (29a) |
| stair wall                                                 | 13.5000     | 2.1000         | 11.4000                | 0.1800           | 2.0520                                   | 140.0000          | 1596.0000 (29a) |
| Total net area of external elements Aum(A, m2)             |             |                | 70.6000                |                  |                                          |                   | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                        |             |                | (26) ... (30) + (32) = |                  | 33.0522                                  |                   | (33)            |
| Party Wall 1                                               |             |                | 8.4000                 | 0.0000           | 0.0000                                   | 140.0000          | 1176.0000 (32)  |
| Party Floor 1                                              |             |                | 51.4000                |                  |                                          | 80.0000           | 4112.0000 (32d) |
| Party Ceilings 1                                           |             |                | 51.4000                |                  |                                          | 80.0000           | 4112.0000 (32b) |
| Internal Wall                                              |             |                | 95.0000                |                  |                                          | 9.0000            | 855.0000 (32c)  |
| Heat capacity Cm = Sum(A x k)                              |             |                |                        |                  | (28) ... (30) + (32) + (32a) ... (32e) = |                   | 17672.2000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K          |             |                |                        |                  |                                          |                   | 343.8171 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) |             |                |                        |                  |                                          |                   | 7.1785 (36)     |
| Total fabric heat loss                                     |             |                |                        |                  |                                          | (33) + (36) =     | 40.2307 (37)    |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                  |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.7314 (42)      |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 79.2842 (43)     |
| Daily hot water use                      | Jan 87.2127 | Feb 84.0413 | Mar 80.8699 | Apr 77.6986 | May 74.5272 | Jun 71.3558 | Jul 71.3558 | Aug 74.5272 | Sep 77.6986 | Oct 80.8699 | Nov 84.0413 | Dec 87.2127 (44) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Energy content (annual)                                         | 129.3339 | 113.1162 | 116.7258 | 101.7644 | 97.6454  | 84.2605  | 78.0798  | 89.5977  | 90.6677  | 105.6645 | 115.3411 | 125.2529 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          | 19.4001  | 16.9674  | 17.5089  | 15.2647  | 14.6468  | 12.6391  | 11.7120  | 13.4396  | 13.6002  | 15.8497  | 17.3012  | 1247.4498 (45) |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)    |
| Total storage loss                                              | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month | 175.5363 | 154.8474 | 162.9282 | 146.4764 | 143.8478 | 128.9725 | 124.2822 | 135.8001 | 135.3797 | 151.8669 | 160.0531 | 171.4553 (62)  |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)    |
| Output from w/h                                                 | 175.5363 | 154.8474 | 162.9282 | 146.4764 | 143.8478 | 128.9725 | 124.2822 | 135.8001 | 135.3797 | 151.8669 | 160.0531 | 171.4553 (64)  |
| Heat gains from water heating, kWh/month                        | 79.9654  | 70.9961  | 75.7733  | 69.6063  | 69.4290  | 63.7862  | 62.9234  | 66.7531  | 65.9166  | 72.0954  | 74.1205  | 78.6085 (65)   |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |          |          |          |          |          |          |          | 1791.4458 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.4501  | 11.9463  | 9.7153   | 7.3551   | 5.4981   | 4.6417   | 5.0155   | 6.5193   | 8.7503   | 11.1105  | 12.9675  | 13.8239 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 150.8691 | 152.4347 | 148.4896 | 140.0908 | 129.4890 | 119.5247 | 112.8679 | 111.3024 | 115.2475 | 123.6462 | 134.2481 | 144.2124 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 (71) |
| Water heating gains (Table 5)                                                       | 107.4804 | 105.6490 | 101.8458 | 96.6754  | 93.3185  | 88.5920  | 84.5745  | 89.7220  | 91.5509  | 96.9024  | 102.9451 | 105.6566 (72) |
| Total internal gains                                                                | 320.7702 | 319.0005 | 309.0212 | 293.0919 | 277.2761 | 261.7289 | 251.4285 | 256.5142 | 264.5192 | 280.6296 | 299.1314 | 312.6635 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |              | Gains<br>W |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|------------|----------|---------------|
| South       |          |          |          | 8.3900     | 46.7521                        | 0.3700                            | 0.8900                             | 0.7700                       | 89.5133 (78) |            |          |               |
| East        |          |          |          | 3.3300     | 19.6403                        | 0.5600                            | 0.6800                             | 0.7700                       | 17.2592 (76) |            |          |               |
| South       |          |          |          | 3.8000     | 46.7521                        | 0.5600                            | 0.6800                             | 0.7700                       | 46.8829 (78) |            |          |               |
| Solar gains | 153.6555 | 257.1446 | 340.1513 | 402.6949   | 434.5115                       | 424.2517                          | 411.9743                           | 389.2214                     | 361.9129     | 281.0007   | 183.1963 | 132.0521 (83) |
| Total gains | 474.4257 | 576.1451 | 649.1726 | 695.7867   | 711.7876                       | 685.9806                          | 663.4028                           | 645.7356                     | 626.4320     | 561.6303   | 482.3277 | 444.7155 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 93.9883 | 94.2590 | 94.5314 | 95.9170 | 96.1990 | 97.6343 | 97.6343 | 97.9265 | 97.0551 | 96.1990 | 95.6366 | 95.0808      |
| alpha                                                                       | 7.2659  | 7.2839  | 7.3021  | 7.3945  | 7.4133  | 7.5090  | 7.5090  | 7.5284  | 7.4703  | 7.4133  | 7.3758  | 7.3387       |
| util living area                                                            | 0.9945  | 0.9787  | 0.9341  | 0.8237  | 0.6553  | 0.4682  | 0.3334  | 0.3570  | 0.5540  | 0.8547  | 0.9812  | 0.9964 (86)  |
| MIT                                                                         | 20.4250 | 20.6055 | 20.7893 | 20.9336 | 20.9883 | 20.9992 | 20.9999 | 20.9999 | 20.9972 | 20.9270 | 20.6542 | 20.3897 (87) |
| Th 2                                                                        | 20.0699 | 20.0723 | 20.0748 | 20.0869 | 20.0894 | 20.1015 | 20.1015 | 20.1040 | 20.0967 | 20.0894 | 20.0845 | 20.0796 (88) |
| util rest of house                                                          | 0.9922  | 0.9707  | 0.9125  | 0.7801  | 0.5958  | 0.4030  | 0.2654  | 0.2875  | 0.4831  | 0.8067  | 0.9727  | 0.9948 (89)  |
| MIT 2                                                                       | 19.3276 | 19.5865 | 19.8379 | 20.0241 | 20.0809 | 20.1012 | 20.1015 | 20.1040 | 20.0952 | 20.0235 | 19.6684 | 19.2844 (90) |
| Living area fraction                                                        | 19.8037 | 20.0286 | 20.2506 | 20.4187 | 20.4746 | 20.4908 | 20.4913 | 20.4927 | 20.4865 | 20.4155 | 20.0961 | 19.7639 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.8037 | 20.0286 | 20.2506 | 20.4187 | 20.4746 | 20.4908 | 20.4913 | 20.4927 | 20.4865 | 20.4155 | 20.0961 | 19.7639 (93) |

#### 8. Space heating requirement

|                | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|----------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Utilisation    | 0.9914   | 0.9703   | 0.9171   | 0.7967   | 0.6214   | 0.4313   | 0.2949   | 0.3177   | 0.5139   | 0.8251   | 0.9729   | 0.9941 (94)   |
| Useful gains   | 470.3374 | 559.0242 | 595.3440 | 554.3276 | 442.3035 | 295.8738 | 195.6365 | 205.1361 | 321.9084 | 463.3746 | 469.2449 | 442.1121 (95) |
| Ext temp.      | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)   |
| Heat loss rate | W        |          |          |          |          |          |          |          |          |          |          |               |
|                | 809.7466 | 787.8858 | 714.0609 | 589.5149 | 447.7598 | 296.1811 | 195.6509 | 205.1611 | 323.0233 | 500.8760 | 667.0788 | 803.5525 (97) |
| Month fracti   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)  |
| Space heating  | kWh      |          |          |          |          |          |          |          |          |          |          |               |
|                | 252.5205 | 153.7950 | 88.3254  | 25.3349  | 4.0595   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 27.9010  | 142.4404 | 268.9117 (98) |
| Space heating  |          |          |          |          |          |          |          |          |          |          |          | 963.2883 (98) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 18.7410 (99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |           |        |
|-----------------------------------------------------------------------------------------|-----------|--------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)  |
| Fraction of space heat from community system                                            | 1.0000    | (302)  |
| Fraction of heat from community Boilers                                                 | 1.0000    | (303a) |
| Fraction of total space heat from community Boilers                                     | 1.0000    | (304a) |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)  |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a) |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000    | (306)  |
| Space heating:                                                                          |           |        |
| Annual space heating requirement                                                        | 963.2883  | (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 1059.6171 | (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)  |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)  |
| Water heating                                                                           |           |        |
| Annual water heating requirement                                                        | 1791.4458 | (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 1970.5904 | (310a) |
| Electricity used for heat distribution                                                  | 30.3021   | (313)  |
| Annual totals kWh/year                                                                  |           |        |
| Electricity for pumps and fans:                                                         |           |        |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |           |        |
| mechanical ventilation fans (SFP = 0.6625)                                              | 105.9373  | (330a) |
| Total electricity for the above, kWh/year                                               | 105.9373  | (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 237.5329  | (332)  |
| Total delivered energy for all uses                                                     | 3373.6777 | (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 3227.0581          | 0.2160                        | 697.0445 (367)           |
| Electrical energy for heat distribution                                                    | 30.3021            | 0.5190                        | 15.7268 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 712.7713 (373)           |
| Space and water heating                                                                    |                    |                               | 712.7713 (376)           |
| Pumps and fans                                                                             | 105.9373           | 0.5190                        | 54.9815 (378)            |
| Energy for lighting                                                                        | 237.5329           | 0.5190                        | 123.2796 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 891.0323 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 17.3400 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |  |         |     |
|---------------------------------------------------------------------------------|--|---------|-----|
| DER                                                                             |  | 17.3400 | ZC1 |
| Total Floor Area                                                                |  | 51.4000 |     |
| Assumed number of occupants                                                     |  | 1.7314  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             |  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |  | 17.3934 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |  | 3.1236  | ZC3 |
| Total CO2 emissions                                                             |  | 37.8570 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |  | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |  | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |  | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |  | 37.8570 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 51.4000 (1b)              | x 2.5500 (2b)                   | = 131.0700 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 131.0700 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1526 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.4026 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 1 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3724 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4748 | 0.4655 | 0.4562 | 0.4096 | 0.4003 | 0.3538 | 0.3538 | 0.3445 | 0.3724 | 0.4003 | 0.4189 | 0.4376 (22b) |
| Effective ac    | 0.6127 | 0.6083 | 0.6041 | 0.5839 | 0.5801 | 0.5626 | 0.5626 | 0.5593 | 0.5693 | 0.5801 | 0.5878 | 0.5957 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2  | U-value<br>W/m2K     | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------|----------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|------|
| TER Semi-glazed door                                                |                |                | 2.1000         | 1.2000               | 2.5200         |                   |                | (26a)          |                |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                | 10.7500        | 1.3258               | 14.2519        |                   |                | (27)           |                |                |                |                |      |
| External Wall 1                                                     | 57.1000        | 10.7500        | 46.3500        | 0.1800               | 8.3430         |                   |                | (29a)          |                |                |                |                |      |
| stair wall                                                          | 13.5000        | 2.1000         | 11.4000        | 0.1800               | 2.0520         |                   |                | (29a)          |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 70.6000        |                      |                |                   |                | (31)           |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                | (26)...(30) + (32) = | 27.1669        |                   |                | (33)           |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                      |                |                   |                | 250.0000 (35)  |                |                |                |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                |                      |                |                   |                | 5.2610 (36)    |                |                |                |                |      |
| Total fabric heat loss                                              |                |                |                |                      |                | (33) + (36) =     | 32.4279        | (37)           |                |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                      |                |                   |                |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>26.5020 | Feb<br>26.3127 | Mar<br>26.1271 | Apr<br>25.2555       | May<br>25.0924 | Jun<br>24.3333    | Jul<br>24.3333 | Aug<br>24.1927 | Sep<br>24.6257 | Oct<br>25.0924 | Nov<br>25.4223 | Dec<br>25.7672 | (38) |
| Heat transfer coeff                                                 | 58.9299        | 58.7406        | 58.5550        | 57.6834              | 57.5203        | 56.7612           | 56.7612        | 56.6206        | 57.0536        | 57.5203        | 57.8502        | 58.1951        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                |                      |                |                   |                |                |                |                |                | 57.6826        | (39) |
| HLP                                                                 | Jan<br>1.1465  | Feb<br>1.1428  | Mar<br>1.1392  | Apr<br>1.1222        | May<br>1.1191  | Jun<br>1.1043     | Jul<br>1.1043  | Aug<br>1.1016  | Sep<br>1.1100  | Oct<br>1.1191  | Nov<br>1.1255  | Dec<br>1.1322  | (40) |
| HLP (average)                                                       |                |                |                |                      |                |                   |                |                |                |                |                | 1.1222         | (40) |
| Days in month                                                       | 31             | 28             | 31             | 30                   | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |         |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |                    |          | 1.7314 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |                    |          | 75.3200 (43)   |
| Jan                                                         | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov                | Dec      |                |
| Daily hot water use                                         | 82.8520  | 79.8392  | 76.8264  | 73.8136 | 70.8008 | 67.7880 | 67.7880 | 70.8008 | 73.8136 | 76.8264            | 79.8392  | 82.8520 (44)   |
| Energy conte                                                | 122.8672 | 107.4604 | 110.8895 | 96.6762 | 92.7631 | 80.0475 | 74.1758 | 85.1178 | 86.1344 | 100.3813           | 109.5740 | 118.9903 (45)  |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1185.0773 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |         |         |         |         |         |         |                    |          |                |
|                                                             | 18.4301  | 16.1191  | 16.6334  | 14.5014 | 13.9145 | 12.0071 | 11.1264 | 12.7677 | 12.9202 | 15.0572            | 16.4361  | 17.8485 (46)   |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |         |         |         |         |         |         |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |                    |          | 0.1290 (55)    |
| Total storage loss                                          |          |          |          |         |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 150.1273 | 132.0825 | 138.1497 | 123.0570 | 120.0232 | 106.4283 | 101.4359 | 112.3779 | 112.5151 | 127.6414 | 135.9548 | 146.2504 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 150.1273 | 132.0825 | 138.1497 | 123.0570 | 120.0232 | 106.4283 | 101.4359 | 112.3779 | 112.5151 | 127.6414 | 135.9548 | 146.2504 (64) |
|                                                                 | 62.6614  | 55.4282  | 58.6789  | 53.2495  | 52.6518  | 47.7204  | 46.4716  | 50.1098  | 49.7443  | 55.1849  | 57.5380  | 61.3724 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.4909  | 11.9825  | 9.7448   | 7.3775   | 5.5147   | 4.6558   | 5.0307   | 6.5391   | 8.7768   | 11.1442  | 13.0069  | 13.8659  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 150.8691 | 152.4347 | 148.4896 | 140.0908 | 129.4890 | 119.5247 | 112.8679 | 111.3024 | 115.2475 | 123.6462 | 134.2481 | 144.2124 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | (71) |
| Water heating gains (Table 5)                                                       | 84.2224  | 82.4825  | 78.8695  | 73.9576  | 70.7686  | 66.2784  | 62.4618  | 67.3518  | 69.0893  | 74.1732  | 79.9139  | 82.4898  | (72) |
| Total internal gains                                                                | 300.5530 | 298.8703 | 289.0744 | 273.3964 | 257.7429 | 242.4294 | 232.3310 | 237.1639 | 245.0842 | 260.9342 | 279.1395 | 292.5386 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W    |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|---------------|---------------|
| East        |          |          |          |          | 2.3100     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 13.8654       |               |
| South       |          |          |          |          | 8.4400     | 46.7521                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 120.5910 (76) |               |
| <hr/>       |          |          |          |          |            |                                |                                   |                                    |                              |          |               |               |
| Solar gains | 134.4564 | 224.6206 | 296.2449 | 349.4824 | 376.1350   | 366.8741                       | 356.4134                          | 337.4001                           | 314.7526                     | 245.2035 | 160.2300      | 115.6040 (83) |
| Total gains | 435.0094 | 523.4909 | 585.3193 | 622.8788 | 633.8779   | 609.3035                       | 588.7444                          | 574.5640                           | 559.8368                     | 506.1378 | 439.3695      | 408.1426 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 60.5710 | 60.7662 | 60.9588 | 61.8799 | 62.0554 | 62.8853 | 62.8853 | 63.0415 | 62.5630 | 62.0554 | 61.7015 | 61.3358 |              |
| alpha                                                                       | 5.0381  | 5.0511  | 5.0639  | 5.1253  | 5.1370  | 5.1924  | 5.1924  | 5.2028  | 5.1709  | 5.1370  | 5.1134  | 5.0891  |              |
| util living area                                                            | 0.9908  | 0.9768  | 0.9472  | 0.8804  | 0.7588  | 0.5791  | 0.4213  | 0.4492  | 0.6651  | 0.8983  | 0.9788  | 0.9931  | (86)         |
| MIT                                                                         | 19.9887 | 20.2053 | 20.4606 | 20.7253 | 20.9008 | 20.9808 | 20.9969 | 20.9957 | 20.9607 | 20.7362 | 20.3135 | 19.9508 | (87)         |
| Th 2                                                                        | 19.9630 | 19.9660 | 19.9689 | 19.9827 | 19.9853 | 19.9973 | 19.9973 | 19.9996 | 19.9927 | 19.9853 | 19.9801 | 19.9746 | (88)         |
| util rest of house                                                          | 0.9879  | 0.9699  | 0.9319  | 0.8474  | 0.6997  | 0.4957  | 0.3269  | 0.3537  | 0.5826  | 0.8628  | 0.9713  | 0.9910  | (89)         |
| MIT 2                                                                       | 18.6422 | 18.9552 | 19.3167 | 19.6829 | 19.8963 | 19.9856 | 19.9963 | 19.9979 | 19.9656 | 19.7077 | 19.1243 | 18.5958 | (90)         |
| Living area fraction                                                        | 19.2264 | 19.4976 | 19.8130 | 20.1352 | 20.3321 | 20.4174 | 20.4304 | 20.4308 | 20.3973 | 20.1539 | 19.6402 | 19.1837 | (92)         |
| Temperature adjustment                                                      | 19.2264 | 19.4976 | 19.8130 | 20.1352 | 20.3321 | 20.4174 | 20.4304 | 20.4308 | 20.3973 | 20.1539 | 19.6402 | 19.1837 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 0.9852   | 0.9661   | 0.9292   | 0.8529   | 0.7210   | 0.5314   | 0.3680   | 0.3952   | 0.6170   | 0.8695   | 0.9682   | 0.9887    | (94)  |
| Ext temp.            | 428.5853 | 505.7321 | 543.8524 | 531.2384 | 457.0122 | 323.7709 | 216.6380 | 227.0951 | 345.3966 | 440.0616 | 425.3786 | 403.5386  | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Month fracti         | 879.6094 | 857.4694 | 779.5446 | 648.0835 | 496.5225 | 330.1998 | 217.4172 | 228.2269 | 359.2853 | 549.5448 | 725.4556 | 871.9781  | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating per m2 | 335.5619 | 236.3675 | 175.3550 | 84.1285  | 29.3956  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 81.4555  | 216.0554 | 348.5190  | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 1506.8384 | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 29.3159   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1611.5919 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 335.5619 | 236.3675 | 175.3550 | 84.1285  | 29.3956  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 81.4555  | 216.0554 | 348.5190  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 358.8897 | 252.7994 | 187.5455 | 89.9770  | 31.4392  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 87.1182  | 231.0753 | 372.7476  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 150.1273 | 132.0825 | 138.1497 | 123.0570 | 120.0232 | 106.4283 | 101.4359 | 112.3779 | 112.5151 | 127.6414 | 135.9548 | 146.2504  | (64)            |
| Efficiency of water heater (217)m                                     | 86.8984  | 86.3494  | 85.4510  | 83.8243  | 81.7004  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 83.6529  | 86.0440  | 87.0498   | (216)           |
| Fuel for water heating, kWh/month                                     | 172.7619 | 152.9628 | 161.6712 | 146.8035 | 146.9066 | 133.3688 | 127.1127 | 140.8245 | 140.9964 | 152.5846 | 158.0061 | 168.0078  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1802.0065 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1611.5919 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 238.2541  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3726.8525 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1611.5919          | 0.2160                        | 348.1038 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1802.0065          | 0.2160                        | 389.2334 (264)           |
| Space and water heating                                                                           |                    |                               | 737.3373 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 238.2541           | 0.5190                        | 123.6539 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 899.9161 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 14.3451 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.4057 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7573 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (14.3451 * 1.00) + 2.4057 + 0.7573, rounded to 2 d.p. |                    |                               | 17.5100 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | D-3-01                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 79 C                                                                    | DER           | 24.79   | TER            | 23.68      |
| Environmental                      | 84 B                                                                    | % DER<TER     | -4.69   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.03                                                                    | DFEE          | 69.97   | TFEE           | 73.17      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 4.38    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 50 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating: Mains gas (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 23.68 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 24.79 kgCO<sub>2</sub>/m<sup>2</sup> Fail  
Excess emissions = 1.11 kgCO<sub>2</sub>/m<sup>2</sup> (4.7%)

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 73.2 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 70.0 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element          | Average          | Highest          |    |
|------------------|------------------|------------------|----|
| External wall    | 0.18 (max. 0.30) | 0.18 (max. 0.70) | OK |
| Party wall       | 0.00 (max. 0.20) | -                | OK |
| Floor (no floor) |                  |                  |    |
| Roof             | 0.13 (max. 0.20) | 0.13 (max. 0.35) | OK |
| Openings         | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                             |                                      |
|-----------------------------|--------------------------------------|
| Hot water storage           | Measured cylinder loss: 0.74 kWh/day |
| Permitted by DBSCG 0.32     | Fail                                 |
| Primary pipework insulated: | No primary pipework                  |

#### 6 Controls

|                         |                                                                                            |    |
|-------------------------|--------------------------------------------------------------------------------------------|----|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room stats | OK |
|-------------------------|--------------------------------------------------------------------------------------------|----|

Hot water controls:

No cylinder stat

#### 7 Low energy lights

|                                                           |     |    |
|-----------------------------------------------------------|-----|----|
| Percentage of fixed lights with low-energy fittings: 100% |     |    |
| Minimum                                                   | 75% | OK |

#### 8 Mechanical ventilation

|                                      |      |    |
|--------------------------------------|------|----|
| Continuous supply and extract system |      |    |
| Specific fan power:                  | 0.53 |    |
| Maximum                              | 1.5  | OK |
| MVHR efficiency:                     | 94%  |    |
| Minimum:                             | 70%  | OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                      |                                                                         |
|----------------------|-------------------------------------------------------------------------|
| Overshading:         | Average                                                                 |
| Windows facing East: | 7.32 m <sup>2</sup> , Overhang width less than twice window, ratio 1.00 |
| Windows facing West: | 6.66 m <sup>2</sup> , No overhang                                       |
| Air change rate:     | 0.50 ach                                                                |
| Blinds/curtains:     | None                                                                    |

#### 10 Key features

|                    |                                      |
|--------------------|--------------------------------------|
| Party wall U-value | 0.00 W/m <sup>2</sup> K              |
| Air permeability   | 3.0 m <sup>3</sup> /m <sup>2</sup> h |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 49.5000 (1b)              | x 2.5500 (2b)                   | = 126.2250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 49.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 126.2250 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes    |             |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000 |             |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 | (18)        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 1      | (19)        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.9250 | (20)        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1388 | (21)        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1769                       | 0.1734 | 0.1700    | 0.1526 | 0.1492 | 0.1318 | 0.1318                      | 0.1283 | 0.1388      | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2774                       | 0.2739 | 0.2705    | 0.2531 | 0.2497 | 0.2323 | 0.2323                      | 0.2288 | 0.2393      | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| W29 (Uw = 1.40)                                                |                         |                            | 7.3200                    | 1.3258                        | 9.7045       |                                      | (27)            |
| W02 (Uw = 1.40)                                                |                         |                            | 6.6600                    | 1.3258                        | 8.8295       |                                      | (27)            |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                      | (26a)           |
| External Wall 1                                                | 55.6000                 | 13.9800                    | 41.6200                   | 0.1800                        | 7.4916       | 140.0000                             | 5826.8000 (29a) |
| stair wall                                                     | 22.2000                 | 2.1000                     | 20.1000                   | 0.1800                        | 3.6180       | 140.0000                             | 2814.0000 (29a) |
| External Roof 1                                                | 49.5000                 |                            | 49.5000                   | 0.1300                        | 6.4350       | 9.0000                               | 445.5000 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 127.3000                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 39.0187      |                                      | (33)            |
| Party Wall 1                                                   |                         |                            | 5.1000                    | 0.0000                        | 0.0000       | 140.0000                             | 714.0000 (32)   |
| Party Floor 1                                                  |                         |                            | 49.5000                   |                               |              | 80.0000                              | 3960.0000 (32d) |
| Internal Wall                                                  |                         |                            | 64.4000                   |                               |              | 9.0000                               | 579.6000 (32c)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 14339.9000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 289.6949 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 18.7175 (36)    |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 57.7362 (37)    |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan        | Feb        | Mar        | Apr        | May        | Jun        | Jul        | Aug        | Sep        | Oct        | Nov        | Dec             |
|---------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|-----------------|
| (38)m                     | 11.5551    | 11.4107    | 11.2662    | 10.5437    | 10.3992    | 9.6768     | 9.6768     | 9.5323     | 9.9658     | 10.3992    | 10.6882    | 10.9772 (38)    |
| Heat transfer coeff       | 69.2913    | 69.1469    | 69.0024    | 68.2799    | 68.1354    | 67.4130    | 67.4130    | 67.2685    | 67.7020    | 68.1354    | 68.4244    | 68.7134 (39)    |
| Average = Sum(39)m / 12 = |            |            |            |            |            |            |            |            |            |            |            | 68.2438 (39)    |
| HLP                       | Jan 1.3998 | Feb 1.3969 | Mar 1.3940 | Apr 1.3794 | May 1.3765 | Jun 1.3619 | Jul 1.3619 | Aug 1.3590 | Sep 1.3677 | Oct 1.3765 | Nov 1.3823 | Dec 1.3881 (40) |
| HLP (average)             |            |            |            |            |            |            |            |            |            |            |            | 1.3787 (40)     |
| Days in month             | 31         | 28         | 31         | 30         | 31         | 30         | 31         | 31         | 30         | 31         | 30         | 31 (41)         |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                  |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.6754 (42)      |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 77.8847 (43)     |
| Daily hot water use                      | Jan 85.6732 | Feb 82.5578 | Mar 79.4424 | Apr 76.3270 | May 73.2117 | Jun 70.0963 | Jul 70.0963 | Aug 73.2117 | Sep 76.3270 | Oct 79.4424 | Nov 82.5578 | Dec 85.6732 (44) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy content (annual)                                         | 127.0509 | 111.1195 | 114.6654 | 99.9681  | 95.9218  | 82.7732  | 76.7015  | 88.0161  | 89.0673  | 103.7994            | 113.3051 | 123.0420 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1225.4303 (45) |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
| If cylinder contains dedicated solar storage                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| Primary loss                                                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 173.2533 | 152.8507 | 160.8678 | 144.6801 | 142.1242 | 127.4852 | 122.9039 | 134.2185 | 133.7793 | 150.0018            | 158.0171 | 169.2444 (62)  |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 79.2063  | 70.3322  | 75.0882  | 69.0090  | 68.8559  | 63.2917  | 62.4652  | 66.2273  | 65.3845  | 71.4752             | 73.4436  | 77.8734 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.0102  | 11.5556  | 9.3976   | 7.1146   | 5.3183   | 4.4899   | 4.8515   | 6.3062   | 8.4641   | 10.7471  | 12.5435  | 13.3718 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 145.9354 | 147.4497 | 143.6336 | 135.5095 | 125.2544 | 115.6159 | 109.1769 | 107.6625 | 111.4787 | 119.6027 | 129.8579 | 139.4963 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 (71) |
| Water heating gains (Table 5)                                                       | 106.4601 | 104.6610 | 100.9250 | 95.8458  | 92.5483  | 87.9051  | 83.9586  | 89.0152  | 90.8118  | 96.0688  | 102.0049 | 104.6685 (72) |
| Total internal gains                                                                | 313.5366 | 311.7972 | 302.0870 | 286.6008 | 271.2517 | 256.1418 | 246.1178 | 251.1147 | 258.8854 | 274.5495 | 292.5372 | 305.6675 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|
| East        |          |          |          |          | 7.3200     | 19.6403                        | 0.3700                            | 0.8900                             |          |          | 0.7700                       | 32.8083 (76)  |
| West        |          |          |          |          | 6.6600     | 19.6403                        | 0.5600                            | 0.6800                             |          |          | 0.7700                       | 34.5185 (80)  |
| Solar gains | 67.3268  | 131.7054 | 216.9001 | 316.3358 | 387.6814   | 396.8609                       | 377.8278                          | 324.5485                           | 252.2638 | 156.2796 | 83.9486                      | 55.3662 (83)  |
| Total gains | 380.8634 | 443.5026 | 518.9871 | 602.9366 | 658.9331   | 653.0027                       | 623.9456                          | 575.6632                           | 511.1491 | 430.8291 | 376.4857                     | 361.0338 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 57.4863 | 57.6065 | 57.7271 | 58.3379 | 58.4616 | 59.0881 | 59.0881 | 59.2150 | 58.8359 | 58.4616 | 58.2147 | 57.9699      |
| alpha                                                                       | 4.8324  | 4.8404  | 4.8485  | 4.8892  | 4.8974  | 4.9392  | 4.9392  | 4.9477  | 4.9224  | 4.8974  | 4.8810  | 4.8647       |
| util living area                                                            | 0.9969  | 0.9930  | 0.9796  | 0.9313  | 0.8138  | 0.6291  | 0.4690  | 0.5257  | 0.7917  | 0.9638  | 0.9934  | 0.9976 (86)  |
| MIT                                                                         | 19.7403 | 19.9093 | 20.2019 | 20.5698 | 20.8416 | 20.9663 | 20.9935 | 20.9889 | 20.8983 | 20.5229 | 20.0624 | 19.7109 (87) |
| Th 2                                                                        | 19.7635 | 19.7657 | 19.7679 | 19.7792 | 19.7814 | 19.7927 | 19.7927 | 19.7949 | 19.7882 | 19.7814 | 19.7769 | 19.7724 (88) |
| util rest of house                                                          | 0.9956  | 0.9902  | 0.9713  | 0.9040  | 0.7484  | 0.5243  | 0.3438  | 0.3942  | 0.6967  | 0.9436  | 0.9903  | 0.9966 (89)  |
| MIT 2                                                                       | 18.1207 | 18.3679 | 18.7908 | 19.3084 | 19.6445 | 19.7744 | 19.7909 | 19.7915 | 19.7191 | 19.2598 | 18.6001 | 18.0840 (90) |
| Living area fraction                                                        | 18.8896 | 19.0997 | 19.4607 | 19.9073 | 20.2128 | 20.3403 | 20.3618 | 20.3600 | 20.2789 | 19.8595 | 19.2943 | 18.8564 (91) |
| MIT                                                                         | 18.8896 | 19.0997 | 19.4607 | 19.9073 | 20.2128 | 20.3403 | 20.3618 | 20.3600 | 20.2789 | 19.8595 | 19.2943 | 18.8564 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 18.8896 | 19.0997 | 19.4607 | 19.9073 | 20.2128 | 20.3403 | 20.3618 | 20.3600 | 20.2789 | 19.8595 | 19.2943 | 18.8564 (93) |

#### 8. Space heating requirement

|                      |           |          |          |          |          |          |          |          |          |          |          |                           |
|----------------------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|
| Utilisation          | Jan       | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec                       |
| Useful gains         | 0.9944    | 0.9882   | 0.9687   | 0.9074   | 0.7735   | 0.5735   | 0.4036   | 0.4572   | 0.7386   | 0.9453   | 0.9886   | 0.9956 (94)               |
| Ext temp.            | 378.7343  | 438.2615 | 502.7463 | 547.0783 | 509.6774 | 374.5182 | 251.8246 | 263.1880 | 377.5536 | 407.2436 | 372.1979 | 359.4543 (95)             |
| Heat loss rate W     | 4.3000    | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)               |
| Month fracti         | 1010.9322 | 981.8646 | 894.3196 | 751.5743 | 580.0223 | 386.9684 | 253.5965 | 266.3821 | 418.3223 | 630.8968 | 834.3898 | 1007.0878 (97)            |
| Space heating kWh    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)              |
| Space heating        | 470.3552  | 365.3013 | 291.3306 | 147.2371 | 52.3366  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 166.3979 | 332.7782 | 481.8393 (98)             |
| Space heating per m2 |           |          |          |          |          |          |          |          |          |          |          | 2307.5762 (98)            |
|                      |           |          |          |          |          |          |          |          |          |          |          | (98) / (4) = 46.6177 (99) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

-----  
8c. Space cooling requirement  
-----

Not applicable

-----  
9b. Energy requirements  
-----

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 2307.5762 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 2538.3338 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1769.4263 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 1946.3689 (310a) |
| Electricity used for heat distribution                                                  | 44.8470 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 102.0214 (330a)  |
| Total electricity for the above, kWh/year                                               | 102.0214 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 229.7650 (332)   |
| Total delivered energy for all uses                                                     | 4816.4891 (338)  |

-----  
12b. Carbon dioxide emissions - Community heating scheme  
-----

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 4776.0412          | 0.2160                        | 1031.6249 (367)          |
| Electrical energy for heat distribution                                                    | 44.8470            | 0.5190                        | 23.2756 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 1054.9005 (373)          |
| Space and water heating                                                                    |                    |                               | 1054.9005 (376)          |
| Pumps and fans                                                                             | 102.0214           | 0.5190                        | 52.9491 (378)            |
| Energy for lighting                                                                        | 229.7650           | 0.5190                        | 119.2480 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1227.0976 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 24.7900 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 24.7900 ZC1 |
| Total Floor Area                                                                | TFA 49.5000 |
| Assumed number of occupants                                                     | N 1.6754    |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF 0.5190   |
| CO2 emissions from appliances, equation (L14)                                   | 17.4704 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 3.2164 ZC3  |
| Total CO2 emissions                                                             | 45.4767 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 45.4767 ZC8 |

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 49.5000 (1b)              | x 2.5500 (2b)                   | = 126.2250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 49.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 126.2250 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1584 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.4084 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 1 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3778 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4817 | 0.4723 | 0.4628 | 0.4156 | 0.4061 | 0.3589 | 0.3589 | 0.3495 | 0.3778 | 0.4061 | 0.4250 | 0.4439 (22b) |
| Effective ac    | 0.6160 | 0.6115 | 0.6071 | 0.5864 | 0.5825 | 0.5644 | 0.5644 | 0.5611 | 0.5714 | 0.5825 | 0.5903 | 0.5985 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K                 | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K              |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|------------------------------|--------------------------------|----------------------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200                       |                                | (26a)                      |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 10.2700                   | 1.3258                        | 13.6155                      |                                | (27)                       |
| External Wall 1                                                | 55.6000                 | 10.2700                    | 45.3300                   | 0.1800                        | 8.1594                       |                                | (29a)                      |
| stair wall                                                     | 22.2000                 | 2.1000                     | 20.1000                   | 0.1800                        | 3.6180                       |                                | (29a)                      |
| External Roof 1                                                | 49.5000                 |                            | 49.5000                   | 0.1300                        | 6.4350                       |                                | (30)                       |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 127.3000                  |                               |                              |                                | (31)                       |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           |                               | (26)...(30) + (32) = 34.3479 |                                | (33)                       |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |                              |                                | 250.0000 (35)              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |                              |                                | 15.4685 (36)               |
| Total fabric heat loss                                         |                         |                            |                           |                               |                              |                                | (33) + (36) = 49.8164 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 25.6600 | 25.4723 | 25.2884 | 24.4244 | 24.2627 | 23.5102 | 23.5102 | 23.3708 | 23.8001 | 24.2627 | 24.5897 | 24.9316 (38) |
| Heat transfer coeff       | 75.4764 | 75.2888 | 75.1048 | 74.2408 | 74.0791 | 73.3266 | 73.3266 | 73.1873 | 73.6165 | 74.0791 | 74.4062 | 74.7481 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 74.2400 (39) |
| HLP                       | 1.5248  | 1.5210  | 1.5173  | 1.4998  | 1.4965  | 1.4813  | 1.4813  | 1.4785  | 1.4872  | 1.4965  | 1.5032  | 1.5101 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.4998 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |         |          | 1.6754 (42)                       |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|---------|----------|-----------------------------------|
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |         |          | 73.9905 (43)                      |
|                                                             | Jan      | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov      | Dec                               |
| Daily hot water use                                         | 81.3896  | 78.4299  | 75.4703  | 72.5107 | 69.5511 | 66.5915 | 66.5915 | 69.5511 | 72.5107 | 75.4703 | 78.4299  | 81.3896 (44)                      |
| Energy conte                                                | 120.6984 | 105.5636 | 108.9321 | 94.9697 | 91.1257 | 78.6345 | 72.8664 | 83.6153 | 84.6139 | 98.6094 | 107.6399 | 116.8899 (45)                     |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         |         |          | Total = Sum(45)m = 1164.1588 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 18.1048  | 15.8345  | 16.3398  | 14.2455 | 13.6688 | 11.7952 | 10.9300 | 12.5423 | 12.6921 | 14.7914 | 16.1460  | 17.5335 (46)                      |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |         |          | 2.0000 (47)                       |
| Store volume                                                |          |          |          |         |         |         |         |         |         |         |          | 0.2388 (48)                       |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |         |          | 0.5400 (49)                       |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |         |          | 0.1290 (55)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |         |          |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501 (64) |
| Heat gains from water heating, kWh/month                        | 61.9403  | 54.7975  | 58.0280  | 52.6820  | 52.1074  | 47.2506  | 46.0362  | 49.6102  | 49.2388  | 54.5957  | 56.8949  | 60.6740 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.0577  | 11.5978  | 9.4319   | 7.1406   | 5.3377   | 4.5063   | 4.8692   | 6.3292   | 8.4950   | 10.7863  | 12.5893  | 13.4206 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 145.9354 | 147.4497 | 143.6336 | 135.5095 | 125.2544 | 115.6159 | 109.1769 | 107.6625 | 111.4787 | 119.6027 | 129.8579 | 139.4963 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 (71) |
| Water heating gains (Table 5)                                                       | 83.2531  | 81.5440  | 77.9947  | 73.1695  | 70.0368  | 65.6258  | 61.8766  | 66.6804  | 68.3872  | 73.3814  | 79.0207  | 81.5511 (72)  |
| Total internal gains                                                                | 293.3771 | 291.7223 | 282.1911 | 266.9505 | 251.7597 | 236.8789 | 227.0536 | 231.8029 | 239.4917 | 254.9013 | 272.5987 | 285.5989 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W    |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|---------------|
| East        |          |          |          | 5.3800     | 19.6403                        | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 32.2925 (76)  |
| West        |          |          |          | 4.8900     | 19.6403                        | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 29.3513 (80)  |
| -----       |          |          |          |            |                                |                                   |          |                                    |          |                              |          |               |
| Solar gains | 61.6438  | 120.5884 | 198.5919 | 289.6345   | 354.9579                       | 363.3626                          | 345.9360 | 297.1539                           | 230.9706 | 143.0883                     | 76.8626  | 50.6929 (83)  |
| Total gains | 355.0209 | 412.3107 | 480.7830 | 556.5849   | 606.7176                       | 600.2415                          | 572.9896 | 528.9568                           | 470.4623 | 397.9896                     | 349.4613 | 336.2918 (84) |
| -----       |          |          |          |            |                                |                                   |          |                                    |          |                              |          |               |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 45.5440 | 45.6575 | 45.7694 | 46.3020 | 46.4031 | 46.8793 | 46.8793 | 46.9686 | 46.6947 | 46.4031 | 46.1991 | 45.9878      |
| alpha                                                                       | 4.0363  | 4.0438  | 4.0513  | 4.0868  | 4.0935  | 4.1253  | 4.1253  | 4.1312  | 4.1130  | 4.0935  | 4.0799  | 4.0659       |
| util living area                                                            | 0.9957  | 0.9915  | 0.9793  | 0.9411  | 0.8511  | 0.6956  | 0.5388  | 0.5968  | 0.8340  | 0.9665  | 0.9921  | 0.9965 (86)  |
| MIT                                                                         | 19.3892 | 19.5723 | 19.9007 | 20.3320 | 20.6921 | 20.9074 | 20.9751 | 20.9624 | 20.7934 | 20.3115 | 19.7743 | 19.3608 (87) |
| Th 2                                                                        | 19.6690 | 19.6718 | 19.6746 | 19.6876 | 19.6901 | 19.7015 | 19.7015 | 19.7036 | 19.6971 | 19.6901 | 19.6851 | 19.6800 (88) |
| util rest of house                                                          | 0.9942  | 0.9885  | 0.9716  | 0.9182  | 0.7936  | 0.5866  | 0.3916  | 0.4471  | 0.7478  | 0.9490  | 0.9887  | 0.9953 (89)  |
| MIT 2                                                                       | 17.5696 | 17.8378 | 18.3141 | 18.9305 | 19.4015 | 19.6439 | 19.6935 | 19.6898 | 19.5394 | 18.9172 | 18.1423 | 17.5353 (90) |
| Living area fraction                                                        | 18.4334 | 18.6613 | 19.0673 | 19.5958 | 20.0142 | 20.2437 | 20.3019 | 20.2940 | 20.1347 | 19.5791 | 18.9171 | 18.4020 (92) |
| MIT                                                                         | 18.4334 | 18.6613 | 19.0673 | 19.5958 | 20.0142 | 20.2437 | 20.3019 | 20.2940 | 20.1347 | 19.5791 | 18.9171 | 18.4020 (93) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 18.4334 | 18.6613 | 19.0673 | 19.5958 | 20.0142 | 20.2437 | 20.3019 | 20.2940 | 20.1347 | 19.5791 | 18.9171 | 18.4020 (93) |

#### 8. Space heating requirement

|                      |           |           |          |          |          |          |          |          |          |          |          |                |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Useful gains         | 352.2176  | 406.2735  | 464.9174 | 509.9808 | 491.2399 | 381.2791 | 264.7523 | 274.3318 | 367.2934 | 376.9226 | 344.5353 | 334.1402 (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 1066.7409 | 1036.0695 | 943.8668 | 794.0681 | 615.9100 | 413.8365 | 271.4504 | 284.9905 | 444.2548 | 665.1670 | 879.2667 | 1061.5690 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 531.6053  | 423.2230  | 356.3383 | 204.5428 | 92.7546  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 214.4538 | 385.0066 | 541.2070 (98)  |
| Space heating        |           |           |          |          |          |          |          |          |          |          |          | 2749.1315 (98) |
| Space heating per m2 |           |           |          |          |          |          |          |          |          |          |          | 55.5380 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2940.2476 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 531.6053 | 423.2230 | 356.3383 | 204.5428 | 92.7546  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 214.4538 | 385.0066 | 541.2070  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 568.5619 | 452.6449 | 381.1105 | 218.7624 | 99.2028  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 229.3623 | 411.7718 | 578.8311  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501  | (64)            |
| Efficiency of water heater (217)m                                     | 87.9329  | 87.7327  | 87.2645  | 86.1964  | 84.1719  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 86.2240  | 87.4715  | 88.0177   | (217)           |
| Fuel for water heating, kWh/month                                     | 168.2630 | 148.3890 | 156.0683 | 140.7837 | 140.6477 | 131.5981 | 125.4719 | 138.9417 | 139.0911 | 145.9797 | 153.2164 | 163.7739  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1752.2245 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2940.2476 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 230.6035  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4998.0756 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2940.2476          | 0.2160                        | 635.0935 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1752.2245          | 0.2160                        | 378.4805 (264)           |
| Space and water heating                                                                           |                    |                               | 1013.5740 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 230.6035           | 0.5190                        | 119.6832 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1172.1822 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 20.4762 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.4178 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7864 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (20.4762 * 1.00) + 2.4178 + 0.7864, rounded to 2 d.p. |                    |                               | 23.6800 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | D-3-02                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP - Be Lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 80 C                                                                    | DER           | 22.58   | TER            | 21.72      |
| Environmental                      | 85 B                                                                    | % DER<TER     | -3.96   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.98                                                                    | DFEE          | 61.35   | TFEE           | 63.85      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 3.90    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Top-floor flat, total floor area 51 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 21.72 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 22.58 kgCO<sub>2</sub>/m<sup>2</sup>Fail  
Excess emissions =0.86 kgCO<sub>2</sub>/m<sup>2</sup> (4.0%)

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)63.8 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)61.4 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element             | Average          | Highest          |    |
|---------------------|------------------|------------------|----|
| External wall       | 0.18 (max. 0.30) | 0.18 (max. 0.70) | OK |
| Party wall          | 0.00 (max. 0.20) | -                | OK |
| Floor<br>(no floor) |                  |                  |    |
| Roof                | 0.13 (max. 0.20) | 0.13 (max. 0.35) | OK |
| Openings            | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls:

No cylinderstat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail

Based on:

Overshading: Average  
Windows facing East: 3.33 m<sup>2</sup>, No overhang  
Windows facing South: 12.19 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 51.4000 (1b)              | x 2.5500 (2b)                   | = 131.0700 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 131.0700 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes    |             |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000 |             |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 | (18)        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 1      | (19)        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.9250 | (20)        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1388 | (21)        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1769                       | 0.1734 | 0.1700    | 0.1526 | 0.1492 | 0.1318 | 0.1318                      | 0.1283 | 0.1388      | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2774                       | 0.2739 | 0.2705    | 0.2531 | 0.2497 | 0.2323 | 0.2323                      | 0.2288 | 0.2393      | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                    | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K     | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K |                                                      |
|------------------------------------------------------------|-------------|----------------|---------------|----------------------|--------------|-------------------|---------------|------------------------------------------------------|
| W03 (Uw = 1.40)                                            |             |                | 8.3900        | 1.3258               | 11.1231      |                   |               | (27)                                                 |
| W02 (Uw = 1.40)                                            |             |                | 7.1300        | 1.3258               | 9.4527       |                   |               | (27)                                                 |
| door                                                       |             |                | 2.1000        | 1.4000               | 2.9400       |                   |               | (26a)                                                |
| External Wall 1                                            | 57.1000     | 15.5200        | 41.5800       | 0.1800               | 7.4844       | 140.0000          | 5821.2000     | (29a)                                                |
| stair wall                                                 | 13.5000     | 2.1000         | 11.4000       | 0.1800               | 2.0520       | 140.0000          | 1596.0000     | (29a)                                                |
| External Roof 1                                            | 51.4000     |                | 51.4000       | 0.1300               | 6.6820       | 9.0000            | 462.6000      | (30)                                                 |
| Total net area of external elements Aum(A, m2)             |             |                | 122.0000      |                      |              |                   |               | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                        |             |                |               | (26)...(30) + (32) = | 39.7342      |                   |               | (33)                                                 |
| Party Wall 1                                               |             |                | 8.4000        | 0.0000               | 0.0000       | 140.0000          | 1176.0000     | (32)                                                 |
| Party Floor 1                                              |             |                | 51.4000       |                      |              | 80.0000           | 4112.0000     | (32d)                                                |
| Internal Wall                                              |             |                | 95.0000       |                      |              | 9.0000            | 855.0000      | (32c)                                                |
| Heat capacity Cm = Sum(A x k)                              |             |                |               |                      |              |                   |               | (28)...(30) + (32) + (32a)...(32e) = 14022.8000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K          |             |                |               |                      |              |                   |               | 272.8171 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) |             |                |               |                      |              |                   |               | 19.6885 (36)                                         |
| Total fabric heat loss                                     |             |                |               |                      |              | (33) + (36) =     | 59.4227       | (37)                                                 |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                  |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.7314 (42)      |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 79.2842 (43)     |
| Daily hot water use                      | Jan 87.2127 | Feb 84.0413 | Mar 80.8699 | Apr 77.6986 | May 74.5272 | Jun 71.3558 | Jul 71.3558 | Aug 74.5272 | Sep 77.6986 | Oct 80.8699 | Nov 84.0413 | Dec 87.2127 (44) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Energy content (annual)                                         | 129.3339 | 113.1162 | 116.7258 | 101.7644 | 97.6454  | 84.2605  | 78.0798  | 89.5977  | 90.6677  | 105.6645 | 115.3411 | 125.2529 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          | 19.4001  | 16.9674  | 17.5089  | 15.2647  | 14.6468  | 12.6391  | 11.7120  | 13.4396  | 13.6002  | 15.8497  | 17.3012  | 1247.4498 (45) |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)    |
| Total storage loss                                              | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month | 175.5363 | 154.8474 | 162.9282 | 146.4764 | 143.8478 | 128.9725 | 124.2822 | 135.8001 | 135.3797 | 151.8669 | 160.0531 | 171.4553 (62)  |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)    |
| Output from w/h                                                 | 175.5363 | 154.8474 | 162.9282 | 146.4764 | 143.8478 | 128.9725 | 124.2822 | 135.8001 | 135.3797 | 151.8669 | 160.0531 | 171.4553 (64)  |
| Heat gains from water heating, kWh/month                        | 79.9654  | 70.9961  | 75.7733  | 69.6063  | 69.4290  | 63.7862  | 62.9234  | 66.7531  | 65.9166  | 72.0954  | 74.1205  | 78.6085 (65)   |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |          |          |          |          |          |          |          | 1791.4458 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.4501  | 11.9463  | 9.7153   | 7.3551   | 5.4981   | 4.6417   | 5.0155   | 6.5193   | 8.7503   | 11.1105  | 12.9675  | 13.8239 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 150.8691 | 152.4347 | 148.4896 | 140.0908 | 129.4890 | 119.5247 | 112.8679 | 111.3024 | 115.2475 | 123.6462 | 134.2481 | 144.2124 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 (71) |
| Water heating gains (Table 5)                                                       | 107.4804 | 105.6490 | 101.8458 | 96.6754  | 93.3185  | 88.5920  | 84.5745  | 89.7220  | 91.5509  | 96.9024  | 102.9451 | 105.6566 (72) |
| Total internal gains                                                                | 320.7702 | 319.0005 | 309.0212 | 293.0919 | 277.2761 | 261.7289 | 251.4285 | 256.5142 | 264.5192 | 280.6296 | 299.1314 | 312.6635 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W   |
|-------------|----------|----------|----------|------------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|--------------|
|             |          |          |          |            |                                |          |                                   |          |                                    |          |                              |          |              |
| South       |          |          |          | 8.3900     | 46.7521                        |          | 0.3700                            |          | 0.8900                             |          | 0.7700                       |          | 89.5133 (78) |
| East        |          |          |          | 3.3300     | 19.6403                        |          | 0.5600                            |          | 0.6800                             |          | 0.7700                       |          | 17.2592 (76) |
| South       |          |          |          | 3.8000     | 46.7521                        |          | 0.5600                            |          | 0.6800                             |          | 0.7700                       |          | 46.8829 (78) |
|             |          |          |          |            |                                |          |                                   |          |                                    |          |                              |          |              |
| Solar gains | 153.6555 | 257.1446 | 340.1513 | 402.6949   | 434.5115                       | 424.2517 | 411.9743                          | 389.2214 | 361.9129                           | 281.0007 | 183.1963                     | 132.0521 | (83)         |
| Total gains | 474.4257 | 576.1451 | 649.1726 | 695.7867   | 711.7876                       | 685.9806 | 663.4028                          | 645.7356 | 626.4320                           | 561.6303 | 482.3277                     | 444.7155 | (84)         |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 54.5386 | 54.6534 | 54.7687 | 55.3526 | 55.4709 | 56.0698 | 56.0698 | 56.1912 | 55.8287                   | 55.4709 | 55.2348 | 55.0008      |
| alpha                                                                       | 4.6359  | 4.6436  | 4.6512  | 4.6902  | 4.6981  | 4.7380  | 4.7380  | 4.7461  | 4.7219                    | 4.6981  | 4.6823  | 4.6667       |
| util living area                                                            | 0.9916  | 0.9793  | 0.9536  | 0.8962  | 0.7872  | 0.6163  | 0.4544  | 0.4849  | 0.7026                    | 0.9133  | 0.9813  | 0.9936 (86)  |
| MIT                                                                         | 19.8172 | 20.0444 | 20.3243 | 20.6255 | 20.8476 | 20.9640 | 20.9930 | 20.9905 | 20.9320                   | 20.6427 | 20.1675 | 19.7729 (87) |
| Th 2                                                                        | 19.7714 | 19.7736 | 19.7759 | 19.7871 | 19.7894 | 19.8007 | 19.8007 | 19.8029 | 19.7961                   | 19.7894 | 19.7849 | 19.7804 (88) |
| util rest of house                                                          | 0.9886  | 0.9722  | 0.9378  | 0.8615  | 0.7209  | 0.5144  | 0.3339  | 0.3634  | 0.6052                    | 0.8765  | 0.9737  | 0.9914 (89)  |
| MIT                                                                         | 18.2460 | 18.5740 | 18.9707 | 19.3859 | 19.6571 | 19.7804 | 19.7986 | 19.7999 | 19.7520                   | 19.4209 | 18.7628 | 18.1882 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4339 (91)  |
| MIT                                                                         | 18.9277 | 19.2119 | 19.5579 | 19.9237 | 20.1736 | 20.2939 | 20.3168 | 20.3164 | 20.2640                   | 19.9510 | 19.3722 | 18.8757 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.9277 | 19.2119 | 19.5579 | 19.9237 | 20.1736 | 20.2939 | 20.3168 | 20.3164 | 20.2640                   | 19.9510 | 19.3722 | 18.8757 (93) |

#### 8. Space heating requirement

|                   | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
|-------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation       | 9858      | 0.9681    | 0.9344   | 0.8659   | 0.7436   | 0.5579   | 0.3865   | 0.4164   | 0.6453   | 0.8822   | 0.9703   | 0.9890 (94)    |
| Useful gains      | 467.6800  | 557.7437  | 606.5990 | 602.4913 | 529.2740 | 382.6784 | 256.3988 | 268.8962 | 404.2353 | 495.4900 | 467.9875 | 439.8336 (95)  |
| Ext temp.         | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Heat loss rate W  | 1044.7268 | 1020.0298 | 928.6975 | 775.7482 | 595.0239 | 395.5584 | 258.2108 | 271.4898 | 430.0652 | 656.6383 | 865.4502 | 1039.3540 (97) |
| Month fracti      | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating kWh | 429.3228  | 310.6563  | 239.6413 | 124.7450 | 48.9179  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 119.8944 | 286.1731 | 446.0432 (98)  |
| Space heating     |           |           |          |          |          |          |          |          |          |          |          | 2005.3940 (98) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 39.0154 (99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 2005.3940 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 2205.9333 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1791.4458 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 1970.5904 (310a) |
| Electricity used for heat distribution                                                  | 41.7652 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 105.9373 (330a)  |
| Total electricity for the above, kWh/year                                               | 105.9373 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 237.5329 (332)   |
| Total delivered energy for all uses                                                     | 4519.9939 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 4447.8421          | 0.2160                        | 960.7339 (367)           |
| Electrical energy for heat distribution                                                    | 41.7652            | 0.5190                        | 21.6762 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 982.4101 (373)           |
| Space and water heating                                                                    |                    |                               | 982.4101 (376)           |
| Pumps and fans                                                                             | 105.9373           | 0.5190                        | 54.9815 (378)            |
| Energy for lighting                                                                        | 237.5329           | 0.5190                        | 123.2796 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1160.6711 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 22.5800 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 22.5800 ZC1 |
| Total Floor Area                                                                | 51.4000     |
| Assumed number of occupants                                                     | N 1.7314    |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF 0.5190   |
| CO2 emissions from appliances, equation (L14)                                   | 17.3934 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 3.1236 ZC3  |
| Total CO2 emissions                                                             | 43.0970 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 43.0970 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 51.4000 (1b)              | x 2.5500 (2b)                   | = 131.0700 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 131.0700 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m3 per hour                |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour       |
| Pressure test                                                             |                 |                      |       |                             | 20.0000 / (5) = 0.1526 (8) |
| Measured/design AP50                                                      |                 |                      |       |                             | Yes                        |
| Infiltration rate                                                         |                 |                      |       |                             | 5.0000                     |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0.4026 (18)                |
|                                                                           |                 |                      |       |                             | 1 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.9250 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3724 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4748 | 0.4655 | 0.4562 | 0.4096 | 0.4003 | 0.3538 | 0.3538 | 0.3445 | 0.3724 | 0.4003 | 0.4189 | 0.4376 (22b) |
|                 | 0.6127 | 0.6083 | 0.6041 | 0.5839 | 0.5801 | 0.5626 | 0.5626 | 0.5593 | 0.5693 | 0.5801 | 0.5878 | 0.5957 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 10.7500                   | 1.3258                        | 14.2519      |                                | (27)          |
| External Wall 1                                                | 57.1000                 | 10.7500                    | 46.3500                   | 0.1800                        | 8.3430       |                                | (29a)         |
| stair wall                                                     | 13.5000                 | 2.1000                     | 11.4000                   | 0.1800                        | 2.0520       |                                | (29a)         |
| External Roof 1                                                | 51.4000                 |                            | 51.4000                   | 0.1300                        | 6.6820       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 122.0000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 33.8489      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 16.2370 (36)  |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 50.0859 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 26.5020 | 26.3127 | 26.1271 | 25.2555 | 25.0924 | 24.3333 | 24.3333 | 24.1927 | 24.6257 | 25.0924 | 25.4223 | 25.7672 (38) |
| Heat transfer coeff       | 76.5879 | 76.3986 | 76.2130 | 75.3414 | 75.1783 | 74.4192 | 74.4192 | 74.2786 | 74.7116 | 75.1783 | 75.5082 | 75.8531 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 75.3406 (39) |
| HLP                       | 1.4900  | 1.4864  | 1.4827  | 1.4658  | 1.4626  | 1.4478  | 1.4478  | 1.4451  | 1.4535  | 1.4626  | 1.4690  | 1.4757 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.4658 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |         |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |                    |          | 1.7314 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |                    |          | 75.3200 (43)   |
| Daily hot water use                                         | 82.8520  | 79.8392  | 76.8264  | 73.8136 | 70.8008 | 67.7880 | 67.7880 | 70.8008 | 73.8136 | 76.8264            | 79.8392  | 82.8520 (44)   |
| Energy conte                                                | 122.8672 | 107.4604 | 110.8895 | 96.6762 | 92.7631 | 80.0475 | 74.1758 | 85.1178 | 86.1344 | 100.3813           | 109.5740 | 118.9903 (45)  |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1185.0773 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 18.4301  | 16.1191  | 16.6334  | 14.5014 | 13.9145 | 12.0071 | 11.1264 | 12.7677 | 12.9202 | 15.0572            | 16.4361  | 17.8485 (46)   |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |                    |          | 2.0000 (47)    |
| Store volume                                                |          |          |          |         |         |         |         |         |         |                    |          | 0.2388 (48)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |                    |          | 0.1290 (55)    |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 150.1273 | 132.0825 | 138.1497 | 123.0570 | 120.0232 | 106.4283 | 101.4359 | 112.3779 | 112.5151 | 127.6414 | 135.9548 | 146.2504 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 150.1273 | 132.0825 | 138.1497 | 123.0570 | 120.0232 | 106.4283 | 101.4359 | 112.3779 | 112.5151 | 127.6414 | 135.9548 | 146.2504 (64) |
| Heat gains from water heating, kWh/month                        | 62.6614  | 55.4282  | 58.6789  | 53.2495  | 52.6518  | 47.7204  | 46.4716  | 50.1098  | 49.7443  | 55.1849  | 57.5380  | 61.3724 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.4909  | 11.9825  | 9.7448   | 7.3775   | 5.5147   | 4.6558   | 5.0307   | 6.5391   | 8.7768   | 11.1442  | 13.0069  | 13.8659 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 150.8691 | 152.4347 | 148.4896 | 140.0908 | 129.4890 | 119.5247 | 112.8679 | 111.3024 | 115.2475 | 123.6462 | 134.2481 | 144.2124 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 (71) |
| Water heating gains (Table 5)                                                       | 84.2224  | 82.4825  | 78.8695  | 73.9576  | 70.7686  | 66.2784  | 62.4618  | 67.3518  | 69.0893  | 74.1732  | 79.9139  | 82.4898 (72)  |
| Total internal gains                                                                | 300.5530 | 298.8703 | 289.0744 | 273.3964 | 257.7429 | 242.4294 | 232.3310 | 237.1639 | 245.0842 | 260.9342 | 279.1395 | 292.5386 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W    |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|---------------|---------------|
| East        |          |          |          |          | 2.3100     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 13.8654 (76)  |               |
| South       |          |          |          |          | 8.4400     | 46.7521                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 120.5910 (78) |               |
| -----       |          |          |          |          |            |                                |                                   |                                    |                              |          |               |               |
| Solar gains | 134.4564 | 224.6206 | 296.2449 | 349.4824 | 376.1350   | 366.8741                       | 356.4134                          | 337.4001                           | 314.7526                     | 245.2035 | 160.2300      | 115.6040 (83) |
| Total gains | 435.0094 | 523.4909 | 585.3193 | 622.8788 | 633.8779   | 609.3035                       | 588.7444                          | 574.5640                           | 559.8368                     | 506.1378 | 439.3695      | 408.1426 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 46.6058 | 46.7213 | 46.8351 | 47.3769 | 47.4797 | 47.9640 | 47.9640 | 48.0548 | 47.7763                   | 47.4797 | 47.2723 | 47.0573      |
| alpha                                                                       | 4.1071  | 4.1148  | 4.1223  | 4.1585  | 4.1653  | 4.1976  | 4.1976  | 4.2037  | 4.1851                    | 4.1653  | 4.1515  | 4.1372       |
| util living area                                                            | 0.9921  | 0.9827  | 0.9644  | 0.9244  | 0.8438  | 0.6976  | 0.5341  | 0.5656  | 0.7725                    | 0.9355  | 0.9842  | 0.9939 (86)  |
| MIT                                                                         | 19.5419 | 19.7680 | 20.0686 | 20.4198 | 20.7159 | 20.9112 | 20.9775 | 20.9710 | 20.8562                   | 20.4670 | 19.9343 | 19.5017 (87) |
| Th 2                                                                        | 19.6950 | 19.6977 | 19.7005 | 19.7133 | 19.7157 | 19.7268 | 19.7268 | 19.7289 | 19.7225                   | 19.7157 | 19.7108 | 19.7057 (88) |
| util rest of house                                                          | 0.9894  | 0.9770  | 0.9522  | 0.8971  | 0.7855  | 0.5902  | 0.3903  | 0.4232  | 0.6776                    | 0.9065  | 0.9779  | 0.9918 (89)  |
| MIT 2                                                                       | 17.8083 | 18.1366 | 18.5682 | 19.0658 | 19.4505 | 19.6712 | 19.7195 | 19.7185 | 19.6193                   | 19.1421 | 18.3891 | 17.7571 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4339 (91)  |
| MIT                                                                         | 18.5604 | 18.8444 | 19.2192 | 19.6532 | 19.9995 | 20.2092 | 20.2653 | 20.2619 | 20.1559                   | 19.7169 | 19.0595 | 18.5140 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.5604 | 18.8444 | 19.2192 | 19.6532 | 19.9995 | 20.2092 | 20.2653 | 20.2619 | 20.1559                   | 19.7169 | 19.0595 | 18.5140 (93) |

#### 8. Space heating requirement

|                      |           |           |          |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|                      | 0.9862    | 0.9719    | 0.9464   | 0.8956   | 0.8000   | 0.6338   | 0.4533   | 0.4854   | 0.7131   | 0.9065       | 0.9736   | 0.9890 (94)    |
| Useful gains         | 428.9857  | 508.7947  | 553.9737 | 557.8700 | 507.0898 | 386.1825 | 266.8658 | 278.8945 | 399.2082 | 458.8118     | 427.7503 | 403.6659 (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 1092.1765 | 1065.3307 | 969.3684 | 810.1605 | 623.9452 | 417.4322 | 272.7678 | 286.8561 | 452.4491 | 685.3951     | 903.0411 | 1085.7582 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 493.4140  | 373.9922  | 309.0537 | 181.6491 | 86.9404  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 168.5780     | 342.2094 | 507.4767 (98)  |
| Space heating        |           |           |          |          |          |          |          |          |          |              |          | 2463.3134 (98) |
| Space heating per m2 |           |           |          |          |          |          |          |          |          | (98) / (4) = |          | 47.9244 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2634.5598 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 493.4140 | 373.9922 | 309.0537 | 181.6491 | 86.9404  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 168.5780 | 342.2094 | 507.4767  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 527.7155 | 399.9917 | 330.5387 | 194.2772 | 92.9844  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 180.2973 | 365.9993 | 542.7558  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 150.1273 | 132.0825 | 138.1497 | 123.0570 | 120.0232 | 106.4283 | 101.4359 | 112.3779 | 112.5151 | 127.6414 | 135.9548 | 146.2504  | (64)            |
| Efficiency of water heater (217)m                                     | 87.7550  | 87.4400  | 86.9005  | 85.8511  | 83.9705  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.5567  | 87.1765  | 79.8000   | (216)           |
| Fuel for water heating, kWh/month                                     | 171.0754 | 151.0550 | 158.9746 | 143.3377 | 142.9350 | 133.3688 | 127.1127 | 140.8245 | 140.9964 | 149.1892 | 155.9535 | 166.4503  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1781.2730 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2634.5598 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 238.2541  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4729.0870 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2634.5598          | 0.2160                        | 569.0649 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1781.2730          | 0.2160                        | 384.7550 (264)           |
| Space and water heating                                                                           |                    |                               | 953.8199 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 238.2541           | 0.5190                        | 123.6539 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1116.3988 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 18.5568 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.4057 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7573 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (18.5568 * 1.00) + 2.4057 + 0.7573, rounded to 2 d.p. |                    |                               | 21.7200 (273)            |

## APPENDIX B2 - SAP OUTPUTS FOR SAMPLE UNITS “GREEN”

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-0-01                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP 46%                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 87 B                                                                    | DER           | 10.98   | TER            | 16.84      |
| Environmental                      | 92 A                                                                    | % DER<TER     | 34.80   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.62                                                                    | DFEE          | 44.76   | TFEE           | 47.91      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 6.57    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Ground-floor flat, total floor area 74 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 16.84 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 10.98 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 47.9 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 44.8 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | 0.11 (max. 0.25) | 0.11 (max. 0.70) | OK |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK  
Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing North East: 3.35 m<sup>2</sup>, No overhang  
Windows facing West: 15.10 m<sup>2</sup>, Overhang width less than twice window, ratio 1.00  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Floor U-value 0.11 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 74.0000 (1b)              | x 2.5400 (2b)                   | = 187.9600 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 187.9600 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 2                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2631                       | 0.2599 | 0.2567    | 0.2408 | 0.2376 | 0.2216 | 0.2216                      | 0.2184      | 0.2280 | 0.2376 | 0.2439 | 0.2503 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364      |                                | (27)                                                 |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                | (26a)                                                |
| W01 (Uw = 1.40)                                                |                         |                            | 10.0500                   | 1.3258                        | 13.3239      |                                | (27)                                                 |
| Heat Loss Floor 1                                              |                         |                            | 74.0000                   | 0.1100                        | 8.1400       | 110.0000                       | 8140.0000 (28a)                                      |
| External Wall 1                                                | 49.5300                 | 20.5500                    | 28.9800                   | 0.1500                        | 4.3470       | 140.0000                       | 4057.2000 (29a)                                      |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 123.5300                  |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      | 39.8872                       |              |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 42.5000                   | 0.0000                        | 0.0000       | 140.0000                       | 5950.0000 (32)                                       |
| Party Ceilings                                                 |                         |                            | 74.0000                   |                               |              | 80.0000                        | 5920.0000 (32b)                                      |
| Internal Wall                                                  |                         |                            | 132.0000                  |                               |              | 9.0000                         | 1188.0000 (32c)                                      |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 25255.2000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 341.2865 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 7.7649 (36)                                          |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 47.6521 (37)                           |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 16.3169 | 16.1192 | 15.9215 | 14.9330 | 14.7352 | 13.7467 | 13.7467 | 13.5490 | 14.1421 | 14.7352 | 15.1307 | 15.5261 (38) |
| Heat transfer coeff       | 63.9691 | 63.7713 | 63.5736 | 62.5851 | 62.3874 | 61.3988 | 61.3988 | 61.2011 | 61.7942 | 62.3874 | 62.7828 | 63.1782 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 62.5357 (39) |
| HLP                       | 0.8644  | 0.8618  | 0.8591  | 0.8457  | 0.8431  | 0.8297  | 0.8297  | 0.8270  | 0.8351  | 0.8431  | 0.8484  | 0.8538 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.8451 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |              |             |             |             |             |             |             |             |             |              |                   |
|------------------------------------------|--------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------------|
| Assumed occupancy                        |              |              |             |             |             |             |             |             |             |             |              | 2.3392 (42)       |
| Average daily hot water use (litres/day) |              |              |             |             |             |             |             |             |             |             |              | 94.4799 (43)      |
| Daily hot water use                      | Jan 103.9278 | Feb 100.1486 | Mar 96.3694 | Apr 92.5903 | May 88.8111 | Jun 85.0319 | Jul 85.0319 | Aug 88.8111 | Sep 92.5903 | Oct 96.3694 | Nov 100.1486 | Dec 103.9278 (44) |
| Energy conte                             | 154.1220     | 134.7961     | 139.0975    | 121.2685    | 116.3601    | 100.4099    | 93.0445     | 106.7699    | 108.0451    | 125.9162    | 137.4473     | 149.2589 (45)     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                                    |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------------------------------|
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = 1486.5360 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |          |                                    |
|                                                                 | 23.1183  | 20.2194  | 20.8646  | 18.1903  | 17.4540  | 15.0615  | 13.9567  | 16.0155  | 16.2068  | 18.8874  | 20.6171  | 22.3888 (46)                       |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |                                    |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)                        |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)                        |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)                        |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)                        |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |                                    |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (56)                       |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |                                    |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (57)                       |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)                       |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |                                    |
|                                                                 | 200.3244 | 176.5273 | 185.2999 | 165.9805 | 162.5625 | 145.1219 | 139.2469 | 152.9723 | 152.7571 | 172.1186 | 182.1593 | 195.4613 (62)                      |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)                        |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)                        |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |                                    |
|                                                                 | 200.3244 | 176.5273 | 185.2999 | 165.9805 | 162.5625 | 145.1219 | 139.2469 | 152.9723 | 152.7571 | 172.1186 | 182.1593 | 195.4613 (64)                      |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |                                    |
|                                                                 | 88.2075  | 78.2047  | 83.2118  | 76.0914  | 75.6516  | 69.1559  | 67.8992  | 72.4629  | 71.6946  | 78.8290  | 81.4708  | 86.5905 (65)                       |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 18.4049  | 16.3471  | 13.2943  | 10.0647  | 7.5235   | 6.3516   | 6.8632   | 8.9210   | 11.9737  | 15.2034  | 17.7446  | 18.9165 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 206.4473 | 208.5895 | 203.1911 | 191.6984 | 177.1909 | 163.5559 | 154.4469 | 152.3047 | 157.7031 | 169.1958 | 183.7033 | 197.3383 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 118.5584 | 116.3760 | 111.8439 | 105.6825 | 101.6823 | 96.0498  | 91.2624  | 97.3964  | 99.5758  | 105.9530 | 113.1539 | 116.3851 (72) |
| Total internal gains                                                                | 401.4985 | 399.4005 | 386.4172 | 365.5335 | 344.4846 | 324.0453 | 310.6604 | 316.7100 | 327.3406 | 348.4402 | 372.6898 | 390.7277 (73) |

#### 6. Solar gains

|             |          |            |          |             |          |             |          |          |          |              |          |               |
|-------------|----------|------------|----------|-------------|----------|-------------|----------|----------|----------|--------------|----------|---------------|
| [Jan]       |          |            |          |             |          |             |          |          |          |              |          |               |
|             | Area     | Solar flux |          | g           |          | FF          |          | Access   |          | Gains        |          |               |
|             | m2       | Table 6a   |          | or Table 6b |          | or Table 6c |          | factor   |          | W            |          |               |
|             |          | W/m2       |          |             |          |             |          | Table 6d |          |              |          |               |
| West        | 8.4000   | 19.6403    |          | 0.3700      |          | 0.8900      |          | 0.7700   |          | 37.6488 (80) |          |               |
| Northeast   | 3.3500   | 11.2829    |          | 0.3700      |          | 0.6500      |          | 0.7700   |          | 6.2996 (75)  |          |               |
| West        | 6.7000   | 19.6403    |          | 0.3700      |          | 0.6500      |          | 0.7700   |          | 21.9316 (80) |          |               |
| Solar gains | 65.8801  | 129.3751   | 215.0477 | 317.8816    | 394.0780 | 405.5728    | 385.2214 | 327.7574 | 251.3909 | 153.9696     | 82.2164  | 54.1407 (83)  |
| Total gains | 467.3786 | 528.7756   | 601.4648 | 683.4151    | 738.5626 | 729.6182    | 695.8818 | 644.4673 | 578.7315 | 502.4097     | 454.9061 | 444.8684 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |          |          |          |          |          |          |          |          |          |          |          |              |
|-----------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |          |          |          |          |          |          |          |          |          |          |          | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |          |          |          |          |          |          |          |          |          |          |          |              |
|                                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec          |
| tau                                                                         | 109.6676 | 110.0076 | 110.3497 | 112.0927 | 112.4480 | 114.2584 | 114.2584 | 114.6276 | 113.5273 | 112.4480 | 111.7398 | 111.0404     |
| alpha                                                                       | 8.3112   | 8.3338   | 8.3566   | 8.4728   | 8.4965   | 8.6172   | 8.6172   | 8.6418   | 8.5685   | 8.4965   | 8.4493   | 8.4027       |
| util living area                                                            | 0.9994   | 0.9981   | 0.9900   | 0.9342   | 0.7615   | 0.5374   | 0.3882   | 0.4366   | 0.7218   | 0.9718   | 0.9980   | 0.9996 (86)  |
| MIT                                                                         | 20.3830  | 20.4877  | 20.6648  | 20.8777  | 20.9817  | 20.9991  | 21.0000  | 20.9999  | 20.9911  | 20.8347  | 20.5693  | 20.3661 (87) |
| Th 2                                                                        | 20.1978  | 20.2001  | 20.2024  | 20.2139  | 20.2162  | 20.2277  | 20.2277  | 20.2300  | 20.2231  | 20.2162  | 20.2116  | 20.2070 (88) |
| util rest of house                                                          | 0.9992   | 0.9972   | 0.9855   | 0.9096   | 0.7065   | 0.4732   | 0.3201   | 0.3637   | 0.6478   | 0.9558   | 0.9970   | 0.9994 (89)  |
| MIT 2                                                                       | 19.3711  | 19.5258  | 19.7837  | 20.0835  | 20.2018  | 20.2272  | 20.2276  | 20.2299  | 20.2178  | 20.0356  | 19.6546  | 19.3539 (90) |
| Living area fraction                                                        |          |          |          |          |          |          |          |          |          |          |          |              |
| MIT                                                                         | 19.7157  | 19.8534  | 20.0837  | 20.3540  | 20.4674  | 20.4901  | 20.4906  | 20.4921  | 20.4811  | 20.3077  | 19.9661  | 19.6986 (92) |
| Temperature adjustment                                                      |          |          |          |          |          |          |          |          |          |          |          | 0.0000       |
| adjusted MIT                                                                | 19.7157  | 19.8534  | 20.0837  | 20.3540  | 20.4674  | 20.4901  | 20.4906  | 20.4921  | 20.4811  | 20.3077  | 19.9661  | 19.6986 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |                           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec                       |
|                      | 0.9989   | 0.9967   | 0.9847   | 0.9145   | 0.7247   | 0.4951   | 0.3433   | 0.3885   | 0.6730   | 0.9581   | 0.9966   | 0.9993 (94)               |
| Useful gains         | 466.8819 | 527.0392 | 592.2678 | 624.9806 | 535.2354 | 361.2121 | 238.8654 | 250.3989 | 389.5016 | 481.3338 | 453.3459 | 444.5474 (95)             |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)               |
| Heat loss rate W     | 986.1293 | 953.5985 | 863.5678 | 716.8495 | 546.9752 | 361.6434 | 238.8810 | 250.4423 | 394.3163 | 605.6402 | 807.7716 | 979.1719 (97)             |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)              |
| Space heating kWh    | 386.3200 | 286.6478 | 201.8473 | 66.1456  | 8.7344   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 92.4840  | 255.1865 | 397.7606 (98)             |
| Space heating        |          |          |          |          |          |          |          |          |          |          |          | 1695.1262 (98)            |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | (98) / (4) = 22.9071 (99) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1695.1262 (98)   |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 818.7459 (307a)  |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 961.1365 (307b)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2030.5320 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 980.7469 (310a)  |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1151.3116 (310b) |
| Electricity used for heat distribution                                                  | 39.1194 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 151.9187 (330a)  |
| Total electricity for the above, kWh/year                                               | 151.9187 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 325.0367 (332)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415        |
| Total delivered energy for all uses                                                     | 4016.2550 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 486.3494           | 0.5190                        | 252.4154 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 2249.6786          | 0.2160                        | 485.9306 (368)           |
| Electrical energy for heat distribution                                                    | 39.1194            | 0.5190                        | 20.3030 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 758.6489 (373)           |
| Space and water heating                                                                    |                    |                               | 758.6489 (376)           |
| Pumps and fans                                                                             | 151.9187           | 0.5190                        | 78.8458 (378)            |
| Energy for lighting                                                                        | 325.0367           | 0.5190                        | 168.6941 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 812.7878 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 10.9800 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 10.9800 ZC1 |
| Total Floor Area                                                                | TFA | 74.0000     |
| Assumed number of occupants                                                     | N   | 2.3392      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 16.5319 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.3668 ZC3  |
| Total CO2 emissions                                                             |     | 29.8787 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 29.8787 ZC8 |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 74.0000 (1b)              | x 2.5400 (2b)                   | = 187.9600 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 187.9600 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | =               | 0 * 40 = 0.0000 (6a)    |
| Number of open flues                                                      | 0               | +                    | 0                           | =               | 0 * 20 = 0.0000 (6b)    |
| Number of intermittent fans                                               |                 |                      |                             |                 | 3 * 10 = 30.0000 (7a)   |
| Number of passive vents                                                   |                 |                      |                             |                 | 0 * 10 = 0.0000 (7b)    |
| Number of flueless gas fires                                              |                 |                      |                             |                 | 0 * 40 = 0.0000 (7c)    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 30.0000 / (5) = | 0.1596 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.4096 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 2 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.8500 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3482 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4439 | 0.4352 | 0.4265 | 0.3830 | 0.3743 | 0.3308 | 0.3308 | 0.3221 | 0.3482 | 0.3743 | 0.3917 | 0.4091 (22b) |
|                 | 0.5985 | 0.5947 | 0.5910 | 0.5733 | 0.5700 | 0.5547 | 0.5547 | 0.5519 | 0.5606 | 0.5700 | 0.5767 | 0.5837 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2         | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|-----------------------|------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|------|
| TER Semi-glazed door                                                |                |                | 2.1000                | 1.2000           | 2.5200         |                   |                | (26a)          |                |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                | 16.4100               | 1.3258           | 21.7557        |                   |                | (27)           |                |                |                |                |      |
| Heat Loss Floor 1                                                   |                |                | 74.0000               | 0.1300           | 9.6200         |                   |                | (28a)          |                |                |                |                |      |
| External Wall 1                                                     | 49.5300        | 18.5100        | 31.0200               | 0.1800           | 5.5836         |                   |                | (29a)          |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 123.5300              |                  |                |                   |                | (31)           |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26)... (30) + (32) = |                  | 39.4793        |                   |                | (33)           |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                       |                  |                |                   | 250.0000       | (35)           |                |                |                |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                       |                  |                |                   | 5.5349         | (36)           |                |                |                |                |      |
| Total fabric heat loss                                              |                |                |                       |                  |                | (33) + (36) =     | 45.0142        | (37)           |                |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                       |                  |                |                   |                |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>37.1249 | Feb<br>36.8875 | Mar<br>36.6549        | Apr<br>35.5623   | May<br>35.3579 | Jun<br>34.4063    | Jul<br>34.4063 | Aug<br>34.2301 | Sep<br>34.7729 | Oct<br>35.3579 | Nov<br>35.7715 | Dec<br>36.2038 | (38) |
| Heat transfer coeff                                                 | 82.1390        | 81.9017        | 81.6691               | 80.5765          | 80.3721        | 79.4205           | 79.4205        | 79.2443        | 79.7870        | 80.3721        | 80.7856        | 81.2180        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                       |                  |                |                   |                |                |                |                |                | 80.5755        | (39) |
| HLP                                                                 | Jan<br>1.1100  | Feb<br>1.1068  | Mar<br>1.1036         | Apr<br>1.0889    | May<br>1.0861  | Jun<br>1.0732     | Jul<br>1.0732  | Aug<br>1.0709  | Sep<br>1.0782  | Oct<br>1.0861  | Nov<br>1.0917  | Dec<br>1.0975  | (40) |
| HLP (average)                                                       |                |                |                       |                  |                |                   |                |                |                |                |                | 1.0889         | (40) |
| Days in month                                                       | 31             | 28             | 31                    | 30               | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |          |          |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|----------|----------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |          |          |                    |          | 2.3392 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |          |          |                    |          | 89.7559 (43)   |
| Daily hot water use                                         | 98.7314  | 95.1412  | 91.5510  | 87.9607  | 84.3705  | 80.7803 | 80.7803 | 84.3705  | 87.9607  | 91.5510            | 95.1412  | 98.7314 (44)   |
| Energy conte                                                | 146.4159 | 128.0563 | 132.1426 | 115.2051 | 110.5421 | 95.3894 | 88.3923 | 101.4314 | 102.6429 | 119.6204           | 130.5750 | 141.7960 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |          | 1412.2092 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 21.9624  | 19.2084  | 19.8214  | 17.2808  | 16.5813  | 14.3084 | 13.2588 | 15.2147  | 15.3964  | 17.9431            | 19.5862  | 21.2694 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |          |          |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |          |          |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |          |          |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |          |          |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |          |          |                    |          | 0.1290 (55)    |
| Total storage loss                                          |          |          |          |          |          |         |         |          |          |                    |          |                |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 173.6760 | 152.6783 | 159.4027 | 141.5859 | 137.8022 | 121.7702 | 115.6524 | 128.6916 | 129.0236 | 146.8805 | 156.9558 | 169.0561 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 173.6760 | 152.6783 | 159.4027 | 141.5859 | 137.8022 | 121.7702 | 115.6524 | 128.6916 | 129.0236 | 146.8805 | 156.9558 | 169.0561 (64) |
|                                                                 | 70.4914  | 62.2764  | 65.7455  | 59.4103  | 58.5633  | 52.8216  | 51.1986  | 55.5341  | 55.2334  | 61.5819  | 64.5208  | 68.9553 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 18.4071  | 16.3490  | 13.2959  | 10.0659  | 7.5244   | 6.3524   | 6.8640   | 8.9221   | 11.9752  | 15.2052  | 17.7467  | 18.9187  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 206.4473 | 208.5895 | 203.1911 | 191.6984 | 177.1909 | 163.5559 | 154.4469 | 152.3047 | 157.7031 | 169.1958 | 183.7033 | 197.3383 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | (71) |
| Water heating gains (Table 5)                                                       | 94.7465  | 92.6732  | 88.3676  | 82.5143  | 78.7142  | 73.3633  | 68.8153  | 74.6426  | 76.7130  | 82.7713  | 89.6122  | 92.6818  | (72) |
| Total internal gains                                                                | 380.6888 | 378.6997 | 365.9426 | 345.3665 | 324.5174 | 304.3596 | 291.2141 | 296.9572 | 307.4792 | 328.2603 | 352.1502 | 370.0267 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| Northeast   |          |          |          |          | 2.9800     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 10.2757      |               |
| West        |          |          |          |          | 13.4300    | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 80.6112 (75) |               |
| <hr/>       |          |          |          |          |            |                                |                                   |                                    |                              |          |              |               |
| Solar gains | 90.8868  | 178.6090 | 297.3819 | 440.6420 | 547.3670   | 563.8571                       | 535.3462                          | 454.7292                           | 347.9580                     | 212.6770 | 113.4421     | 74.6823 (83)  |
| Total gains | 471.5756 | 557.3086 | 663.3245 | 786.0085 | 871.8843   | 868.2167                       | 826.5602                          | 751.6864                           | 655.4372                     | 540.9373 | 465.5923     | 444.7090 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 62.5633 | 62.7446 | 62.9233 | 63.7765 | 63.9387 | 64.7048 | 64.7048 | 64.8487 | 64.4076 | 63.9387 | 63.6114 | 63.2728 |              |
| alpha                                                                       | 5.1709  | 5.1830  | 5.1949  | 5.2518  | 5.2626  | 5.3137  | 5.3137  | 5.3232  | 5.2938  | 5.2626  | 5.2408  | 5.2182  |              |
| util living area                                                            | 0.9974  | 0.9933  | 0.9777  | 0.9155  | 0.7694  | 0.5708  | 0.4202  | 0.4796  | 0.7598  | 0.9618  | 0.9942  | 0.9981  | (86)         |
| MIT                                                                         | 19.8476 | 20.0214 | 20.3144 | 20.6722 | 20.9016 | 20.9837 | 20.9973 | 20.9948 | 20.9325 | 20.5947 | 20.1533 | 19.8203 | (87)         |
| Th 2                                                                        | 19.9927 | 19.9953 | 19.9979 | 20.0099 | 20.0122 | 20.0227 | 20.0227 | 20.0247 | 20.0187 | 20.0122 | 20.0076 | 20.0028 | (88)         |
| util rest of house                                                          | 0.9965  | 0.9911  | 0.9703  | 0.8893  | 0.7119  | 0.4899  | 0.3283  | 0.3807  | 0.6798  | 0.9444  | 0.9919  | 0.9974  | (89)         |
| MIT 2                                                                       | 18.4590 | 18.7138 | 19.1378 | 19.6412 | 19.9230 | 20.0128 | 20.0218 | 20.0227 | 19.9685 | 19.5503 | 18.9161 | 18.4265 | (90)         |
| Living area fraction                                                        | 18.9319 | 19.1591 | 19.5385 | 19.9923 | 20.2563 | 20.3434 | 20.3540 | 20.3537 | 20.2967 | 19.9060 | 19.3375 | 18.9012 | (92)         |
| Temperature adjustment                                                      | 18.9319 | 19.1591 | 19.5385 | 19.9923 | 20.2563 | 20.3434 | 20.3540 | 20.3537 | 20.2967 | 19.9060 | 19.3375 | 18.9012 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |          |          |           |       |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 469.2973  | 550.9451  | 640.7266  | 698.5949 | 633.8343 | 448.9376 | 297.2982 | 311.5720 | 461.5349 | 509.6110 | 460.7879 | 443.0931  | (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Heat loss rate W     | 1201.8494 | 1167.8433 | 1064.8433 | 893.7774 | 687.6842 | 456.1431 | 298.1449 | 313.3112 | 494.4197 | 747.9389 | 988.6105 | 1193.9990 | (97)  |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating kWh    | 545.0187  | 414.5556  | 315.5428  | 140.5314 | 40.0644  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 177.3160 | 380.0323 | 558.6740  | (98)  |
| Space heating        |           |           |           |          |          |          |          |          |          |          |          | 2571.7350 | (98)  |
| Space heating per m2 |           |           |           |          |          |          |          |          |          |          |          | 34.7532   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2750.5188 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 545.0187 | 414.5556 | 315.5428 | 140.5314 | 40.0644  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 177.3160 | 380.0323 | 558.6740  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 582.9077 | 443.3749 | 337.4789 | 150.3010 | 42.8496  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 189.6428 | 406.4516 | 597.5123  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 173.6760 | 152.6783 | 159.4027 | 141.5859 | 137.8022 | 121.7702 | 115.6524 | 128.6916 | 129.0236 | 146.8805 | 156.9558 | 169.0561  | (64)            |
| Efficiency of water heater (217)m                                     | 87.6596  | 87.3476  | 86.6027  | 84.7939  | 81.9834  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.3171  | 87.0869  | 87.7662   | (216)           |
| Fuel for water heating, kWh/month                                     | 198.1255 | 174.7940 | 184.0621 | 166.9764 | 168.0856 | 152.5942 | 144.9279 | 161.2677 | 161.6838 | 172.1583 | 180.2289 | 192.6210  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2057.5253 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2750.5188 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 325.0756  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5208.1196 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2750.5188          | 0.2160                        | 594.1121 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2057.5253          | 0.2160                        | 444.4255 (264)           |
| Space and water heating                                                                           |                    |                               | 1038.5375 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 325.0756           | 0.5190                        | 168.7142 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1246.1767 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 14.0343 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.2799 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5260 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (14.0343 * 1.00) + 2.2799 + 0.5260, rounded to 2 d.p. |                    |                               | 16.8400 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-0-02                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP 46%                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 87 B                                                                    | DER           | 10.98   | TER            | 16.84      |
| Environmental                      | 92 A                                                                    | % DER<TER     | 34.80   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.62                                                                    | DFEE          | 44.76   | TFEE           | 47.91      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 6.57    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Ground-floor flat, total floor area 74 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 16.84 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 10.98 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 47.9 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 44.8 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | 0.11 (max. 0.25) | 0.11 (max. 0.70) | OK |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK  
Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing North East: 3.35 m<sup>2</sup>, No overhang  
Windows facing East: 15.10 m<sup>2</sup>, Overhang width less than twice window, ratio 1.00  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Floor U-value 0.11 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 74.0000 (1b)              | x 2.5400 (2b)                   | = 187.9600 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 187.9600 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 2                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2631                       | 0.2599 | 0.2567    | 0.2408 | 0.2376 | 0.2216 | 0.2216                      | 0.2184      | 0.2280 | 0.2376 | 0.2439 | 0.2503 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364      |                                | (27)                                                 |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                | (26a)                                                |
| W01 (Uw = 1.40)                                                |                         |                            | 10.0500                   | 1.3258                        | 13.3239      |                                | (27)                                                 |
| Heat Loss Floor 1                                              |                         |                            | 74.0000                   | 0.1100                        | 8.1400       | 110.0000                       | 8140.0000 (28a)                                      |
| External Wall 1                                                | 49.5300                 | 20.5500                    | 28.9800                   | 0.1500                        | 4.3470       | 140.0000                       | 4057.2000 (29a)                                      |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 123.5300                  |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      | 39.8872                       |              |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 42.5000                   | 0.0000                        | 0.0000       | 140.0000                       | 5950.0000 (32)                                       |
| Party Ceilings                                                 |                         |                            | 74.0000                   |                               |              | 80.0000                        | 5920.0000 (32b)                                      |
| Internal Wall                                                  |                         |                            | 132.0000                  |                               |              | 9.0000                         | 1188.0000 (32c)                                      |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 25255.2000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 341.2865 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 7.7649 (36)                                          |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 47.6521 (37)                           |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 16.3169 | 16.1192 | 15.9215 | 14.9330 | 14.7352 | 13.7467 | 13.7467 | 13.5490 | 14.1421 | 14.7352 | 15.1307 | 15.5261 (38) |
| Heat transfer coeff       | 63.9691 | 63.7713 | 63.5736 | 62.5851 | 62.3874 | 61.3988 | 61.3988 | 61.2011 | 61.7942 | 62.3874 | 62.7828 | 63.1782 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 62.5357 (39) |
| HLP                       | 0.8644  | 0.8618  | 0.8591  | 0.8457  | 0.8431  | 0.8297  | 0.8297  | 0.8270  | 0.8351  | 0.8431  | 0.8484  | 0.8538 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.8451 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |              |             |             |             |             |             |             |             |             |              |                   |
|------------------------------------------|--------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------------|
| Assumed occupancy                        |              |              |             |             |             |             |             |             |             |             |              | 2.3392 (42)       |
| Average daily hot water use (litres/day) |              |              |             |             |             |             |             |             |             |             |              | 94.4799 (43)      |
| Daily hot water use                      | Jan 103.9278 | Feb 100.1486 | Mar 96.3694 | Apr 92.5903 | May 88.8111 | Jun 85.0319 | Jul 85.0319 | Aug 88.8111 | Sep 92.5903 | Oct 96.3694 | Nov 100.1486 | Dec 103.9278 (44) |
| Energy conte                             | 154.1220     | 134.7961     | 139.0975    | 121.2685    | 116.3601    | 100.4099    | 93.0445     | 106.7699    | 108.0451    | 125.9162    | 137.4473     | 149.2589 (45)     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                                          |          |          |          |                    |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|----------|----------|--------------------|----------------|
| Energy content (annual)                                         |          |          |          |          |          |          |          |                                          |          |          |          | Total = Sum(45)m = | 1486.5360 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |                                          |          |          |          |                    |                |
|                                                                 | 23.1183  | 20.2194  | 20.8646  | 18.1903  | 17.4540  | 15.0615  | 13.9567  | 16.0155                                  | 16.2068  | 18.8874  | 20.6171  | 22.3888 (46)       |                |
| Water storage loss:                                             |          |          |          |          |          |          |          |                                          |          |          |          |                    |                |
| Store volume                                                    |          |          |          |          |          |          |          |                                          |          |          |          | 2.0000 (47)        |                |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |                                          |          |          |          | 0.7400 (48)        |                |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |          |          | 1.0000 (49)        |                |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |          |          | 0.7400 (55)        |                |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |          |          |                    |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400                                  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (56)       |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                          |          |          |          |                    |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400                                  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (57)       |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)       |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |          |          |                    |                |
|                                                                 | 200.3244 | 176.5273 | 185.2999 | 165.9805 | 162.5625 | 145.1219 | 139.2469 | 152.9723                                 | 152.7571 | 172.1186 | 182.1593 | 195.4613 (62)      |                |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)        |                |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |          |          | 0.0000 (63)        |                |
| Output from w/h                                                 |          |          |          |          |          |          |          |                                          |          |          |          |                    |                |
|                                                                 | 200.3244 | 176.5273 | 185.2999 | 165.9805 | 162.5625 | 145.1219 | 139.2469 | 152.9723                                 | 152.7571 | 172.1186 | 182.1593 | 195.4613 (64)      |                |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |          |          | 2030.5320 (64)     |                |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |                                          |          |          |          |                    |                |
|                                                                 | 88.2075  | 78.2047  | 83.2118  | 76.0914  | 75.6516  | 69.1559  | 67.8992  | 72.4629                                  | 71.6946  | 78.8290  | 81.4708  | 86.5905 (65)       |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1695.1262 (98)   |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 818.7459 (307a)  |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 961.1365 (307b)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2030.5320 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 980.7469 (310a)  |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1151.3116 (310b) |
| Electricity used for heat distribution                                                  | 39.1194 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 151.9187 (330a)  |
| Total electricity for the above, kWh/year                                               | 151.9187 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 325.0367 (332)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415        |
| Total delivered energy for all uses                                                     | 4016.2550 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 486.3494           | 0.5190                        | 252.4154 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 2249.6786          | 0.2160                        | 485.9306 (368)           |
| Electrical energy for heat distribution                                                    | 39.1194            | 0.5190                        | 20.3030 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 758.6489 (373)           |
| Space and water heating                                                                    |                    |                               | 758.6489 (376)           |
| Pumps and fans                                                                             | 151.9187           | 0.5190                        | 78.8458 (378)            |
| Energy for lighting                                                                        | 325.0367           | 0.5190                        | 168.6941 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 812.7878 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 10.9800 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 10.9800 ZC1 |
| Total Floor Area                                                                | TFA | 74.0000     |
| Assumed number of occupants                                                     | N   | 2.3392      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 16.5319 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.3668 ZC3  |
| Total CO2 emissions                                                             |     | 29.8787 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 29.8787 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 74.0000 (1b)              | x 2.5400 (2b)                   | = 187.9600 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 74.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 187.9600 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | =               | 0 * 40 = 0.0000 (6a)    |
| Number of open flues                                                      | 0               | +                    | 0                           | =               | 0 * 20 = 0.0000 (6b)    |
| Number of intermittent fans                                               |                 |                      |                             |                 | 3 * 10 = 30.0000 (7a)   |
| Number of passive vents                                                   |                 |                      |                             |                 | 0 * 10 = 0.0000 (7b)    |
| Number of flueless gas fires                                              |                 |                      |                             |                 | 0 * 40 = 0.0000 (7c)    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 30.0000 / (5) = | 0.1596 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.4096 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 2 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.8500 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3482 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4439 | 0.4352 | 0.4265 | 0.3830 | 0.3743 | 0.3308 | 0.3308 | 0.3221 | 0.3482 | 0.3743 | 0.3917 | 0.4091 (22b) |
| Effective ac    | 0.5985 | 0.5947 | 0.5910 | 0.5733 | 0.5700 | 0.5547 | 0.5547 | 0.5519 | 0.5606 | 0.5700 | 0.5767 | 0.5837 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------------|------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|------|
| TER Semi-glazed door                                                |                |                | 2.1000               | 1.2000           | 2.5200         |                   |                | (26a)          |                |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                | 16.4100              | 1.3258           | 21.7557        |                   |                | (27)           |                |                |                |                |      |
| Heat Loss Floor 1                                                   |                |                | 74.0000              | 0.1300           | 9.6200         |                   |                | (28a)          |                |                |                |                |      |
| External Wall 1                                                     | 49.5300        | 18.5100        | 31.0200              | 0.1800           | 5.5836         |                   |                | (29a)          |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 123.5300             |                  |                |                   |                | (31)           |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26)...(30) + (32) = |                  | 39.4793        |                   |                | (33)           |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                      |                  |                |                   | 250.0000       | (35)           |                |                |                |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                      |                  |                |                   | 5.5349         | (36)           |                |                |                |                |      |
| Total fabric heat loss                                              |                |                |                      |                  |                | (33) + (36) =     | 45.0142        | (37)           |                |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                      |                  |                |                   |                |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>37.1249 | Feb<br>36.8875 | Mar<br>36.6549       | Apr<br>35.5623   | May<br>35.3579 | Jun<br>34.4063    | Jul<br>34.4063 | Aug<br>34.2301 | Sep<br>34.7729 | Oct<br>35.3579 | Nov<br>35.7715 | Dec<br>36.2038 | (38) |
| Heat transfer coeff                                                 | 82.1390        | 81.9017        | 81.6691              | 80.5765          | 80.3721        | 79.4205           | 79.4205        | 79.2443        | 79.7870        | 80.3721        | 80.7856        | 81.2180        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                      |                  |                |                   |                |                |                |                |                | 80.5755        | (39) |
| HLP                                                                 | Jan<br>1.1100  | Feb<br>1.1068  | Mar<br>1.1036        | Apr<br>1.0889    | May<br>1.0861  | Jun<br>1.0732     | Jul<br>1.0732  | Aug<br>1.0709  | Sep<br>1.0782  | Oct<br>1.0861  | Nov<br>1.0917  | Dec<br>1.0975  | (40) |
| HLP (average)                                                       |                |                |                      |                  |                |                   |                |                |                |                |                | 1.0889         | (40) |
| Days in month                                                       | 31             | 28             | 31                   | 30               | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |          |          |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|----------|----------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |          |          |                    |          | 2.3392 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |          |          |                    |          | 89.7559 (43)   |
| Daily hot water use                                         | 98.7314  | 95.1412  | 91.5510  | 87.9607  | 84.3705  | 80.7803 | 80.7803 | 84.3705  | 87.9607  | 91.5510            | 95.1412  | 98.7314 (44)   |
| Energy conte                                                | 146.4159 | 128.0563 | 132.1426 | 115.2051 | 110.5421 | 95.3894 | 88.3923 | 101.4314 | 102.6429 | 119.6204           | 130.5750 | 141.7960 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |          |          | Total = Sum(45)m = |          | 1412.2092 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 21.9624  | 19.2084  | 19.8214  | 17.2808  | 16.5813  | 14.3084 | 13.2588 | 15.2147  | 15.3964  | 17.9431            | 19.5862  | 21.2694 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |          |          |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |          |          |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |          |          |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |          |          |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |          |          |                    |          | 0.1290 (55)    |
| Total storage loss                                          |          |          |          |          |          |         |         |          |          |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 173.6760 | 152.6783 | 159.4027 | 141.5859 | 137.8022 | 121.7702 | 115.6524 | 128.6916 | 129.0236 | 146.8805 | 156.9558 | 169.0561 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 173.6760 | 152.6783 | 159.4027 | 141.5859 | 137.8022 | 121.7702 | 115.6524 | 128.6916 | 129.0236 | 146.8805 | 156.9558 | 169.0561 (64) |
|                                                                 | 70.4914  | 62.2764  | 65.7455  | 59.4103  | 58.5633  | 52.8216  | 51.1986  | 55.5341  | 55.2334  | 61.5819  | 64.5208  | 68.9553 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | 116.9597 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 18.4071  | 16.3490  | 13.2959  | 10.0659  | 7.5244   | 6.3524   | 6.8640   | 8.9221   | 11.9752  | 15.2052  | 17.7467  | 18.9187  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 206.4473 | 208.5895 | 203.1911 | 191.6984 | 177.1909 | 163.5559 | 154.4469 | 152.3047 | 157.7031 | 169.1958 | 183.7033 | 197.3383 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | 34.6960  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | -93.5678 | (71) |
| Water heating gains (Table 5)                                                       | 94.7465  | 92.6732  | 88.3676  | 82.5143  | 78.7142  | 73.3633  | 68.8153  | 74.6426  | 76.7130  | 82.7713  | 89.6122  | 92.6818  | (72) |
| Total internal gains                                                                | 380.6888 | 378.6997 | 365.9426 | 345.3665 | 324.5174 | 304.3596 | 291.2141 | 296.9572 | 307.4792 | 328.2603 | 352.1502 | 370.0267 | (73) |

#### 6. Solar gains

| [Jan]       | Area<br>m2 |          |          |          | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |          |               |
|-------------|------------|----------|----------|----------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|----------|---------------|
| Northeast   | 2.9800     |          |          |          | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 10.2757 (75) |          |               |
| East        | 13.4300    |          |          |          | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 80.6112 (76) |          |               |
| -----       |            |          |          |          |                                |                                   |                                    |                              |          |              |          |               |
| Solar gains | 90.8868    | 178.6090 | 297.3819 | 440.6420 | 547.3670                       | 563.8571                          | 535.3462                           | 454.7292                     | 347.9580 | 212.6770     | 113.4421 | 74.6823 (83)  |
| Total gains | 471.5756   | 557.3086 | 663.3245 | 786.0085 | 871.8843                       | 868.2167                          | 826.5602                           | 751.6864                     | 655.4372 | 540.9373     | 465.5923 | 444.7090 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 62.5633 | 62.7446 | 62.9233 | 63.7765 | 63.9387 | 64.7048 | 64.7048 | 64.8487 | 64.4076                   | 63.9387 | 63.6114 | 63.2728 |              |
| alpha                                                                       | 5.1709  | 5.1830  | 5.1949  | 5.2518  | 5.2626  | 5.3137  | 5.3137  | 5.3232  | 5.2938                    | 5.2626  | 5.2408  | 5.2182  |              |
| util living area                                                            | 0.9974  | 0.9933  | 0.9777  | 0.9155  | 0.7694  | 0.5708  | 0.4202  | 0.4796  | 0.7598                    | 0.9618  | 0.9942  | 0.9981  | (86)         |
| MIT                                                                         | 19.8476 | 20.0214 | 20.3144 | 20.6722 | 20.9016 | 20.9837 | 20.9973 | 20.9948 | 20.9325                   | 20.5947 | 20.1533 | 19.8203 | (87)         |
| Th 2                                                                        | 19.9927 | 19.9953 | 19.9979 | 20.0099 | 20.0122 | 20.0227 | 20.0227 | 20.0247 | 20.0187                   | 20.0122 | 20.0076 | 20.0028 | (88)         |
| util rest of house                                                          | 0.9965  | 0.9911  | 0.9703  | 0.8893  | 0.7119  | 0.4899  | 0.3283  | 0.3807  | 0.6798                    | 0.9444  | 0.9919  | 0.9974  | (89)         |
| MIT 2                                                                       | 18.4590 | 18.7138 | 19.1378 | 19.6412 | 19.9230 | 20.0128 | 20.0218 | 20.0227 | 19.9685                   | 19.5503 | 18.9161 | 18.4265 | (90)         |
| Living area fraction                                                        | 18.9319 | 19.1591 | 19.5385 | 19.9923 | 20.2563 | 20.3434 | 20.3540 | 20.3537 | fLA = Living area / (4) = | 19.0600 | 19.3375 | 0.3405  | (91)         |
| MIT                                                                         | 18.9319 | 19.1591 | 19.5385 | 19.9923 | 20.2563 | 20.3434 | 20.3540 | 20.3537 | 20.2967                   | 19.0600 | 19.3375 | 18.9012 | (92)         |
| Temperature adjustment                                                      | 18.9319 | 19.1591 | 19.5385 | 19.9923 | 20.2563 | 20.3434 | 20.3540 | 20.3537 | 20.2967                   | 19.0600 | 19.3375 | 18.9012 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |          |          |           |       |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 469.2973  | 550.9451  | 640.7266  | 698.5949 | 633.8343 | 448.9376 | 297.2982 | 311.5720 | 461.5349 | 509.6110 | 460.7879 | 443.0931  | (94)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Heat loss rate W     | 1201.8494 | 1167.8433 | 1064.8433 | 893.7774 | 687.6842 | 456.1431 | 298.1449 | 313.3112 | 494.4197 | 747.9389 | 988.6105 | 1193.9990 | (97)  |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating kWh    | 545.0187  | 414.5556  | 315.5428  | 140.5314 | 40.0644  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 177.3160 | 380.0323 | 558.6740  | (98)  |
| Space heating        |           |           |           |          |          |          |          |          |          |          |          | 2571.7350 | (98)  |
| Space heating per m2 |           |           |           |          |          |          |          |          |          |          |          | 34.7532   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2750.5188 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 545.0187 | 414.5556 | 315.5428 | 140.5314 | 40.0644  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 177.3160 | 380.0323 | 558.6740  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 582.9077 | 443.3749 | 337.4789 | 150.3010 | 42.8496  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 189.6428 | 406.4516 | 597.5123  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 173.6760 | 152.6783 | 159.4027 | 141.5859 | 137.8022 | 121.7702 | 115.6524 | 128.6916 | 129.0236 | 146.8805 | 156.9558 | 169.0561  | (64)            |
| Efficiency of water heater (217)m                                     | 87.6596  | 87.3476  | 86.6027  | 84.7939  | 81.9834  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.3171  | 87.0869  | 87.7662   | (216)           |
| Fuel for water heating, kWh/month                                     | 198.1255 | 174.7940 | 184.0621 | 166.9764 | 168.0856 | 152.5942 | 144.9279 | 161.2677 | 161.6838 | 172.1583 | 180.2289 | 192.6210  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2057.5253 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2750.5188 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 325.0756  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5208.1196 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2750.5188          | 0.2160                        | 594.1121 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2057.5253          | 0.2160                        | 444.4255 (264)           |
| Space and water heating                                                                           |                    |                               | 1038.5375 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 325.0756           | 0.5190                        | 168.7142 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1246.1767 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 14.0343 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.2799 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5260 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (14.0343 * 1.00) + 2.2799 + 0.5260, rounded to 2 d.p. |                    |                               | 16.8400 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-0-06                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP 46%                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 87 B                                                                    | DER           | 10.30   | TER            | 15.30      |
| Environmental                      | 92 A                                                                    | % DER<TER     | 32.70   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.80                                                                    | DFEE          | 43.30   | TFEE           | 47.30      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 8.45    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Ground-floor flat, total floor area 102 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 15.30 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 10.30 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 47.3 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 43.3 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | 0.11 (max. 0.25) | 0.11 (max. 0.70) | OK |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK  
Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing East: 7.61 m<sup>2</sup>, No overhang  
Windows facing South West: 15.08 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Floor U-value 0.11 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 102.0000 (1b)             | x 2.5400 (2b)                   | = 259.0800 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 102.0000                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 259.0800 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |        |             |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |        |             |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)   |             |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 1                           | (19)   |             |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.9250 | (20)        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1388 | (21)        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1769                       | 0.1734 | 0.1700    | 0.1526 | 0.1492 | 0.1318 | 0.1318                      | 0.1283 | 0.1388      | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2774                       | 0.2739 | 0.2705    | 0.2531 | 0.2497 | 0.2323 | 0.2323                      | 0.2288 | 0.2393      | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W08 (Uw = 1.40)                                                |                         |                            | 11.2800                   | 1.3258                        | 14.9545      |                                | (27)                                                 |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                | (26a)                                                |
| W11 (Uw = 1.40)                                                |                         |                            | 11.4100                   | 1.3258                        | 15.1269      |                                | (27)                                                 |
| Heat Loss Floor 1                                              |                         |                            | 102.0000                  | 0.1100                        | 11.2200      | 110.0000                       | 11220.0000 (28a)                                     |
| External Wall 1                                                | 71.1000                 | 22.6900                    | 48.4100                   | 0.1500                        | 7.2615       | 140.0000                       | 6777.4000 (29a)                                      |
| Corridor wall                                                  | 3.8000                  | 2.1000                     | 1.7000                    | 0.1409                        | 0.2395       | 110.0000                       | 187.0000 (29a)                                       |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 176.9000                  |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 51.7425      |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 45.7000                   | 0.0000                        | 0.0000       | 140.0000                       | 6398.0000 (32)                                       |
| Party Ceilings                                                 |                         |                            | 102.0000                  |                               |              | 80.0000                        | 8160.0000 (32b)                                      |
| Internal Wall                                                  |                         |                            | 166.0000                  |                               |              | 9.0000                         | 1494.0000 (32c)                                      |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 34236.4000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 335.6510 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 11.3039 (36)                                         |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 63.0464 (37)                           |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 23.7172 | 23.4207 | 23.1241 | 21.6413 | 21.3447 | 19.8619 | 19.8619 | 19.5653 | 20.4550 | 21.3447 | 21.9378 | 22.5310 (38) |
| Heat transfer coeff       | 86.7636 | 86.4671 | 86.1705 | 84.6877 | 84.3911 | 82.9083 | 82.9083 | 82.6117 | 83.5014 | 84.3911 | 84.9842 | 85.5774 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 84.6135 (39) |
| HLP                       | 0.8506  | 0.8477  | 0.8448  | 0.8303  | 0.8274  | 0.8128  | 0.8128  | 0.8099  | 0.8186  | 0.8274  | 0.8332  | 0.8390 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.8295 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |          |          |          |          |         |         |         |         |          |          |          |               |
|------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|----------|---------------|
| Assumed occupancy                        |          |          |          |          |         |         |         |         |          |          |          | 2.7573 (42)   |
| Average daily hot water use (litres/day) |          |          |          |          |         |         |         |         |          |          |          | 104.9321 (43) |
| Jan                                      | 115.4253 | 111.2280 | 107.0308 | 102.8335 | 98.6362 | 94.4389 | 94.4389 | 98.6362 | 102.8335 | 107.0308 | 111.2280 | 115.4253 (44) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Energy content (annual)                                         | 171.1724 | 149.7085 | 154.4858 | 134.6844 | 129.2329 | 111.5182 | 103.3380 | 118.5819 | 119.9981 | 139.8462 | 152.6531 | 165.7714 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          | 25.6759  | 22.4563  | 23.1729  | 20.2027  | 19.3849  | 16.7277  | 15.5007  | 17.7873  | 17.9997  | 20.9769  | 22.8980  | 24.8657 (46)  |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |               |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)   |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)   |
| Total storage loss                                              | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (56)  |
| If cylinder contains dedicated solar storage                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (57)  |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 217.3748 | 191.4397 | 200.6882 | 179.3964 | 175.4353 | 156.2302 | 149.5404 | 164.7843 | 164.7101 | 186.0486 | 197.3651 | 211.9738 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 217.3748 | 191.4397 | 200.6882 | 179.3964 | 175.4353 | 156.2302 | 149.5404 | 164.7843 | 164.7101 | 186.0486 | 197.3651 | 211.9738 (64) |
| Heat gains from water heating, kWh/month                        | 93.8768  | 83.1630  | 88.3284  | 80.5522  | 79.9319  | 72.8494  | 71.3218  | 76.3904  | 75.6690  | 83.4608  | 86.5267  | 92.0809 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 23.1365   | 20.5496   | 16.7121   | 12.6521   | 9.4576    | 7.9845    | 8.6275    | 11.2144   | 15.0520   | 19.1119   | 22.3064   | 23.7795 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 259.5211  | 262.2141  | 255.4278  | 240.9805  | 222.7434  | 205.6032  | 194.1524  | 191.4594  | 198.2457  | 212.6930  | 230.9300  | 248.0703 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864 (69)   |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 (71) |
| Water heating gains (Table 5)                                                       | 126.1784  | 123.7545  | 118.7210  | 111.8780  | 107.4353  | 101.1797  | 95.8626   | 102.6753  | 105.0958  | 112.1785  | 120.1760  | 123.7646 (72)  |
| Total internal gains                                                                | 473.1953  | 470.8775  | 455.2201  | 429.8699  | 403.9956  | 379.1267  | 363.0019  | 369.7083  | 382.7527  | 408.3426  | 437.7718  | 459.9738 (73)  |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|------------|--------------------------------|----------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| Southwest   |          |          |          | 11.2800    | 36.7938                        |          | 0.3700                            | 0.8900                             | 0.7700                       |          | 94.7129 (79) |               |
| East        |          |          |          | 7.6100     | 19.6403                        |          | 0.3700                            | 0.6800                             | 0.7700                       |          | 26.0601 (76) |               |
| Southwest   |          |          |          | 3.8000     | 36.7938                        |          | 0.3700                            | 0.6800                             | 0.7700                       |          | 24.3782 (79) |               |
|             |          |          |          |            |                                |          |                                   |                                    |                              |          |              |               |
| Solar gains | 145.1512 | 253.8353 | 361.5120 | 466.3500   | 535.2631                       | 536.0306 | 514.9372                          | 463.5048                           | 398.1787                     | 284.6903 | 175.1376     | 123.3477 (83) |
| Total gains | 618.3465 | 724.7128 | 816.7322 | 896.2200   | 939.2587                       | 915.1573 | 877.9391                          | 833.2131                           | 780.9315                     | 693.0330 | 612.9094     | 583.3215 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |          |          |          |          |          |          |          |          |          |          |          |              |
|-----------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |          |          |          |          |          |          |          |          |          |          |          | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec          |
| tau                                                                         | 109.6094 | 109.9854 | 110.3639 | 112.2963 | 112.6909 | 114.7064 | 114.7064 | 115.1182 | 113.8916 | 112.6909 | 111.9044 | 111.1288     |
| alpha                                                                       | 8.3073   | 8.3324   | 8.3576   | 8.4864   | 8.5127   | 8.6471   | 8.6471   | 8.6745   | 8.5928   | 8.5127   | 8.4603   | 8.4086       |
| util living area                                                            | 0.9995   | 0.9979   | 0.9899   | 0.9441   | 0.7992   | 0.5776   | 0.4154   | 0.4558   | 0.7228   | 0.9685   | 0.9981   | 0.9997 (86)  |
| MIT                                                                         | 20.3710  | 20.4934  | 20.6659  | 20.8644  | 20.9741  | 20.9985  | 20.9999  | 20.9998  | 20.9911  | 20.8432  | 20.5677  | 20.3520 (87) |
| Th 2                                                                        | 20.2097  | 20.2122  | 20.2147  | 20.2272  | 20.2297  | 20.2422  | 20.2422  | 20.2447  | 20.2372  | 20.2297  | 20.2247  | 20.2197 (88) |
| util rest of house                                                          | 0.9993   | 0.9970   | 0.9855   | 0.9223   | 0.7462   | 0.5104   | 0.3439   | 0.3811   | 0.6501   | 0.9514   | 0.9971   | 0.9996 (89)  |
| MIT 2                                                                       | 19.3643  | 19.5450  | 19.7964  | 20.0797  | 20.2086  | 20.2415  | 20.2422  | 20.2447  | 20.2319  | 20.0591  | 19.6642  | 19.3446 (90) |
| Living area fraction                                                        | 19.7364  | 19.8956  | 20.1177  | 20.3697  | 20.4915  | 20.5213  | 20.5223  | 20.5238  | 20.5125  | 20.3489  | 19.9981  | 19.7169 (92) |
| Temperature adjustment                                                      |          |          |          |          |          |          |          |          |          |          |          | 0.0000       |
| adjusted MIT                                                                | 19.7364  | 19.8956  | 20.1177  | 20.3697  | 20.4915  | 20.5213  | 20.5223  | 20.5238  | 20.5125  | 20.3489  | 19.9981  | 19.7169 (93) |

#### 8. Space heating requirement

|                   |           |           |           |          |          |          |          |          |          |          |           |                |
|-------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Utilisation       | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec            |
| Useful gains      | 0.9991    | 0.9965    | 0.9848    | 0.9269   | 0.7650   | 0.5353   | 0.3704   | 0.4088   | 0.6770   | 0.9545   | 0.9968    | 0.9994 (94)    |
| Ext temp.         | 617.8042  | 722.1926  | 804.3025  | 830.6661 | 718.5060 | 489.8757 | 325.1500 | 340.5879 | 528.6959 | 661.5021 | 610.9256  | 582.9973 (95)  |
| Heat loss rate W  | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000 (96)    |
| Month fracti      | 1339.3169 | 1296.6215 | 1173.4481 | 971.3416 | 741.9246 | 490.9211 | 325.1882 | 340.6739 | 535.4507 | 822.7185 | 1096.1374 | 1327.8995 (97) |
| Space heating kWh | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000 (97a)   |
| Space heating     | 536.8054  | 386.0162  | 274.6443  | 101.2863 | 17.4234  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 119.9450 | 349.3525  | 554.2073 (98)  |
|                   |           |           |           |          |          |          |          |          |          |          |           | 2339.6805 (98) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 22.9380 (99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 2339.6805 (98)   |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 1130.0657 (307a) |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 1326.5988 (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2194.9869 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 1060.1786 (310a) |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1244.5575 (310b) |
| Electricity used for heat distribution                                                  | 47.6140 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 209.4014 (330a)  |
| Total electricity for the above, kWh/year                                               | 209.4014 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 408.5977 (332)   |
| Energy saving/generation technologies (Appendices M, N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415 (333)  |
| Total delivered energy for all uses                                                     | 5006.7583 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 591.9579           | 0.5190                        | 307.2262 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 2738.1857          | 0.2160                        | 591.4481 (368)           |
| Electrical energy for heat distribution                                                    | 47.6140            | 0.5190                        | 24.7117 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 923.3859 (373)           |
| Space and water heating                                                                    |                    |                               | 923.3859 (376)           |
| Pumps and fans                                                                             | 209.4014           | 0.5190                        | 108.6793 (378)           |
| Energy for lighting                                                                        | 408.5977           | 0.5190                        | 212.0622 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 1050.7266 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 10.3000 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |              |
|---------------------------------------------------------------------------------|--------------|
| DER                                                                             | 10.3000 ZC1  |
| Total Floor Area                                                                | TFA 102.0000 |
| Assumed number of occupants                                                     | N 2.7573     |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF 0.5190    |
| CO2 emissions from appliances, equation (L14)                                   | 15.0771 ZC2  |
| CO2 emissions from cooking, equation (L16)                                      | 1.8154 ZC3   |
| Total CO2 emissions                                                             | 27.1926 ZC4  |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5   |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6   |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7   |
| Net CO2 emissions                                                               | 27.1926 ZC8  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 102.0000 (1b)             | x 2.5400 (2b)                   | = 259.0800 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 102.0000                  |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 259.0800 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | 0                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | 0                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 4 * 10 =        | 40.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 40.0000 / (5) = | 0.1544 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.4044 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 1 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.9250 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3741 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4769 | 0.4676 | 0.4582 | 0.4115 | 0.4021 | 0.3554 | 0.3554 | 0.3460 | 0.3741 | 0.4021 | 0.4208 | 0.4395 (22b) |
| Effective ac    | 0.6137 | 0.6093 | 0.6050 | 0.5847 | 0.5808 | 0.5631 | 0.5631 | 0.5599 | 0.5700 | 0.5808 | 0.5885 | 0.5966 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 22.6900                   | 1.3258                        | 30.0814      |                                | (27)          |
| Heat Loss Floor 1                                              |                         |                            | 102.0000                  | 0.1300                        | 13.2600      |                                | (28a)         |
| External Wall 1                                                | 71.1000                 | 22.6900                    | 48.4100                   | 0.1800                        | 8.7138       |                                | (29a)         |
| Corridor wall                                                  | 3.8000                  | 2.1000                     | 1.7000                    | 0.1800                        | 0.3060       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 176.9000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 54.8812      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 8.9914 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 63.8726 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| (38)m                     | 52.4718  | 52.0942  | 51.7241  | 49.9858  | 49.6605  | 48.1465  | 48.1465  | 47.8661  | 48.7297  | 49.6605  | 50.3185  | 51.0064 (38)  |
| Heat transfer coeff       | 116.3445 | 115.9669 | 115.5968 | 113.8584 | 113.5332 | 112.0191 | 112.0191 | 111.7387 | 112.6023 | 113.5332 | 114.1911 | 114.8790 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 113.8569 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.1406 | 1.1369 | 1.1333 | 1.1163 | 1.1131 | 1.0982 | 1.0982 | 1.0955 | 1.1039 | 1.1131 | 1.1195 | 1.1263 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.1162 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

| Assumed occupancy                                           |          |          |          |          |          |          |         |          |          |                    |          | 2.7573 (42)    |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|--------------------|----------|----------------|
| Average daily hot water use (litres/day)                    |          |          |          |          |          |          |         |          |          |                    |          | 99.6855 (43)   |
|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct                | Nov      | Dec            |
| Daily hot water use                                         | 109.6541 | 105.6666 | 101.6792 | 97.6918  | 93.7044  | 89.7170  | 89.7170 | 93.7044  | 97.6918  | 101.6792           | 105.6666 | 109.6541 (44)  |
| Energy conte                                                | 162.6138 | 142.2231 | 146.7615 | 127.9502 | 122.7713 | 105.9423 | 98.1711 | 112.6528 | 113.9982 | 132.8539           | 145.0204 | 157.4828 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |          |         |          |          | Total = Sum(45)m = |          | 1568.4413 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 24.3921  | 21.3335  | 22.0142  | 19.1925  | 18.4157  | 15.8913  | 14.7257 | 16.8979  | 17.0997  | 19.9281            | 21.7531  | 23.6224 (46)   |
| Water storage loss:                                         |          |          |          |          |          |          |         |          |          |                    |          |                |
| Store volume                                                |          |          |          |          |          |          |         |          |          |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |          |         |          |          |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |          |         |          |          |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |          |         |          |          |                    |          | 0.1290 (55)    |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 189.8740 | 166.8451 | 174.0216 | 154.3310 | 150.0314 | 132.3231 | 125.4312 | 139.9129 | 140.3790 | 160.1140 | 171.4012 | 184.7429 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 189.8740 | 166.8451 | 174.0216 | 154.3310 | 150.0314 | 132.3231 | 125.4312 | 139.9129 | 140.3790 | 160.1140 | 171.4012 | 184.7429 (64) |
| Heat gains from water heating, kWh/month                        | 75.8772  | 66.9868  | 70.6063  | 63.6481  | 62.6296  | 56.3304  | 54.4500  | 59.2652  | 59.0090  | 65.9820  | 69.3239  | 74.1711 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642  | 137.8642 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 23.1376   | 20.5506   | 16.7129   | 12.6527   | 9.4581    | 7.9849    | 8.6280    | 11.2149   | 15.0527   | 19.1128   | 22.3075   | 23.7806 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 259.5211  | 262.2141  | 255.4278  | 240.9805  | 222.7434  | 205.6032  | 194.1524  | 191.4594  | 198.2457  | 212.6930  | 230.9300  | 248.0703 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864   | 36.7864 (69)   |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 | -110.2914 (71) |
| Water heating gains (Table 5)                                                       | 101.9855  | 99.6828   | 94.9009   | 88.4001   | 84.1795   | 78.2367   | 73.1855   | 79.6575   | 81.9570   | 88.6855   | 96.2832   | 99.6924 (72)   |
| Total internal gains                                                                | 452.0034  | 449.8067  | 434.4009  | 409.3926  | 383.7403  | 359.1840  | 343.3251  | 349.6911  | 362.6146  | 387.8506  | 416.8800  | 438.9026 (73)  |

#### 6. Solar gains

| [Jan]       |          |          |          |           |           |           |           |           |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |  | Specific data<br>g<br>or Table 6b |  | Specific data<br>FF<br>or Table 6c |  | Access<br>factor<br>Table 6d |  | Gains<br>W    |  |
|-------------|----------|----------|----------|-----------|-----------|-----------|-----------|-----------|----------|----------|----------|------------|--------------------------------|--|-----------------------------------|--|------------------------------------|--|------------------------------|--|---------------|--|
| East        |          |          |          |           |           |           |           |           |          |          |          | 7.6100     | 19.6403                        |  | 0.6300                            |  | 0.7000                             |  | 0.7700                       |  | 45.6777 (76)  |  |
| Southwest   |          |          |          |           |           |           |           |           |          |          |          | 15.0800    | 36.7938                        |  | 0.6300                            |  | 0.7000                             |  | 0.7700                       |  | 169.5697 (79) |  |
|             |          |          |          |           |           |           |           |           |          |          |          |            |                                |  |                                   |  |                                    |  |                              |  |               |  |
| Solar gains | 215.2473 | 378.1951 | 542.3586 | 704.2933  | 811.4994  | 813.7609  | 781.3036  | 701.2876  | 599.0693 | 425.2571 | 260.0601 | 182.6794   | (83)                           |  |                                   |  |                                    |  |                              |  |               |  |
| Total gains | 667.2508 | 828.0018 | 976.7595 | 1113.6859 | 1195.2397 | 1172.9450 | 1124.6288 | 1050.9786 | 961.6839 | 813.1077 | 676.9401 | 621.5820   | (84)                           |  |                                   |  |                                    |  |                              |  |               |  |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 60.8824 | 61.0807 | 61.2762 | 62.2118 | 62.3900 | 63.2333 | 63.2333 | 63.3919 | 62.9058                   | 62.3900 | 62.0305 | 61.6591      |
| alpha                                                                       | 5.0588  | 5.0720  | 5.0851  | 5.1475  | 5.1593  | 5.2156  | 5.2156  | 5.2261  | 5.1937                    | 5.1593  | 5.1354  | 5.1106       |
| util living area                                                            | 0.9971  | 0.9909  | 0.9722  | 0.9121  | 0.7816  | 0.5921  | 0.4349  | 0.4830  | 0.7380                    | 0.9495  | 0.9928  | 0.9979 (86)  |
| MIT                                                                         | 19.8216 | 20.0341 | 20.3290 | 20.6648 | 20.8873 | 20.9791 | 20.9965 | 20.9941 | 20.9376                   | 20.6211 | 20.1526 | 19.7889 (87) |
| Th 2                                                                        | 19.9678 | 19.9708 | 19.9737 | 19.9876 | 19.9902 | 20.0023 | 20.0023 | 20.0045 | 19.9976                   | 19.9902 | 19.9849 | 19.9794 (88) |
| util rest of house                                                          | 0.9961  | 0.9880  | 0.9631  | 0.8850  | 0.7241  | 0.5079  | 0.3381  | 0.3817  | 0.6558                    | 0.9277  | 0.9899  | 0.9972 (89)  |
| MIT 2                                                                       | 18.4032 | 18.7141 | 19.1394 | 19.6119 | 19.8874 | 19.9894 | 20.0011 | 20.0023 | 19.9522                   | 19.5669 | 18.8984 | 18.3638 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3696 (91)  |
| MIT                                                                         | 18.9274 | 19.2020 | 19.5791 | 20.0011 | 20.2570 | 20.3552 | 20.3690 | 20.3689 | 20.3164                   | 19.9565 | 19.3619 | 18.8905 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.9274 | 19.2020 | 19.5791 | 20.0011 | 20.2570 | 20.3552 | 20.3690 | 20.3689 | 20.3164                   | 19.9565 | 19.3619 | 18.8905 (93) |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |              |           |                |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|--------------|-----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov       | Dec            |
| Useful gains         | 0.9947    | 0.9850    | 0.9587    | 0.8854    | 0.7404   | 0.5385   | 0.3740   | 0.4193   | 0.6836   | 0.9268       | 0.9875    | 0.9962 (94)    |
| Ext temp.            | 663.6814  | 815.5886  | 936.4452  | 986.0461  | 884.9269 | 631.5766 | 420.6028 | 440.6414 | 657.4375 | 753.6179     | 668.4721  | 619.1937 (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000    | 4.2000 (96)    |
| Month fracti         | 1701.8192 | 1658.5530 | 1511.8966 | 1263.9509 | 971.5007 | 644.6966 | 422.1983 | 443.4760 | 699.9799 | 1062.2786    | 1400.2047 | 1687.6324 (97) |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000    | 1.0000 (97a)   |
| Space heating        | 772.3745  | 566.4721  | 428.1358  | 200.0915  | 64.4109  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 229.6436     | 526.8474  | 794.9184 (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          | (98) / (4) = |           | 35.1264 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 3831.9723 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 772.3745 | 566.4721 | 428.1358 | 200.0915 | 64.4109  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 229.6436 | 526.8474 | 794.9184  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 826.0690 | 605.8525 | 457.8993 | 214.0016 | 68.8887  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 245.6081 | 563.4732 | 850.1801  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 189.8740 | 166.8451 | 174.0216 | 154.3310 | 150.0314 | 132.3231 | 125.4312 | 139.9129 | 140.3790 | 160.1140 | 171.4012 | 184.7429  | (64)            |
| Efficiency of water heater (217)m                                     | 88.1673  | 87.8208  | 87.1239  | 85.5075  | 82.7383  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.7753  | 87.6162  | 88.2681   | (217)           |
| Fuel for water heating, kWh/month                                     | 215.3565 | 189.9836 | 199.7403 | 180.4882 | 181.3326 | 165.8184 | 157.1820 | 175.3295 | 175.9135 | 186.6669 | 195.6274 | 209.2975  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2232.7364 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3831.9723 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 408.6169  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 6548.3256 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 3831.9723          | 0.2160                        | 827.7060 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2232.7364          | 0.2160                        | 482.2711 (264)           |
| Space and water heating                                                                           |                    |                               | 1309.9771 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 408.6169           | 0.5190                        | 212.0722 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1560.9743 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.8429 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.0791 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.3816 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.8429 * 1.00) + 2.0791 + 0.3816, rounded to 2 d.p. |                    |                               | 15.3000 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-1-01                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP 46%                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 86 B                                                                    | DER           | 10.77   | TER            | 17.69      |
| Environmental                      | 93 A                                                                    | % DER<TER     | 39.13   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.46                                                                    | DFEE          | 42.59   | TFEE           | 44.47      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 4.23    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 55 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 17.69 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 10.77 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 44.5 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 42.6 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.14 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.38 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK

Hot water controls:

No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing North: 8.40 m<sup>2</sup>, No overhang  
Windows facing North East: 1.64 m<sup>2</sup>, No overhang  
Windows facing South East: 7.61 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 54.5000 (1b)              | x 2.5400 (2b)                   | = 138.4300 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.4300 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |              |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|--------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |              |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |              |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |              |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |              |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |              |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |              |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |              |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |              |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes    |             |        |        |              |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000 |             |        |        |              |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 | (18)        |        |        |              |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 3      | (19)        |        |        |              |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20)        |        |        |              |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1163 | (21)        |        |        |              |
|                                                                                              | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec          |
| Wind speed                                                                                   | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor                                                                                  | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate                                                                              | 0.1482                       | 0.1453 | 0.1424    | 0.1279 | 0.1250 | 0.1104 | 0.1104                      | 0.1075 | 0.1163      | 0.1250 | 0.1308 | 0.1366 (22b) |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |              |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        |              |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = | 0.5000 (23a)                 |        |           |        |        |        |                             |        |             |        |        |              |
|                                                                                              | 79.9000 (23c)                |        |           |        |        |        |                             |        |             |        |        |              |
| Effective ac                                                                                 | 0.2487                       | 0.2458 | 0.2429    | 0.2284 | 0.2255 | 0.2109 | 0.2109                      | 0.2080 | 0.2168      | 0.2255 | 0.2313 | 0.2371 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| W05 (Uw = 1.40)                                                |                         |                            | 1.6400                    | 1.3258                        | 2.1742       |                                      | (27)            |
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364      |                                      | (27)            |
| W02 (Uw = 1.40)                                                |                         |                            | 7.6100                    | 1.3258                        | 10.0890      |                                      | (27)            |
| door                                                           |                         |                            | 2.1000                    | 1.2500                        | 2.6250       |                                      | (26a)           |
| External Wall 1                                                | 32.4000                 | 17.6500                    | 14.7500                   | 0.1500                        | 2.2125       | 140.0000                             | 2065.0000 (29a) |
| Corridor wall                                                  | 43.3000                 | 2.1000                     | 41.2000                   | 0.1409                        | 5.8055       | 110.0000                             | 4532.0000 (29a) |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 75.7000                   |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 34.0427      |                                      | (33)            |
| Party Wall 1                                                   |                         |                            | 19.4000                   | 0.0000                        | 0.0000       | 140.0000                             | 2716.0000 (32)  |
| Party Floor 1                                                  |                         |                            | 54.5000                   |                               |              | 40.0000                              | 2180.0000 (32d) |
| Party Ceilings                                                 |                         |                            | 54.5000                   |                               |              | 80.0000                              | 4360.0000 (32b) |
| Internal Wall                                                  |                         |                            | 73.4000                   |                               |              | 9.0000                               | 660.6000 (32c)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 16513.6000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 303.0018 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 5.2116 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 39.2543 (37)    |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 11.3619 | 11.2292 | 11.0964 | 10.4326 | 10.2998 | 9.6360  | 9.6360  | 9.5033  | 9.9016  | 10.2998 | 10.5654 | 10.8309 (38) |
| Heat transfer coeff       | 50.6162 | 50.4834 | 50.3507 | 49.6869 | 49.5541 | 48.8903 | 48.8903 | 48.7575 | 49.1558 | 49.5541 | 49.8196 | 50.0852 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 49.6537 (39) |
| HLP                       | 0.9287  | 0.9263  | 0.9239  | 0.9117  | 0.9092  | 0.8971  | 0.8971  | 0.8946  | 0.9019  | 0.9092  | 0.9141  | 0.9190 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.9111 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 1.8227 (42)  |
| Average daily hot water use (litres/day) | 81.5674 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

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|                                                                 |                                          |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Energy conte                                                    | 89.7241                                  | 86.4614  | 83.1987  | 79.9360  | 76.6733  | 73.4106  | 73.4106  | 76.6733  | 79.9360  | 83.1987  | 86.4614  | 89.7241 (44)   |
| 133.0582                                                        | 116.3736                                 | 120.0871 | 104.6949 | 100.4572 | 86.6869  | 80.3282  | 92.1778  | 93.2787  | 108.7073 | 118.6625 | 128.8598 | (45)           |
| Energy content (annual)                                         | Total = Sum(45)m =                       |          |          |          |          |          |          |          |          |          |          | 1283.3722 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          |                                          |          |          |          |          |          |          |          |          |          |          |                |
| 19.9587                                                         | 17.4560                                  | 18.0131  | 15.7042  | 15.0686  | 13.0030  | 12.0492  | 13.8267  | 13.9918  | 16.3061  | 17.7994  | 19.3290  | (46)           |
| Water storage loss:                                             |                                          |          |          |          |          |          |          |          |          |          |          |                |
| Store volume                                                    |                                          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |                                          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |                                          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |                                          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)    |
| Total storage loss                                              |                                          |          |          |          |          |          |          |          |          |          |          |                |
| 22.9400                                                         | 20.7200                                  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | (56)           |
| If cylinder contains dedicated solar storage                    |                                          |          |          |          |          |          |          |          |          |          |          |                |
| 22.9400                                                         | 20.7200                                  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | (57)           |
| Primary loss                                                    | 23.2624                                  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | (59)           |
| Total heat required for water heating calculated for each month |                                          |          |          |          |          |          |          |          |          |          |          |                |
| 179.2606                                                        | 158.1048                                 | 166.2895 | 149.4069 | 146.6596 | 131.3989 | 126.5306 | 138.3802 | 137.9907 | 154.9097 | 163.3745 | 175.0622 | (62)           |
| Solar input                                                     | 0.0000                                   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (63)           |
| Output from w/h                                                 | Solar input (sum of months) = Sum(63)m = |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)    |
| 179.2606                                                        | 158.1048                                 | 166.2895 | 149.4069 | 146.6596 | 131.3989 | 126.5306 | 138.3802 | 137.9907 | 154.9097 | 163.3745 | 175.0622 | (64)           |
| Heat gains from water heating, kWh/month                        | Total per year (kWh/year) = Sum(64)m =   |          |          |          |          |          |          |          |          |          |          | 1827.3682 (64) |
| 81.2038                                                         | 72.0792                                  | 76.8909  | 70.5806  | 70.3639  | 64.5930  | 63.6710  | 67.6110  | 66.7848  | 73.1071  | 75.2249  | 79.8078  | (65)           |

#### 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.1657  | 12.5819  | 10.2323  | 7.7465   | 5.7906   | 4.8887   | 5.2824   | 6.8662   | 9.2158   | 11.7016  | 13.6575  | 14.5594 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 158.8961 | 160.5450 | 156.3899 | 147.5444 | 136.3784 | 125.8840 | 118.8731 | 117.2242 | 121.3793 | 130.2248 | 141.3908 | 151.8852 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 (71) |
| Water heating gains (Table 5)                                                       | 109.1449 | 107.2607 | 103.3480 | 98.0287  | 94.5752  | 89.7125  | 85.5794  | 90.8750  | 92.7566  | 98.2622  | 104.4790 | 107.2686 (72) |
| Total internal gains                                                                | 332.5471 | 330.7279 | 320.3106 | 303.6599 | 287.0846 | 270.8256 | 260.0752 | 265.3059 | 273.6921 | 290.5291 | 309.8677 | 324.0536 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| -----       |          |          |          |            |                                |                                   |                                    |                              | -----        |          |          |               |
| Northeast   |          |          |          | 1.6400     | 11.2829                        | 0.3700                            | 0.7900                             | 0.7700                       | 3.7482 (75)  |          |          |               |
| North       |          |          |          | 8.4000     | 10.6334                        | 0.3700                            | 0.8900                             | 0.7700                       | 20.3834 (74) |          |          |               |
| Southeast   |          |          |          | 7.6100     | 36.7938                        | 0.5600                            | 0.6800                             | 0.7700                       | 73.8907 (77) |          |          |               |
| -----       |          |          |          |            |                                |                                   |                                    |                              | -----        |          |          |               |
| Solar gains | 98.0223  | 172.4466 | 252.1496 | 342.2747   | 412.5714                       | 422.9506                          | 402.1702                           | 347.3383                     | 282.8027     | 194.7990 | 118.3658 | 83.2886 (83)  |
| Total gains | 430.5694 | 503.1745 | 572.4601 | 645.9346   | 699.6560                       | 693.7762                          | 662.2454                           | 612.6442                     | 556.4948     | 485.3280 | 428.2335 | 407.3422 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
| Jan                                                                         | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| 90.6253                                                                     | 90.8637 | 91.1033 | 92.3204 | 92.5677 | 93.8246 | 93.8246 | 94.0801 | 93.3178 | 92.5677 | 92.0744 | 91.5862 |              |
| alpha                                                                       | 7.0417  | 7.0576  | 7.0736  | 7.1547  | 7.1712  | 7.2550  | 7.2550  | 7.2720  | 7.2212  | 7.1712  | 7.1383  | 7.1057       |
| util living area                                                            | 0.9957  | 0.9868  | 0.9550  | 0.8437  | 0.6470  | 0.4502  | 0.3248  | 0.3659  | 0.6027  | 0.9023  | 0.9874  | 0.9970 (86)  |
| MIT                                                                         | 20.3632 | 20.5164 | 20.7195 | 20.9138 | 20.9875 | 20.9992 | 20.9999 | 20.9999 | 20.9942 | 20.8812 | 20.5868 | 20.3335 (87) |
| Th 2                                                                        | 20.1431 | 20.1452 | 20.1473 | 20.1576 | 20.1596 | 20.1700 | 20.1700 | 20.1721 | 20.1658 | 20.1596 | 20.1555 | 20.1514 (88) |
| util rest of house                                                          | 0.9942  | 0.9822  | 0.9405  | 0.8059  | 0.5930  | 0.3922  | 0.2635  | 0.3002  | 0.5330  | 0.8667  | 0.9821  | 0.9959 (89)  |
| MIT 2                                                                       | 19.3061 | 19.5283 | 19.8140 | 20.0706 | 20.1499 | 20.1696 | 20.1700 | 20.1720 | 20.1624 | 20.0405 | 19.6397 | 19.2695 (90) |
| Living area fraction                                                        | 19.7949 | 19.9852 | 20.2327 | 20.4605 | 20.5372 | 20.5532 | 20.5537 | 20.5548 | 20.5470 | 20.4292 | 20.0776 | 19.7615 (92) |
| MIT                                                                         |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 19.7615 (93) |
| adjusted MIT                                                                |         |         |         |         |         |         |         |         |         |         |         |              |

#### 8. Space heating requirement

|                   | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|-------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Utilisation       | 0.9933   | 0.9811   | 0.9422   | 0.8202   | 0.6176   | 0.4191   | 0.2919   | 0.3306   | 0.5652   | 0.8792   | 0.9815   | 0.9952 (94)   |
| Useful gains      | 427.6998 | 493.6744 | 539.3488 | 529.8102 | 432.1033 | 290.7424 | 193.2812 | 202.5342 | 314.5454 | 426.6966 | 420.3181 | 405.3984 (95) |
| Ext temp.         | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)   |
| Heat loss rate W  | 784.2930 | 761.5517 | 691.4495 | 574.4027 | 437.9197 | 291.0522 | 193.2993 | 202.5776 | 316.9081 | 487.0779 | 646.5406 | 779.4005 (97) |
| Month fracti      | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)  |
| Space heating kWh | 265.3054 | 180.0135 | 113.1630 | 32.1066  | 4.3274   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 44.9237  | 162.8802 | 278.2576 (98) |

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Space heating 1080.9773 (98)  
Space heating per m2 (98) / (4) = 19.8344 (99)

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1080.9773 (98)   |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 522.1120 (307a)  |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 612.9141 (307b)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1827.3682 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 882.6188 (310a)  |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1036.1178 (310b) |
| Electricity used for heat distribution                                                  | 30.5376 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 111.8860 (330a)  |
| Total electricity for the above, kWh/year                                               | 111.8860 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 250.1708 (332)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415        |
| Total delivered energy for all uses                                                     | 3043.1781 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 379.6570           | 0.5190                        | 197.0420 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 1756.1575          | 0.2160                        | 379.3300 (368)           |
| Electrical energy for heat distribution                                                    | 30.5376            | 0.5190                        | 15.8490 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 592.2210 (373)           |
| Space and water heating                                                                    |                    |                               | 592.2210 (376)           |
| Pumps and fans                                                                             | 111.8860           | 0.5190                        | 58.0689 (378)            |
| Energy for lighting                                                                        | 250.1708           | 0.5190                        | 129.8386 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 586.7276 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 10.7700 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 10.7700 ZC1 |
| Total Floor Area                                                                | 54.5000     |
| Assumed number of occupants                                                     | 1.8227      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   | 17.2768 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.9861 ZC3  |
| Total CO2 emissions                                                             | 31.0329 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 31.0329 ZC8 |

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 54.5000 (1b)              | x 2.5400 (2b)                   | = 138.4300 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.4300 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1445 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3945 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 3 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3057 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3898 | 0.3821 | 0.3745 | 0.3363 | 0.3286 | 0.2904 | 0.2904 | 0.2828 | 0.3057 | 0.3286 | 0.3439 | 0.3592 (22b) |
| Effective ac    | 0.5760 | 0.5730 | 0.5701 | 0.5565 | 0.5540 | 0.5422 | 0.5422 | 0.5400 | 0.5467 | 0.5540 | 0.5591 | 0.5645 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2  | U-value<br>W/m2K | A x U<br>W/K                 | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------|------------------|------------------------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|------|
| TER Semi-glazed door                                                |                |                | 2.1000         | 1.2000           | 2.5200                       |                   |                | (26a)          |                |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                | 11.5200        | 1.3258           | 15.2727                      |                   |                | (27)           |                |                |                |                |      |
| External Wall 1                                                     | 32.4000        | 11.5200        | 20.8800        | 0.1800           | 3.7584                       |                   |                | (29a)          |                |                |                |                |      |
| Corridor wall                                                       | 43.3000        | 2.1000         | 41.2000        | 0.1800           | 7.4160                       |                   |                | (29a)          |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 75.7000        |                  |                              |                   |                | (31)           |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                |                  | (26)...(30) + (32) = 28.9671 |                   |                | (33)           |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                  |                              |                   |                | 250.0000 (35)  |                |                |                |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                |                  |                              |                   |                | 3.1241 (36)    |                |                |                |                |      |
| Total fabric heat loss                                              |                |                |                |                  |                              | (33) + (36) =     | 32.0912        | (37)           |                |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                  |                              |                   |                |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>26.3114 | Feb<br>26.1766 | Mar<br>26.0445 | Apr<br>25.4241   | May<br>25.3080               | Jun<br>24.7676    | Jul<br>24.7676 | Aug<br>24.6676 | Sep<br>24.9758 | Oct<br>25.3080 | Nov<br>25.5428 | Dec<br>25.7883 | (38) |
| Heat transfer coeff                                                 | 58.4026        | 58.2678        | 58.1357        | 57.5153          | 57.3992                      | 56.8589           | 56.8589        | 56.7588        | 57.0670        | 57.3992        | 57.6341        | 57.8796        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                |                  |                              |                   |                |                |                |                |                | 57.5148        | (39) |
| HLP                                                                 | Jan<br>1.0716  | Feb<br>1.0691  | Mar<br>1.0667  | Apr<br>1.0553    | May<br>1.0532                | Jun<br>1.0433     | Jul<br>1.0433  | Aug<br>1.0414  | Sep<br>1.0471  | Oct<br>1.0532  | Nov<br>1.0575  | Dec<br>1.0620  | (40) |
| HLP (average)                                                       |                |                |                |                  |                              |                   |                |                |                |                |                | 1.0553         | (40) |
| Days in month                                                       | 31             | 28             | 31             | 30               | 31                           | 30                | 31             | 31             | 30             | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |         |         |         |         |         |         |          |          |                                   |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |          |          | 1.8227 (42)                       |
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |          |          | 77.4890 (43)                      |
| Jan                                                         | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov      | Dec      |                                   |
| Daily hot water use                                         | 85.2379  | 82.1383  | 79.0388  | 75.9392 | 72.8397 | 69.7401 | 69.7401 | 72.8397 | 75.9392 | 79.0388  | 82.1383  | 85.2379 (44)                      |
| Energy conte                                                | 126.4053 | 110.5549 | 114.0828 | 99.4601 | 95.4343 | 82.3526 | 76.3118 | 87.5689 | 88.6147 | 103.2719 | 112.7294 | 122.4168 (45)                     |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         |          |          | Total = Sum(45)m = 1219.2036 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |         |         |         |         |         |         |          |          |                                   |
|                                                             | 18.9608  | 16.5832  | 17.1124  | 14.9190 | 14.3152 | 12.3529 | 11.4468 | 13.1353 | 13.2922 | 15.4908  | 16.9094  | 18.3625 (46)                      |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |          |          |                                   |
| Store volume                                                |          |          |          |         |         |         |         |         |         |          |          | 2.0000 (47)                       |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |          |          | 0.2388 (48)                       |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |          |          | 0.5400 (49)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |          |          | 0.1290 (55)                       |
| Total storage loss                                          |          |          |          |         |         |         |         |         |         |          |          |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 153.6655 | 135.1770 | 141.3429 | 125.8409 | 122.6945 | 108.7334 | 103.5719 | 114.8290 | 114.9955 | 130.5321 | 139.1102 | 149.6770 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 153.6655 | 135.1770 | 141.3429 | 125.8409 | 122.6945 | 108.7334 | 103.5719 | 114.8290 | 114.9955 | 130.5321 | 139.1102 | 149.6770 (64) |
|                                                                 | 63.8379  | 56.4572  | 59.7406  | 54.1751  | 53.5400  | 48.4869  | 47.1818  | 50.9248  | 50.5690  | 56.1460  | 58.5871  | 62.5117 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.1983  | 12.6108  | 10.2558  | 7.7643   | 5.8039   | 4.8999   | 5.2945   | 6.8820   | 9.2370   | 11.7285  | 13.6889  | 14.5929  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 158.8961 | 160.5450 | 156.3899 | 147.5444 | 136.3784 | 125.8840 | 118.8731 | 117.2242 | 121.3793 | 130.2248 | 141.3908 | 151.8852 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | (71) |
| Water heating gains (Table 5)                                                       | 85.8036  | 84.0136  | 80.2965  | 75.2432  | 71.9624  | 67.3429  | 63.4164  | 68.4473  | 70.2348  | 75.4651  | 81.3710  | 84.0211  | (72) |
| Total internal gains                                                                | 312.2384 | 310.5098 | 300.2827 | 283.8923 | 267.4851 | 251.4672 | 240.9244 | 245.8939 | 254.1914 | 270.7588 | 289.7911 | 303.8396 | (73) |

#### 6. Solar gains

| [Jan]       |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W |          |          |          |          |      |
|-------------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|------------|----------|----------|----------|----------|------|
| North       |          |          | 5.4800     | 10.6334                        | 0.6300                            | 0.7000                             | 0.7700                       | 17.8084    | (74)     |          |          |          |      |
| Northeast   |          |          | 1.0700     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 3.6896     | (75)     |          |          |          |      |
| Southeast   |          |          | 4.9700     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       | 55.8860    | (77)     |          |          |          |      |
| Solar gains | 77.3840  | 136.7376 | 201.6104   | 276.4969                       | 335.7665                          | 345.2594                           | 327.8724                     | 281.5311   | 227.0507 | 154.8999 | 93.5500  | 65.6858  | (83) |
| Total gains | 389.6224 | 447.2474 | 501.8931   | 560.3892                       | 603.2516                          | 596.7265                           | 568.7967                     | 527.4250   | 481.2421 | 425.6588 | 383.3411 | 369.5255 | (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 64.8040 | 64.9539 | 65.1015 | 65.8037 | 65.9368 | 66.5635 | 66.5635 | 66.6808 | 66.3207                   | 65.9368 | 65.6682 | 65.3896 |              |
| alpha                                                                       | 5.3203  | 5.3303  | 5.3401  | 5.3869  | 5.3958  | 5.4376  | 5.4376  | 5.4454  | 5.4214                    | 5.3958  | 5.3779  | 5.3593  |              |
| util living area                                                            | 0.9954  | 0.9898  | 0.9736  | 0.9191  | 0.7878  | 0.5930  | 0.4370  | 0.4895  | 0.7490                    | 0.9477  | 0.9900  | 0.9965  | (86)         |
| MIT                                                                         | 19.9730 | 20.1335 | 20.3800 | 20.6828 | 20.8973 | 20.9823 | 20.9972 | 20.9949 | 20.9415                   | 20.6605 | 20.2610 | 19.9420 | (87)         |
| Th 2                                                                        | 20.0241 | 20.0261 | 20.0281 | 20.0375 | 20.0392 | 20.0474 | 20.0474 | 20.0489 | 20.0443                   | 20.0392 | 20.0357 | 20.0320 | (88)         |
| util rest of house                                                          | 0.9940  | 0.9866  | 0.9651  | 0.8940  | 0.7326  | 0.5119  | 0.3439  | 0.3912  | 0.6699                    | 0.9258  | 0.9862  | 0.9954  | (89)         |
| MIT 2                                                                       | 18.6643 | 18.8987 | 19.2539 | 19.6789 | 19.9448 | 20.0364 | 20.0464 | 20.0469 | 20.0010                   | 19.6597 | 19.0923 | 18.6250 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4624  | (91)         |
| MIT                                                                         | 19.2694 | 19.4696 | 19.7746 | 20.1431 | 20.3852 | 20.4738 | 20.4860 | 20.4853 | 20.4359                   | 20.1225 | 19.6327 | 19.2339 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.2694 | 19.4696 | 19.7746 | 20.1431 | 20.3852 | 20.4738 | 20.4860 | 20.4853 | 20.4359                   | 20.1225 | 19.6327 | 19.2339 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec       |       |
| Useful gains         | 0.9924   | 0.9842   | 0.9624   | 0.8971   | 0.7536   | 0.5489   | 0.3871   | 0.4368   | 0.7042   | 0.9281       | 0.9842   | 0.9941    | (94)  |
| Ext temp.            | 386.6734 | 440.1748 | 483.0225 | 502.7043 | 454.6279 | 327.5592 | 220.1627 | 230.3874 | 338.8671 | 395.0398     | 377.2728 | 367.3576  | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000    | (96)  |
| Month fracti         | 874.2531 | 848.9417 | 771.7302 | 646.6511 | 498.5266 | 333.9769 | 220.9547 | 231.8747 | 361.5702 | 546.5821     | 722.3110 | 870.1584  | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000    | (97a) |
| Space heating        | 362.7593 | 274.6913 | 214.7985 | 103.6417 | 32.6607  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 112.7475     | 248.4275 | 374.0838  | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |              |          | 1723.8103 | (98)  |
|                      |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 31.6295   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1843.6473 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 362.7593 | 274.6913 | 214.7985 | 103.6417 | 32.6607  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 112.7475 | 248.4275 | 374.0838  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 387.9779 | 293.7875 | 229.7310 | 110.8467 | 34.9312  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 120.5855 | 265.6979 | 400.0896  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 153.6655 | 135.1770 | 141.3429 | 125.8409 | 122.6945 | 108.7334 | 103.5719 | 114.8290 | 114.9955 | 130.5321 | 139.1102 | 149.6770  | (64)            |
| Efficiency of water heater (217)m                                     | 87.0278  | 86.6674  | 85.9274  | 84.3015  | 81.8341  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.4261  | 86.3442  | 79.8000   | (216)           |
| Fuel for water heating, kWh/month                                     | 176.5706 | 155.9721 | 164.4911 | 149.2748 | 149.9308 | 136.2574 | 129.7894 | 143.8960 | 144.1047 | 154.6111 | 161.1113 | 171.7263  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1837.7355 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1843.6473 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 250.7461  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4007.1290 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1843.6473          | 0.2160                        | 398.2278 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1837.7355          | 0.2160                        | 396.9509 (264)           |
| Space and water heating                                                                           |                    |                               | 795.1787 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 250.7461           | 0.5190                        | 130.1372 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 964.2409 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 14.5904 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3878 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7142 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (14.5904 * 1.00) + 2.3878 + 0.7142, rounded to 2 d.p. |                    |                               | 17.6900 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-1-03                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP 46%                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 87 B                                                                    | DER           | 9.25    | TER            | 16.42      |
| Environmental                      | 94 A                                                                    | % DER<TER     | 43.66   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.42                                                                    | DFEE          | 34.79   | TFEE           | 40.16      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 13.37   |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 59 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating:Mains gas (c), Electricity (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 16.42 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 9.25 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)40.2 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)34.8 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.38 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK  
Hot water controls: No cylinderstat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing West: 12.20 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.5000 (1b)              | x 2.5400 (2b)                   | = 148.5900 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 148.5900 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 3                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.7750 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1163 (21) |        |        |        |               |
|                                                                                              | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind speed                                                                                   | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1482                       | 0.1453 | 0.1424    | 0.1279 | 0.1250 | 0.1104 | 0.1104                      | 0.1075      | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2487                       | 0.2458 | 0.2429    | 0.2284 | 0.2255 | 0.2109 | 0.2109                      | 0.2080      | 0.2168 | 0.2255 | 0.2313 | 0.2371 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364      |                                      | (27)            |
| W02 (Uw = 1.40)                                                |                         |                            | 3.8000                    | 1.3258                        | 5.0379       |                                      | (27)            |
| door                                                           |                         |                            | 2.1000                    | 1.2500                        | 2.6250       |                                      | (26a)           |
| External Wall 1                                                | 37.1000                 | 12.2000                    | 24.9000                   | 0.1500                        | 3.7350       | 140.0000                             | 3486.0000 (29a) |
| Corridor wall                                                  | 25.4000                 | 2.1000                     | 23.3000                   | 0.1409                        | 3.2832       | 110.0000                             | 2563.0000 (29a) |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 62.5000                   |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      | 25.8175                       |              |                                      | (33)            |
| Party Wall 1                                                   |                         |                            | 22.6000                   | 0.0000                        | 0.0000       | 140.0000                             | 3164.0000 (32)  |
| Party Floor 1                                                  |                         |                            | 58.5000                   |                               |              | 40.0000                              | 2340.0000 (32d) |
| Party Ceilings                                                 |                         |                            | 58.5000                   |                               |              | 80.0000                              | 4680.0000 (32b) |
| Internal Wall                                                  |                         |                            | 77.4000                   |                               |              | 9.0000                               | 696.6000 (32c)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 16929.6000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 289.3949 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 4.0072 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 29.8247 (37)    |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 12.1958 | 12.0533 | 11.9108 | 11.1983 | 11.0558 | 10.3433 | 10.3433 | 10.2007 | 10.6283 | 11.0558 | 11.3408 | 11.6258 (38) |
| Heat transfer coeff       | 42.0205 | 41.8780 | 41.7355 | 41.0230 | 40.8805 | 40.1679 | 40.1679 | 40.0254 | 40.4529 | 40.8805 | 41.1655 | 41.4505 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 40.9873 (39) |
| HLP                       | 0.7183  | 0.7159  | 0.7134  | 0.7012  | 0.6988  | 0.6866  | 0.6866  | 0.6842  | 0.6915  | 0.6988  | 0.7037  | 0.7086 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.7006 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                  |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.9389 (42)      |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 84.4730 (43)     |
| Daily hot water use                      | Jan 92.9203 | Feb 89.5414 | Mar 86.1625 | Apr 82.7836 | May 79.4046 | Jun 76.0257 | Jul 76.0257 | Aug 79.4046 | Sep 82.7836 | Oct 86.1625 | Nov 89.5414 | Dec 92.9203 (44) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |             |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-------------|----------------|
| Energy conte                                                    | 137.7982 | 120.5191 | 124.3650 | 108.4244 | 104.0358 | 89.7750  | 83.1897  | 95.4614  | 96.6015  | 112.5798 | 122.8896    | 133.4502 (45)  |
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          | Total =  | Sum (45)m = | 1329.0895 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |             |                |
|                                                                 | 20.6697  | 18.0779  | 18.6547  | 16.2637  | 15.6054  | 13.4662  | 12.4785  | 14.3192  | 14.4902  | 16.8870  | 18.4334     | 20.0175 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |             |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |             | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |             | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |             | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |             | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |             |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000     | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |             |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000     | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120     | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |             |                |
|                                                                 | 184.0006 | 162.2503 | 170.5674 | 153.1364 | 150.2382 | 134.4870 | 129.3921 | 141.6638 | 141.3135 | 158.7822 | 167.6016    | 179.6526 (62)  |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000      | 0.0000 (63)    |
|                                                                 |          |          |          |          |          |          |          |          |          |          |             | 0.0000 (63)    |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |             |                |
|                                                                 | 184.0006 | 162.2503 | 170.5674 | 153.1364 | 150.2382 | 134.4870 | 129.3921 | 141.6638 | 141.3135 | 158.7822 | 167.6016    | 179.6526 (64)  |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |             |                |
|                                                                 | 82.7798  | 73.4576  | 78.3133  | 71.8207  | 71.5538  | 65.6198  | 64.6225  | 68.7028  | 67.8896  | 74.3947  | 76.6304     | 81.3341 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
| Jan                                                                                 | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |               |
| (66)m                                                                               | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | (66)          |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 15.0797  | 13.3937  | 10.8925  | 8.2463   | 6.1642   | 5.2041   | 5.6232   | 7.3092   | 9.8104   | 12.4566  | 14.5387  | 15.4988 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 169.1487 | 170.9039 | 166.4808 | 157.0644 | 145.1780 | 134.0065 | 126.5432 | 124.7879 | 129.2111 | 138.6274 | 150.5138 | 161.6854 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 111.2632 | 109.3119 | 105.2598 | 99.7510  | 96.1745  | 91.1386  | 86.8582  | 92.3425  | 94.2911  | 99.9929  | 106.4311 | 109.3200 (72) |
| Total internal gains                                                                | 347.5754 | 345.6933 | 334.7168 | 317.1455 | 299.6005 | 282.4329 | 271.1084 | 276.5235 | 285.3964 | 303.1607 | 323.5674 | 338.5880 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area     | Solar flux | g             | FF            |          |          | Access   | Gains        |               |
|-------------|----------|----------|----------|----------|------------|---------------|---------------|----------|----------|----------|--------------|---------------|
|             |          |          |          | m2       | Table 6a   | Specific data | Specific data |          |          | factor   | W            |               |
|             |          |          |          |          | W/m2       | or Table 6b   | or Table 6c   |          |          | Table 6d |              |               |
| West        |          |          |          | 8.4000   | 19.6403    | 0.3700        | 0.8900        |          |          | 0.7700   | 37.6488 (80) |               |
| West        |          |          |          | 3.8000   | 19.6403    | 0.5600        | 0.6800        |          |          | 0.7700   | 19.6952 (80) |               |
|             |          |          |          |          |            |               |               |          |          |          |              |               |
| Solar gains | 57.3441  | 112.1772 | 184.7398 | 269.4320 | 330.1990   | 338.0175      | 321.8064      | 276.4269 | 214.8600 | 133.1077 | 71.5013      | 47.1570 (83)  |
| Total gains | 404.9194 | 457.8704 | 519.4566 | 586.5775 | 629.7995   | 620.4504      | 592.9148      | 552.9505 | 500.2565 | 436.2683 | 395.0688     | 385.7450 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |          |          |          |          |          |          |          |          |          |                           |          |              |
|-----------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|----------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |          |          |          |          |          |          |          |          |          |                           |          | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |          |          |          |          |          |          |          |          |          |                           |          |              |
| Jan                                                                         | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov                       | Dec      |              |
| tau                                                                         | 111.9136 | 112.2944 | 112.6778 | 114.6350 | 115.0346 | 117.0752 | 117.0752 | 117.4920 | 116.2503 | 115.0346                  | 114.2381 | 113.4526     |
| alpha                                                                       | 8.4609   | 8.4863   | 8.5119   | 8.6423   | 8.6690   | 8.8050   | 8.8050   | 8.8328   | 8.7500   | 8.6690                    | 8.6159   | 8.5635       |
| util living area                                                            | 0.9959   | 0.9877   | 0.9496   | 0.8078   | 0.6006   | 0.4142   | 0.2981   | 0.3330   | 0.5565   | 0.8846                    | 0.9869   | 0.9972 (86)  |
| MIT                                                                         | 20.5419  | 20.6591  | 20.8281  | 20.9653  | 20.9971  | 20.9999  | 21.0000  | 21.0000  | 20.9988  | 20.9396                   | 20.7195  | 20.5207 (87) |
| Th 2                                                                        | 20.3247  | 20.3268  | 20.3290  | 20.3397  | 20.3419  | 20.3527  | 20.3527  | 20.3548  | 20.3483  | 20.3419                   | 20.3376  | 20.3333 (88) |
| util rest of house                                                          | 0.9946   | 0.9837   | 0.9355   | 0.7737   | 0.5593   | 0.3724   | 0.2542   | 0.2863   | 0.5046   | 0.8513                    | 0.9820   | 0.9962 (89)  |
| MIT 2                                                                       | 19.7163  | 19.8868  | 20.1238  | 20.3049  | 20.3395  | 20.3526  | 20.3527  | 20.3548  | 20.3476  | 20.2813                   | 19.9838  | 19.6927 (90) |
| Living area fraction                                                        |          |          |          |          |          |          |          |          |          | fLA = Living area / (4) = |          | 0.4821 (91)  |
| MIT                                                                         | 20.1143  | 20.2591  | 20.4633  | 20.6233  | 20.6565  | 20.6646  | 20.6647  | 20.6658  | 20.6615  | 20.5986                   | 20.3384  | 20.0919 (92) |
| Temperature adjustment                                                      |          |          |          |          |          |          |          |          |          |                           |          | 0.0000       |
| adjusted MIT                                                                | 20.1143  | 20.2591  | 20.4633  | 20.6233  | 20.6565  | 20.6646  | 20.6647  | 20.6658  | 20.6615  | 20.5986                   | 20.3384  | 20.0919 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |                           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec                       |
|                      | 0.9940   | 0.9832   | 0.9386   | 0.7888   | 0.5791   | 0.3926   | 0.2754   | 0.3088   | 0.5296   | 0.8650   | 0.9820   | 0.9957 (94)               |
| Useful gains         | 402.5046 | 450.1909 | 487.5767 | 462.6642 | 364.7469 | 243.5644 | 163.2695 | 170.7376 | 264.9462 | 377.3909 | 387.9459 | 384.1001 (95)             |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)               |
| Heat loss rate W     |          |          |          |          |          |          |          |          |          |          |          |                           |
|                      | 664.5234 | 643.2088 | 582.7669 | 480.9227 | 366.1459 | 243.6038 | 163.2709 | 170.7412 | 265.4338 | 408.7480 | 544.9655 | 658.7253 (97)             |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)              |
| Space heating kWh    |          |          |          |          |          |          |          |          |          |          |          |                           |
|                      | 194.9420 | 129.7080 | 70.8215  | 13.1461  | 1.0409   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 23.3297  | 113.0541 | 204.3211 (98)             |
| Space heating        |          |          |          |          |          |          |          |          |          |          |          | 750.3634 (98)             |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | (98) / (4) = 12.8267 (99) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 750.3634 (98)    |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 362.4255 (307a)  |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 425.4561 (307b)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1873.0855 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 904.7003 (310a)  |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1062.0395 (310b) |
| Electricity used for heat distribution                                                  | 27.5462 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 120.0979 (330a)  |
| Total electricity for the above, kWh/year                                               | 120.0979 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 266.3127 (332)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415        |
| Total delivered energy for all uses                                                     | 2768.3905 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 342.4664           | 0.5190                        | 177.7401 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 1584.1273          | 0.2160                        | 342.1715 (368)           |
| Electrical energy for heat distribution                                                    | 27.5462            | 0.5190                        | 14.2965 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 534.2081 (373)           |
| Space and water heating                                                                    |                    |                               | 534.2081 (376)           |
| Pumps and fans                                                                             | 120.0979           | 0.5190                        | 62.3308 (378)            |
| Energy for lighting                                                                        | 266.3127           | 0.5190                        | 138.2163 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 541.3542 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 9.2500 (384)             |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 9.2500 ZC1  |
| Total Floor Area                                                                | TFA | 58.5000     |
| Assumed number of occupants                                                     | N   | 1.9389      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.1340 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.8296 ZC3  |
| Total CO2 emissions                                                             |     | 29.2136 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 29.2136 ZC8 |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.5000 (1b)              | x 2.5400 (2b)                   | = 148.5900 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 148.5900 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1346 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3846 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 3 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.2981 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.3800 | 0.3726 | 0.3651 | 0.3279 | 0.3204 | 0.2832 | 0.2832 | 0.2757 | 0.2981 | 0.3204 | 0.3353 | 0.3502 (22b) |
| Effective ac    | 0.5722 | 0.5694 | 0.5667 | 0.5537 | 0.5513 | 0.5401 | 0.5401 | 0.5380 | 0.5444 | 0.5513 | 0.5562 | 0.5613 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2  | U-value<br>W/m2K     | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------|----------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|------|
| TER Semi-glazed door                                                |                |                | 2.1000         | 1.2000               | 2.5200         |                   |                | (26a)          |                |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                | 12.2000        | 1.3258               | 16.1742        |                   |                | (27)           |                |                |                |                |      |
| External Wall 1                                                     | 37.1000        | 12.2000        | 24.9000        | 0.1800               | 4.4820         |                   |                | (29a)          |                |                |                |                |      |
| Corridor wall                                                       | 25.4000        | 2.1000         | 23.3000        | 0.1800               | 4.1940         |                   |                | (29a)          |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 62.5000        |                      |                |                   |                | (31)           |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                | (26)...(30) + (32) = | 27.3702        |                   |                | (33)           |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                      |                |                   |                | 250.0000 (35)  |                |                |                |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                |                      |                |                   |                | 2.7572 (36)    |                |                |                |                |      |
| Total fabric heat loss                                              |                |                |                |                      |                | (33) + (36) =     | 30.1274        | (37)           |                |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                      |                |                   |                |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>28.0582 | Feb<br>27.9207 | Mar<br>27.7860 | Apr<br>27.1529       | May<br>27.0345 | Jun<br>26.4832    | Jul<br>26.4832 | Aug<br>26.3810 | Sep<br>26.6955 | Oct<br>27.0345 | Nov<br>27.2741 | Dec<br>27.5246 | (38) |
| Heat transfer coeff                                                 | 58.1857        | 58.0482        | 57.9134        | 57.2804              | 57.1619        | 56.6106           | 56.6106        | 56.5085        | 56.8230        | 57.1619        | 57.4015        | 57.6520        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                |                      |                |                   |                |                |                |                |                | 57.2798        | (39) |
| HLP                                                                 | Jan<br>0.9946  | Feb<br>0.9923  | Mar<br>0.9900  | Apr<br>0.9792        | May<br>0.9771  | Jun<br>0.9677     | Jul<br>0.9677  | Aug<br>0.9660  | Sep<br>0.9713  | Oct<br>0.9771  | Nov<br>0.9812  | Dec<br>0.9855  | (40) |
| HLP (average)                                                       |                |                |                |                      |                |                   |                |                |                |                |                | 0.9791         | (40) |
| Days in month                                                       | 31             | 28             | 31             | 30                   | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |                    |          | 1.9389 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |                    |          | 80.2494 (43)   |
| Jan                                                         | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct     | Nov                | Dec      |                |
| Daily hot water use                                         | 88.2743  | 85.0643  | 81.8544  | 78.6444  | 75.4344 | 72.2244 | 72.2244 | 75.4344 | 78.6444 | 81.8544            | 85.0643  | 88.2743 (44)   |
| Energy conte                                                | 130.9082 | 114.4932 | 118.1467 | 103.0032 | 98.8340 | 85.2862 | 79.0302 | 90.6883 | 91.7714 | 106.9508           | 116.7451 | 126.7776 (45)  |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         | Total = Sum(45)m = |          | 1262.6351 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |         |         |         |         |         |                    |          |                |
|                                                             | 19.6362  | 17.1740  | 17.7220  | 15.4505  | 14.8251 | 12.7929 | 11.8545 | 13.6033 | 13.7657 | 16.0426            | 17.5118  | 19.0166 (46)   |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |         |         |         |         |         |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |                    |          | 0.1290 (55)    |
| Total storage loss                                          |          |          |          |          |         |         |         |         |         |                    |          |                |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (57)  |
| Total heat required for water heating calculated for each month | 158.1684 | 139.1153 | 145.4069 | 129.3840 | 126.0941 | 111.6670 | 106.2904 | 117.9485 | 118.1522 | 134.2109 | 143.1259 | 154.0378 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 158.1684 | 139.1153 | 145.4069 | 129.3840 | 126.0941 | 111.6670 | 106.2904 | 117.9485 | 118.1522 | 134.2109 | 143.1259 | 154.0378 (64) |
| Heat gains from water heating, kWh/month                        | 65.3351  | 57.7666  | 61.0919  | 55.3532  | 54.6704  | 49.4623  | 48.0857  | 51.9620  | 51.6186  | 57.3692  | 59.9224  | 63.9617 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      | (66) |
| (66)m                                                                               | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | 96.9460  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.1287  | 13.4372  | 10.9279  | 8.2731   | 6.1842   | 5.2210   | 5.6415   | 7.3330   | 9.8423   | 12.4971  | 14.5860  | 15.5492  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 169.1487 | 170.9039 | 166.4808 | 157.0644 | 145.1780 | 134.0065 | 126.5432 | 124.7879 | 129.2111 | 138.6274 | 150.5138 | 161.6854 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | 32.6946  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | -77.5568 | (71) |
| Water heating gains (Table 5)                                                       | 87.8160  | 85.9623  | 82.1128  | 76.8794  | 73.4817  | 68.6976  | 64.6313  | 69.8414  | 71.6925  | 77.1092  | 83.2255  | 85.9700  | (72) |
| Total internal gains                                                                | 327.1772 | 325.3872 | 314.6052 | 297.3008 | 279.9278 | 263.0089 | 251.8997 | 257.0461 | 265.8298 | 283.3175 | 303.4091 | 318.2884 | (73) |

#### 6. Solar gains

| [Jan]       |  |  | Area<br>m2 |          | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|--|--|------------|----------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|--------------|---------------|
| West        |  |  | 12.2000    |          | 19.6403                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 73.2283 (80) |               |
| Solar gains |  |  | 73.2283    | 143.2501 | 235.9125                       | 344.0643 | 421.6637                          | 431.6479 | 410.9464                           | 352.9969 | 274.3760                     | 169.9783 | 91.3071      | 60.2194 (83)  |
| Total gains |  |  | 400.4055   | 468.6373 | 550.5177                       | 641.3651 | 701.5916                          | 694.6568 | 662.8461                           | 610.0430 | 540.2058                     | 453.2958 | 394.7162     | 378.5078 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 69.8196 | 69.9850 | 70.1478 | 70.9231 | 71.0700 | 71.7622 | 71.7622 | 71.8919 | 71.4940 | 71.0700 | 70.7734 | 70.4659 |              |
| alpha                                                                       | 5.6546  | 5.6657  | 5.6765  | 5.7282  | 5.7380  | 5.7841  | 5.7841  | 5.7928  | 5.7663  | 5.7380  | 5.7182  | 5.6977  |              |
| util living area                                                            | 0.9961  | 0.9899  | 0.9667  | 0.8823  | 0.7135  | 0.5157  | 0.3750  | 0.4243  | 0.6904  | 0.9403  | 0.9909  | 0.9971  | (86)         |
| MIT                                                                         | 20.0535 | 20.2220 | 20.4914 | 20.7892 | 20.9486 | 20.9933 | 20.9991 | 20.9982 | 20.9683 | 20.7211 | 20.3263 | 20.0217 | (87)         |
| Th 2                                                                        | 20.0878 | 20.0898 | 20.0917 | 20.1007 | 20.1024 | 20.1103 | 20.1103 | 20.1118 | 20.1073 | 20.1024 | 20.0990 | 20.0954 | (88)         |
| util rest of house                                                          | 0.9948  | 0.9868  | 0.9565  | 0.8515  | 0.6580  | 0.4466  | 0.2996  | 0.3434  | 0.6146  | 0.9168  | 0.9875  | 0.9962  | (89)         |
| MIT 2                                                                       | 18.8288 | 19.0747 | 19.4606 | 19.8691 | 20.0571 | 20.1062 | 20.1100 | 20.1111 | 20.0846 | 19.7927 | 19.2344 | 18.7881 | (90)         |
| Living area fraction                                                        | 19.4192 | 19.6278 | 19.9575 | 20.3126 | 20.4869 | 20.5338 | 20.5386 | 20.5387 | 20.5106 | 20.2402 | 19.7608 | 19.3827 | (91)         |
| MIT                                                                         | 19.4192 | 19.6278 | 19.9575 | 20.3126 | 20.4869 | 20.5338 | 20.5386 | 20.5387 | 20.5106 | 20.2402 | 19.7608 | 19.3827 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.4192 | 19.6278 | 19.9575 | 20.3126 | 20.4869 | 20.5338 | 20.5386 | 20.5387 | 20.5106 | 20.2402 | 19.7608 | 19.3827 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 0.9936   | 0.9847   | 0.9547   | 0.8594   | 0.6825   | 0.4798   | 0.3360   | 0.3825   | 0.6500   | 0.9209   | 0.9858   | 0.9952    | (94)  |
| Ext temp.            | 397.8464 | 461.4833 | 525.6024 | 551.1703 | 478.8403 | 333.3036 | 222.6952 | 233.3149 | 351.1260 | 417.4595 | 389.1258 | 376.6914  | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Month fracti         | 879.7202 | 854.9202 | 779.3700 | 653.7200 | 502.2740 | 335.9174 | 222.9665 | 233.8742 | 364.2687 | 551.0533 | 726.7470 | 875.3156  | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating        | 358.5140 | 264.3896 | 188.8031 | 73.8358  | 17.4347  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 99.3938  | 243.0872 | 370.9764  | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 1616.4346 | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 27.6314   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 1728.8070 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                             | 358.5140 | 264.3896 | 188.8031 | 73.8358  | 17.4347  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 99.3938  | 243.0872 | 370.9764 (98)   |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000 (210)   |
| Space heating fuel (main heating system)                              | 383.4375 | 282.7696 | 201.9284 | 78.9687  | 18.6468  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 106.3036 | 259.9863 | 396.7662 (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (215)    |
| Water heating requirement                                             | 158.1684 | 139.1153 | 145.4069 | 129.3840 | 126.0941 | 111.6670 | 106.2904 | 117.9485 | 118.1522 | 134.2109 | 143.1259 | 154.0378 (64)   |
| Efficiency of water heater (217)m                                     | 86.9317  | 86.5012  | 85.5115  | 83.3819  | 80.9628  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.0270  | 86.2159  | 79.8000 (216)   |
| Fuel for water heating, kWh/month                                     | 181.9455 | 160.8246 | 170.0436 | 155.1704 | 155.7433 | 139.9336 | 133.1959 | 147.8051 | 148.0604 | 159.7236 | 166.0087 | 176.9035 (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1895.3584 (219) |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1728.8070 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 267.1781 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3966.3435 (238) |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1728.8070          | 0.2160                        | 373.4223 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1895.3584          | 0.2160                        | 409.3974 (264)           |
| Space and water heating                                                                           |                    |                               | 782.8197 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 267.1781           | 0.5190                        | 138.6654 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 960.4102 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 13.3815 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3703 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6654 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (13.3815 * 1.00) + 2.3703 + 0.6654, rounded to 2 d.p. |                    |                               | 16.4200 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-1-07                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP-1-2                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 86 B                                                                    | DER           | 12.09   | TER            | 19.36      |
| Environmental                      | 92 A                                                                    | % DER<TER     | 37.56   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.51                                                                    | DFEE          | 49.09   | TFEE           | 53.02      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 7.42    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 55 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 19.36 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.09 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 53.0 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 49.1 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.14 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | 0.11 (max. 0.25) | 0.11 (max. 0.70) | OK |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK

Hot water controls:

No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail

Based on:

Overshading: Average  
Windows facing North: 8.40 m<sup>2</sup>, No overhang  
Windows facing North East: 1.64 m<sup>2</sup>, No overhang  
Windows facing South East: 7.61 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Exposed floor U-value 0.11 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 54.5000 (1b)              | x 2.5400 (2b)                   | = 138.4300 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.4300 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 3                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.7750 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1163 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1482                       | 0.1453 | 0.1424    | 0.1279 | 0.1250 | 0.1104 | 0.1104                      | 0.1075      | 0.1163 | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2487                       | 0.2458 | 0.2429    | 0.2284 | 0.2255 | 0.2109 | 0.2109                      | 0.2080      | 0.2168 | 0.2255 | 0.2313 | 0.2371 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K                         | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------------------------------|--------------------------------|-----------------|
| W05 (Uw = 1.40)                                                |                         |                            | 1.6400                    | 1.3258                        | 2.1742                               |                                | (27)            |
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364                              |                                | (27)            |
| W02 (Uw = 1.40)                                                |                         |                            | 7.6100                    | 1.3258                        | 10.0890                              |                                | (27)            |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400                               |                                | (26a)           |
| Heat Loss Floor 1                                              |                         |                            | 54.5000                   | 0.1100                        | 5.9950                               |                                | (28b)           |
| External Wall 1                                                | 32.4000                 | 17.6500                    | 14.7500                   | 0.1500                        | 2.2125                               | 140.0000                       | 2065.0000 (29a) |
| Corridor wall                                                  | 43.3000                 | 2.1000                     | 41.2000                   | 0.1409                        | 5.8055                               | 110.0000                       | 4532.0000 (29a) |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 130.2000                  |                               |                                      |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               |                                      | 40.3527                        | (33)            |
| Party Wall 1                                                   |                         |                            | 19.4000                   | 0.0000                        | 0.0000                               | 140.0000                       | 2716.0000 (32)  |
| Party Ceilings                                                 |                         |                            | 54.5000                   |                               |                                      | 80.0000                        | 4360.0000 (32b) |
| Internal Wall                                                  |                         |                            | 73.4000                   |                               |                                      | 9.0000                         | 660.6000 (32c)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               | (28)...(30) + (32) + (32a)...(32e) = |                                |                 |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |                                      |                                |                 |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |                                      |                                |                 |
| Total fabric heat loss                                         |                         |                            |                           |                               | (33) + (36) =                        |                                |                 |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 11.3619 | 11.2292 | 11.0964 | 10.4326 | 10.2998 | 9.6360  | 9.6360  | 9.5033  | 9.9016  | 10.2998 | 10.5654 | 10.8309 (38) |
| Heat transfer coeff       | 56.9262 | 56.7934 | 56.6607 | 55.9969 | 55.8641 | 55.2003 | 55.2003 | 55.0675 | 55.4658 | 55.8641 | 56.1296 | 56.3952 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 55.9637 (39) |
| HLP                       | 1.0445  | 1.0421  | 1.0396  | 1.0275  | 1.0250  | 1.0128  | 1.0128  | 1.0104  | 1.0177  | 1.0250  | 1.0299  | 1.0348 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.0269 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 1.8227 (42)  |
| Average daily hot water use (litres/day) | 81.5674 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |                                           |                     |                |              |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|-------------------------------------------|---------------------|----------------|--------------|
| Energy conte                                                    | 89.7241  | 86.4614  | 83.1987  | 79.9360  | 76.6733  | 73.4106  | 73.4106  | 76.6733  | 79.9360                                   | 83.1987             | 86.4614        | 89.7241 (44) |
| 133.0582                                                        | 116.3736 | 120.0871 | 104.6949 | 100.4572 | 86.6869  | 80.3282  | 92.1778  | 93.2787  | 108.7073                                  | 118.6625            | 128.8598 (45)  |              |
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |                                           | Total = Sum (45)m = | 1283.3722 (45) |              |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |                                           |                     |                |              |
| 19.9587                                                         | 17.4560  | 18.0131  | 15.7042  | 15.0686  | 13.0030  | 12.0492  | 13.8267  | 13.9918  | 16.3061                                   | 17.7994             | 19.3290 (46)   |              |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |                                           |                     |                |              |
| Store volume                                                    |          |          |          |          |          |          |          |          |                                           |                     |                | 2.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |                                           |                     |                | 0.7400 (48)  |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |                                           |                     |                | 1.0000 (49)  |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |                                           |                     |                | 0.7400 (55)  |
| Total storage loss                                              |          |          |          |          |          |          |          |          |                                           |                     |                |              |
| 22.9400                                                         | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400                                   | 22.2000             | 22.9400 (56)   |              |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |                                           |                     |                |              |
| 22.9400                                                         | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400                                   | 22.2000             | 22.9400 (57)   |              |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624                                   | 22.5120             | 23.2624 (59)   |              |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |                                           |                     |                |              |
| 179.2606                                                        | 158.1048 | 166.2895 | 149.4069 | 146.6596 | 131.3989 | 126.5306 | 138.3802 | 137.9907 | 154.9097                                  | 163.3745            | 175.0622 (62)  |              |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                    | 0.0000              | 0.0000 (63)    |              |
| Output from w/h                                                 |          |          |          |          |          |          |          |          | Solar input (sum of months) = Sum (63)m = | 0.0000 (63)         |                |              |
| 179.2606                                                        | 158.1048 | 166.2895 | 149.4069 | 146.6596 | 131.3989 | 126.5306 | 138.3802 | 137.9907 | 154.9097                                  | 163.3745            | 175.0622 (64)  |              |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum (64)m =   | 1827.3682 (64)      |                |              |
| 81.2038                                                         | 72.0792  | 76.8909  | 70.5806  | 70.3639  | 64.5930  | 63.6710  | 67.6110  | 66.7848  | 73.1071                                   | 75.2249             | 79.8078 (65)   |              |

#### 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 14.1657  | 12.5819  | 10.2323  | 7.7465   | 5.7906   | 4.8887   | 5.2824   | 6.8662   | 9.2158   | 11.7016  | 13.6575  | 14.5594 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 158.8961 | 160.5450 | 156.3899 | 147.5444 | 136.3784 | 125.8840 | 118.8731 | 117.2242 | 121.3793 | 130.2248 | 141.3908 | 151.8852 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 109.1449 | 107.2607 | 103.3480 | 98.0287  | 94.5752  | 89.7125  | 85.5794  | 90.8750  | 92.7566  | 98.2622  | 104.4790 | 107.2686 (72) |
| Total internal gains                                                                |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 332.5471 | 330.7279 | 320.3106 | 303.6599 | 287.0846 | 270.8256 | 260.0752 | 265.3059 | 273.6921 | 290.5291 | 309.8677 | 324.0536 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| <hr/>       |          |          |          |            |                                |                                   |                                    |                              |              |          |          |               |
| Northeast   |          |          |          | 1.6400     | 11.2829                        | 0.3700                            | 0.7900                             | 0.7700                       | 3.7482 (75)  |          |          |               |
| North       |          |          |          | 8.4000     | 10.6334                        | 0.3700                            | 0.8900                             | 0.7700                       | 20.3834 (74) |          |          |               |
| Southeast   |          |          |          | 7.6100     | 36.7938                        | 0.5600                            | 0.6800                             | 0.7700                       | 73.8907 (77) |          |          |               |
| <hr/>       |          |          |          |            |                                |                                   |                                    |                              |              |          |          |               |
| Solar gains | 98.0223  | 172.4466 | 252.1496 | 342.2747   | 412.5714                       | 422.9506                          | 402.1702                           | 347.3383                     | 282.8027     | 194.7990 | 118.3658 | 83.2886 (83)  |
| Total gains | 430.5694 | 503.1745 | 572.4601 | 645.9346   | 699.6560                       | 693.7762                          | 662.2454                           | 612.6442                     | 556.4948     | 485.3280 | 428.2335 | 407.3422 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 69.9424 | 70.1059 | 70.2702 | 71.1032 | 71.2722 | 72.1293 | 72.1293 | 72.3031 | 71.7840 | 71.2722 | 70.9350 | 70.6010      |
| alpha                                                                       | 5.6628  | 5.6737  | 5.6847  | 5.7402  | 5.7515  | 5.8086  | 5.8086  | 5.8202  | 5.7856  | 5.7515  | 5.7290  | 5.7067       |
| util living area                                                            | 0.9938  | 0.9845  | 0.9573  | 0.8712  | 0.7027  | 0.5042  | 0.3661  | 0.4120  | 0.6610  | 0.9168  | 0.9852  | 0.9954 (86)  |
| MIT                                                                         | 20.1185 | 20.2932 | 20.5383 | 20.8058 | 20.9528 | 20.9941 | 20.9992 | 20.9985 | 20.9748 | 20.7698 | 20.3942 | 20.0845 (87) |
| Th 2                                                                        | 20.0464 | 20.0484 | 20.0504 | 20.0605 | 20.0625 | 20.0726 | 20.0726 | 20.0747 | 20.0686 | 20.0625 | 20.0585 | 20.0545 (88) |
| util rest of house                                                          | 0.9918  | 0.9796  | 0.9442  | 0.8372  | 0.6444  | 0.4335  | 0.2893  | 0.3299  | 0.5826  | 0.8857  | 0.9797  | 0.9938 (89)  |
| MIT 2                                                                       | 18.8872 | 19.1406 | 19.4887 | 19.8520 | 20.0222 | 20.0692 | 20.0724 | 20.0741 | 20.0516 | 19.8178 | 19.2962 | 18.8439 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 19.4565 | 19.6735 | 19.9740 | 20.2930 | 20.4525 | 20.4969 | 20.5009 | 20.5016 | 20.4785 | 20.2580 | 19.8039 | 19.4175 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.4565 | 19.6735 | 19.9740 | 20.2930 | 20.4525 | 20.4969 | 20.5009 | 20.5016 | 20.4785 | 20.2580 | 19.8039 | 19.4175 (93) |

#### 8. Space heating requirement

|                   | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|-------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Utilisation       | 0.9901   | 0.9772   | 0.9430   | 0.8463   | 0.6694   | 0.4661   | 0.3248   | 0.3680   | 0.6181   | 0.8930   | 0.9778   | 0.9925 (94)   |
| Useful gains      | 426.3166 | 491.7265 | 539.8231 | 546.6573 | 468.3686 | 323.3670 | 215.1203 | 225.4336 | 343.9566 | 433.4008 | 418.7113 | 404.2767 (95) |
| Ext temp.         | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)   |
| Heat loss rate W  |          |          |          |          |          |          |          |          |          |          |          |               |
|                   | 862.8018 | 839.0397 | 763.4457 | 637.9732 | 488.9507 | 325.5098 | 215.3333 | 225.8625 | 353.7873 | 539.5339 | 713.0660 | 858.1947 (97) |
| Month fracti      | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)  |
| Space heating kWh |          |          |          |          |          |          |          |          |          |          |          |               |
|                   | 324.7450 | 233.3945 | 166.3752 | 65.7474  | 15.3131  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 78.9630  | 211.9354 | 337.7150 (98) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating 1434.1887 (98)  
Space heating per m2 (98) / (4) = 26.3154 (99)

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1434.1887 (98)   |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 692.7131 (307a)  |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 813.1850 (307b)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1827.3682 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 882.6188 (310a)  |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1036.1178 (310b) |
| Electricity used for heat distribution                                                  | 34.2463 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 111.8860 (330a)  |
| Total electricity for the above, kWh/year                                               | 111.8860 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 250.1708 (332)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415        |
| Total delivered energy for all uses                                                     | 3414.0500 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 425.7654           | 0.5190                        | 220.9722 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 1969.4385          | 0.2160                        | 425.3987 (368)           |
| Electrical energy for heat distribution                                                    | 34.2463            | 0.5190                        | 17.7739 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 664.1448 (373)           |
| Space and water heating                                                                    |                    |                               | 664.1448 (376)           |
| Pumps and fans                                                                             | 111.8860           | 0.5190                        | 58.0689 (378)            |
| Energy for lighting                                                                        | 250.1708           | 0.5190                        | 129.8386 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 658.6514 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.0900 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 12.0900 ZC1 |
| Total Floor Area                                                                | TFA | 54.5000     |
| Assumed number of occupants                                                     | N   | 1.8227      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.2768 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.9861 ZC3  |
| Total CO2 emissions                                                             |     | 32.3529 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 32.3529 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 54.5000 (1b)              | x 2.5400 (2b)                   | = 138.4300 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 138.4300 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour    |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|----------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                          |                              |                      |       |       | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 20.0000 / (5) = 0.1445 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                        |
| Measured/design AP50                                 |                              |                      |       |       | 5.0000                     |
| Infiltration rate                                    |                              |                      |       |       | 0.3945 (18)                |
| Number of sides sheltered                            |                              |                      |       |       | 3 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.3057 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.3898 | 0.3821 | 0.3745 | 0.3363 | 0.3286 | 0.2904 | 0.2904 | 0.2828 | 0.3057 | 0.3286 | 0.3439 | 0.3592 (22b) |
| Effective ac    | 0.5760 | 0.5730 | 0.5701 | 0.5565 | 0.5540 | 0.5422 | 0.5422 | 0.5400 | 0.5467 | 0.5540 | 0.5591 | 0.5645 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 11.5200                   | 1.3258                        | 15.2727      |                                | (27)          |
| Heat Loss Floor 1                                              |                         |                            | 54.5000                   | 0.1300                        | 7.0850       |                                | (28b)         |
| External Wall 1                                                | 32.4000                 | 11.5200                    | 20.8800                   | 0.1800                        | 3.7584       |                                | (29a)         |
| Corridor wall                                                  | 43.3000                 | 2.1000                     | 41.2000                   | 0.1800                        | 7.4160       |                                | (29a)         |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 130.2000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 36.0521      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 3.1241 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 39.1762 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 26.3114 | 26.1766 | 26.0445 | 25.4241 | 25.3080 | 24.7676 | 24.7676 | 24.6676 | 24.9758 | 25.3080 | 25.5428 | 25.7883 (38) |
| Heat transfer coeff       | 65.4876 | 65.3528 | 65.2207 | 64.6003 | 64.4842 | 63.9439 | 63.9439 | 63.8438 | 64.1520 | 64.4842 | 64.7191 | 64.9646 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 64.5998 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.2016 | 1.1991 | 1.1967 | 1.1853 | 1.1832 | 1.1733 | 1.1733 | 1.1714 | 1.1771 | 1.1832 | 1.1875 | 1.1920 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.1853 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |                    |          | 1.8227 (42)    |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |                    |          | 77.4890 (43)   |
|                                                             | Jan      | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct                | Nov      | Dec            |
| Daily hot water use                                         | 85.2379  | 82.1383  | 79.0388  | 75.9392 | 72.8397 | 69.7401 | 69.7401 | 72.8397 | 75.9392 | 79.0388            | 82.1383  | 85.2379 (44)   |
| Energy conte                                                | 126.4053 | 110.5549 | 114.0828 | 99.4601 | 95.4343 | 82.3526 | 76.3118 | 87.5689 | 88.6147 | 103.2719           | 112.7294 | 122.4168 (45)  |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1219.2036 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 18.9608  | 16.5832  | 17.1124  | 14.9190 | 14.3152 | 12.3529 | 11.4468 | 13.1353 | 13.2922 | 15.4908            | 16.9094  | 18.3625 (46)   |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |                    |          | 2.0000 (47)    |
| Store volume                                                |          |          |          |         |         |         |         |         |         |                    |          | 0.2388 (48)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |                    |          | 0.1290 (55)    |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 153.6655 | 135.1770 | 141.3429 | 125.8409 | 122.6945 | 108.7334 | 103.5719 | 114.8290 | 114.9955 | 130.5321 | 139.1102 | 149.6770 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 153.6655 | 135.1770 | 141.3429 | 125.8409 | 122.6945 | 108.7334 | 103.5719 | 114.8290 | 114.9955 | 130.5321 | 139.1102 | 149.6770 (64) |
| Heat gains from water heating, kWh/month                        | 63.8379  | 56.4572  | 59.7406  | 54.1751  | 53.5400  | 48.4869  | 47.1818  | 50.9248  | 50.5690  | 56.1460  | 58.5871  | 62.5117 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347  | 91.1347 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.1983  | 12.6108  | 10.2558  | 7.7643   | 5.8039   | 4.8999   | 5.2945   | 6.8820   | 9.2370   | 11.7285  | 13.6889  | 14.5929 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 158.8961 | 160.5450 | 156.3899 | 147.5444 | 136.3784 | 125.8840 | 118.8731 | 117.2242 | 121.3793 | 130.2248 | 141.3908 | 151.8852 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135  | 32.1135 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 | -72.9078 (71) |
| Water heating gains (Table 5)                                                       | 85.8036  | 84.0136  | 80.2965  | 75.2432  | 71.9624  | 67.3429  | 63.4164  | 68.4473  | 70.2348  | 75.4651  | 81.3710  | 84.0211 (72)  |
| Total internal gains                                                                | 312.2384 | 310.5098 | 300.2827 | 283.8923 | 267.4851 | 251.4672 | 240.9244 | 245.8939 | 254.1914 | 270.7588 | 289.7911 | 303.8396 (73) |

#### 6. Solar gains

| [Jan]       |            |          |          |          |                                |          |                                   |          |                                    |          |                              |               |              |
|-------------|------------|----------|----------|----------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|---------------|--------------|
|             | Area<br>m2 |          |          |          | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |               | Gains<br>W   |
| North       | 5.4800     |          |          |          | 10.6334                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |               | 17.8084 (74) |
| Northeast   | 1.0700     |          |          |          | 11.2829                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |               | 3.6896 (75)  |
| Southeast   | 4.9700     |          |          |          | 36.7938                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |               | 55.8860 (77) |
|             |            |          |          |          |                                |          |                                   |          |                                    |          |                              |               |              |
| Solar gains | 77.3840    | 136.7376 | 201.6104 | 276.4969 | 335.7665                       | 345.2594 | 327.8724                          | 281.5311 | 227.0507                           | 154.8999 | 93.5500                      | 65.6858 (83)  |              |
| Total gains | 389.6224   | 447.2474 | 501.8931 | 560.3892 | 603.2516                       | 596.7265 | 568.7967                          | 527.4250 | 481.2421                           | 425.6588 | 383.3411                     | 369.5255 (84) |              |

#### 7. Mean internal temperature (heating season)

|                                                                             |              |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|--------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) | 21.0000 (85) |         |         |         |         |         |         |         |         |         |         |              |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan          | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 57.7930      | 57.9121 | 58.0294 | 58.5867 | 58.6922 | 59.1882 | 59.1882 | 59.2810 | 58.9962 | 58.6922 | 58.4793 | 58.2583      |
| alpha                                                                       | 4.8529       | 4.8608  | 4.8686  | 4.9058  | 4.9128  | 4.9459  | 4.9459  | 4.9521  | 4.9331  | 4.9128  | 4.8986  | 4.8839       |
| util living area                                                            | 0.9957       | 0.9910  | 0.9780  | 0.9357  | 0.8284  | 0.6485  | 0.4868  | 0.5428  | 0.7949  | 0.9580  | 0.9912  | 0.9967 (86)  |
| MIT                                                                         | 19.7952      | 19.9599 | 20.2228 | 20.5594 | 20.8288 | 20.9618 | 20.9924 | 20.9873 | 20.8969 | 20.5498 | 20.1106 | 19.7634 (87) |
| Th 2                                                                        | 19.9187      | 19.9207 | 19.9226 | 19.9318 | 19.9335 | 19.9414 | 19.9414 | 19.9429 | 19.9384 | 19.9335 | 19.9300 | 19.9264 (88) |
| util rest of house                                                          | 0.9943       | 0.9880  | 0.9704  | 0.9133  | 0.7738  | 0.5563  | 0.3738  | 0.4251  | 0.7135  | 0.9387  | 0.9877  | 0.9955 (89)  |
| MIT 2                                                                       | 18.3298      | 18.5704 | 18.9507 | 19.4281 | 19.7726 | 19.9173 | 19.9388 | 19.9380 | 19.8601 | 19.4260 | 18.7976 | 18.2888 (90) |
| Living area fraction                                                        | 19.0074      | 19.2129 | 19.5389 | 19.9512 | 20.2610 | 20.4003 | 20.4259 | 20.4232 | 20.3395 | 19.9456 | 19.4047 | 18.9706 (92) |
| Temperature adjustment                                                      | 19.0074      | 19.2129 | 19.5389 | 19.9512 | 20.2610 | 20.4003 | 20.4259 | 20.4232 | 20.3395 | 19.9456 | 19.4047 | 18.9706 (93) |
| adjusted MIT                                                                | 19.0074      | 19.2129 | 19.5389 | 19.9512 | 20.2610 | 20.4003 | 20.4259 | 20.4232 | 20.3395 | 19.9456 | 19.4047 | 18.9706 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |                |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Useful gains         | 0.9926   | 0.9854   | 0.9671   | 0.9138   | 0.7920   | 0.5977   | 0.4263   | 0.4798   | 0.7469   | 0.9390   | 0.9854   | 0.9942 (94)    |
| Ext temp.            | 386.7367 | 440.6969 | 485.3604 | 512.0889 | 477.7910 | 356.6914 | 242.4835 | 253.0661 | 359.4495 | 399.6819 | 377.7319 | 367.3677 (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Month fracti         | 963.1533 | 935.3876 | 850.4056 | 713.9113 | 552.0468 | 370.8910 | 244.6460 | 256.8545 | 400.2780 | 602.6431 | 796.3496 | 959.5682 (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating per m2 | 428.8539 | 332.4322 | 271.5936 | 145.3122 | 55.2463  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 151.0031 | 301.4047 | 440.5971 (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 2126.4432 (98) |
|                      |          |          |          |          |          |          |          |          |          |          |          | 39.0173 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2274.2708 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 428.8539 | 332.4322 | 271.5936 | 145.3122 | 55.2463  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 151.0031 | 301.4047 | 440.5971  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 458.6673 | 355.5425 | 290.4745 | 155.4141 | 59.0870  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 161.5007 | 322.3580 | 471.2269  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 153.6655 | 135.1770 | 141.3429 | 125.8409 | 122.6945 | 108.7334 | 103.5719 | 114.8290 | 114.9955 | 130.5321 | 139.1102 | 149.6770  | (64)            |
| Efficiency of water heater (217)m                                     | 87.4083  | 87.1230  | 86.5287  | 85.1983  | 82.8409  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.2031  | 86.8236  | 87.5242   | (216)           |
| Fuel for water heating, kWh/month                                     | 175.8020 | 155.1565 | 163.3480 | 147.7036 | 148.1085 | 136.2574 | 129.7894 | 143.8960 | 144.1047 | 153.2011 | 160.2215 | 171.0122  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1828.6007 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2274.2708 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 250.7461  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4428.6177 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2274.2708          | 0.2160                        | 491.2425 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1828.6007          | 0.2160                        | 394.9778 (264)           |
| Space and water heating                                                                           |                    |                               | 886.2203 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 250.7461           | 0.5190                        | 130.1372 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1055.2825 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 16.2609 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3878 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7142 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (16.2609 * 1.00) + 2.3878 + 0.7142, rounded to 2 d.p. |                    |                               | 19.3600 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-2-01                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP-1-2                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 87 B                                                                    | DER           | 9.53    | TER            | 15.61      |
| Environmental                      | 93 A                                                                    | % DER<TER     | 38.97   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.52                                                                    | DFEE          | 37.14   | TFEE           | 40.71      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 8.76    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 71 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 15.61 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 9.53 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 40.7 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 37.1 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.38 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK

Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing North East: 1.92 m<sup>2</sup>, No overhang  
Windows facing West: 16.01 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 70.8000 (1b)              | x 2.5400 (2b)                   | = 179.8320 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.8000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 179.8320 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000      | (6a)   |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000      | (6b)   |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000      | (7a)   |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000      | (7b)   |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000      | (7c)   |        |        |               |
|                                                                                              |                              |        |           |        |        |        | Air changes per hour        |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000      | (8)    |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes         |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000      |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500      | (18)   |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 2           | (19)   |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500      | (20)   |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275      | (21)   |        |        |               |
|                                                                                              |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2631                       | 0.2599 | 0.2567    | 0.2408 | 0.2376 | 0.2216 | 0.2216                      | 0.2184      | 0.2280 | 0.2376 | 0.2439 | 0.2503 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K                         | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------------------------------|--------------------------------|-----------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364                              |                                | (27)            |
| W02 (Uw = 1.40)                                                |                         |                            | 7.6100                    | 1.3258                        | 10.0890                              |                                | (27)            |
| door                                                           |                         |                            | 2.1000                    | 1.2500                        | 2.6250                               |                                | (26a)           |
| W10 (Uw = 1.40)                                                |                         |                            | 1.9200                    | 1.3258                        | 2.5455                               |                                | (27)            |
| External Wall 1                                                | 54.1000                 | 17.9300                    | 36.1700                   | 0.1500                        | 5.4255                               | 140.0000                       | 5063.8000 (29a) |
| Corridor wall                                                  | 9.1000                  | 2.1000                     | 7.0000                    | 0.1409                        | 0.9864                               | 110.0000                       | 770.0000 (29a)  |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 63.2000                   |                               |                                      |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 32.8077                              |                                | (33)            |
| Party Wall 1                                                   |                         |                            | 36.5000                   | 0.0000                        | 0.0000                               | 140.0000                       | 5110.0000 (32)  |
| Party Floor                                                    |                         |                            | 70.8000                   |                               |                                      | 80.0000                        | 5664.0000 (32d) |
| Party Ceilings                                                 |                         |                            | 70.8000                   |                               |                                      | 80.0000                        | 5664.0000 (32b) |
| Internal Wall                                                  |                         |                            | 126.6000                  |                               |                                      | 9.0000                         | 1139.4000 (32c) |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               | (28)...(30) + (32) + (32a)...(32e) = |                                | 23411.2000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |                                      |                                | 330.6667 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |                                      |                                | 5.9440 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |                                      | (33) + (36) =                  | 38.7517 (37)    |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 15.6113 | 15.4222 | 15.2330 | 14.2872 | 14.0980 | 13.1522 | 13.1522 | 12.9631 | 13.5306 | 14.0980 | 14.4764 | 14.8547 (38) |
| Heat transfer coeff       | 54.3630 | 54.1739 | 53.9847 | 53.0389 | 52.8498 | 51.9040 | 51.9040 | 51.7148 | 52.2823 | 52.8498 | 53.2281 | 53.6064 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 52.9916 (39) |
| HLP                       | 0.7678  | 0.7652  | 0.7625  | 0.7491  | 0.7465  | 0.7331  | 0.7331  | 0.7304  | 0.7385  | 0.7465  | 0.7518  | 0.7572 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.7485 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 2.2654 (42)  |
| Average daily hot water use (litres/day) | 92.6347 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                    |               |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------------|---------------|----------------|
| Energy conte                                                    | 101.8982 | 98.1928  | 94.4874  | 90.7820  | 87.0766  | 83.3713  | 83.3713  | 87.0766  | 90.7820  | 94.4874            | 98.1928       | 101.8982 (44)  |
| 151.1121                                                        | 132.1636 | 136.3810 | 118.9003 | 114.0876 | 98.4490  | 91.2274  | 104.6848 | 105.9351 | 123.4571 | 134.7631           | 146.3440 (45) |                |
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          | Total = Sum(45)m = |               | 1457.5051 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |                    |               |                |
| 22.6668                                                         | 19.8245  | 20.4572  | 17.8350  | 17.1131  | 14.7673  | 13.6841  | 15.7027  | 15.8903  | 18.5186  | 20.2145            | 21.9516 (46)  |                |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                    |               |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                    |               | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                    |               | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                    |               | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                    |               | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                    |               |                |
| 22.9400                                                         | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000            | 22.9400 (56)  |                |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |                    |               |                |
| 22.9400                                                         | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000            | 22.9400 (57)  |                |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120            | 23.2624 (59)  |                |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |                    |               |                |
| Solar input                                                     | 197.3145 | 173.8948 | 182.5834 | 163.6123 | 160.2900 | 143.1610 | 137.4298 | 150.8872 | 150.6471 | 169.6595           | 179.4751      | 192.5464 (62)  |
| 0.0000                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000             | 0.0000 (63)   |                |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |                    |               | 0.0000 (63)    |
| Output from w/h                                                 | 197.3145 | 173.8948 | 182.5834 | 163.6123 | 160.2900 | 143.1610 | 137.4298 | 150.8872 | 150.6471 | 169.6595           | 179.4751      | 192.5464 (64)  |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |          |          |          |          |          |                    |               | 2001.5011 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |                    |               |                |
| 87.2067                                                         | 77.3294  | 82.3086  | 75.3039  | 74.8961  | 68.5039  | 67.2950  | 71.7696  | 70.9930  | 78.0114  | 80.5783            | 85.6213 (65)  |                |

#### 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.7550  | 15.7698  | 12.8249  | 9.7093   | 7.2578   | 6.1273   | 6.6208   | 8.6060   | 11.5509  | 14.6665  | 17.1180  | 18.2485 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 199.1570 | 201.2236 | 196.0158 | 184.9289 | 170.9337 | 157.7803 | 148.9929 | 146.9263 | 152.1341 | 163.2210 | 177.2161 | 190.3696 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 (71) |
| Water heating gains (Table 5)                                                       | 117.2133 | 115.0735 | 110.6298 | 104.5888 | 100.6667 | 95.1443  | 90.4503  | 96.4645  | 98.6014  | 104.8540 | 111.9143 | 115.0824 (72) |
| Total internal gains                                                                | 391.1061 | 389.0477 | 376.4513 | 356.2078 | 335.8391 | 316.0327 | 303.0449 | 308.9776 | 319.2673 | 339.7224 | 363.2293 | 380.6813 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| West        |          |          |          | 8.4000     | 19.6403                        | 0.3700                            | 0.8900                             | 0.7700                       | 37.6488 (80) |          |          |               |
| West        |          |          |          | 7.6100     | 19.6403                        | 0.5600                            | 0.6800                             | 0.7700                       | 39.4423 (80) |          |          |               |
| Northeast   |          |          |          | 1.9200     | 11.2829                        | 0.3700                            | 0.6500                             | 0.7700                       | 3.6105 (75)  |          |          |               |
| Solar gains | 80.7017  | 158.1560 | 261.5982 | 383.9597   | 473.1374                       | 485.5805                          | 461.7763                           | 394.8582                     | 304.9841     | 187.9262 | 100.6666 | 66.3445 (83)  |
| Total gains | 471.8078 | 547.2037 | 638.0495 | 740.1675   | 808.9765                       | 801.6132                          | 764.8212                           | 703.8358                     | 624.2513     | 527.6486 | 463.8959 | 447.0259 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |          |          |          |          |          |          |          |          |                           |          |          |              |
|-----------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|----------|----------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |          |          |          |          |          |          |          |          |                           |          |          | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |          |          |          |          |          |          |          |          |                           |          |          |              |
|                                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep                       | Oct      | Nov      | Dec          |
| tau                                                                         | 119.6238 | 120.0415 | 120.4621 | 122.6102 | 123.0490 | 125.2913 | 125.2913 | 125.7495 | 124.3846                  | 123.0490 | 122.1745 | 121.3122     |
| alpha                                                                       | 8.9749   | 9.0028   | 9.0308   | 9.1740   | 9.2033   | 9.3528   | 9.3528   | 9.3833   | 9.2923                    | 9.2033   | 9.1450   | 9.0875       |
| util living area                                                            | 0.9986   | 0.9943   | 0.9665   | 0.8264   | 0.6051   | 0.4143   | 0.2986   | 0.3380   | 0.5764                    | 0.9194   | 0.9947   | 0.9991 (86)  |
| MIT                                                                         | 20.5114  | 20.6327  | 20.8140  | 20.9662  | 20.9978  | 20.9999  | 21.0000  | 21.0000  | 20.9989                   | 20.9275  | 20.6877  | 20.4912 (87) |
| Th 2                                                                        | 20.2813  | 20.2836  | 20.2860  | 20.2976  | 20.3000  | 20.3117  | 20.3117  | 20.3140  | 20.3070                   | 20.3000  | 20.2953  | 20.2906 (88) |
| util rest of house                                                          | 0.9981   | 0.9921   | 0.9548   | 0.7900   | 0.5606   | 0.3698   | 0.2519   | 0.2876   | 0.5193                    | 0.8885   | 0.9922   | 0.9988 (89)  |
| MIT 2                                                                       | 19.6292  | 19.8073  | 20.0645  | 20.2651  | 20.2983  | 20.3117  | 20.3117  | 20.3140  | 20.3064                   | 20.2279  | 19.8976  | 19.6076 (90) |
| Living area fraction                                                        |          |          |          |          |          |          |          |          | fLA = Living area / (4) = |          |          | 0.3559 (91)  |
| MIT                                                                         | 19.9432  | 20.1011  | 20.3313  | 20.5146  | 20.5473  | 20.5566  | 20.5567  | 20.5582  | 20.5529                   | 20.4769  | 20.1788  | 19.9221 (92) |
| Temperature adjustment                                                      |          |          |          |          |          |          |          |          |                           |          |          | 0.0000       |
| adjusted MIT                                                                | 19.9432  | 20.1011  | 20.3313  | 20.5146  | 20.5473  | 20.5566  | 20.5567  | 20.5582  | 20.5529                   | 20.4769  | 20.1788  | 19.9221 (93) |

#### 8. Space heating requirement

|                   | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|-------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Utilisation       | 0.9977   | 0.9914   | 0.9557   | 0.8016   | 0.5764   | 0.3857   | 0.2685   | 0.3055   | 0.5396   | 0.8971   | 0.9917   | 0.9985 (94)   |
| Useful gains      | 470.7432 | 542.4931 | 609.7647 | 593.3489 | 466.3018 | 309.1474 | 205.3663 | 215.0373 | 336.8621 | 473.3328 | 460.0529 | 446.3649 (95) |
| Ext temp.         | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)   |
| Heat loss rate W  | 850.4115 | 823.5030 | 746.6776 | 616.0268 | 467.5772 | 309.1730 | 205.3670 | 215.0395 | 337.3724 | 521.9926 | 696.1603 | 842.8051 (97) |
| Month fracti      | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)  |
| Space heating kWh | 282.4732 | 188.8386 | 101.8632 | 16.3281  | 0.9489   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 36.2029  | 169.9973 | 294.9515 (98) |

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Space heating 1091.6038 (98)  
Space heating per m2 (98) / (4) = 15.4181 (99)

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1091.6038 (98)   |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 527.2446 (307a)  |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 618.9393 (307b)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2001.5011 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 966.7250 (310a)  |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1134.8511 (310b) |
| Electricity used for heat distribution                                                  | 32.4776 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 145.3492 (330a)  |
| Total electricity for the above, kWh/year                                               | 145.3492 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 313.5586 (332)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415 (333)  |
| Total delivered energy for all uses                                                     | 3334.0265 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 403.7756           | 0.5190                        | 209.5595 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 1867.7214          | 0.2160                        | 403.4278 (368)           |
| Electrical energy for heat distribution                                                    | 32.4776            | 0.5190                        | 16.8559 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 629.8432 (373)           |
| Space and water heating                                                                    |                    |                               | 629.8432 (376)           |
| Pumps and fans                                                                             | 145.3492           | 0.5190                        | 75.4362 (378)            |
| Energy for lighting                                                                        | 313.5586           | 0.5190                        | 162.7369 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 674.6155 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 9.5300 (384)             |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 9.5300 ZC1  |
| Total Floor Area                                                                | TFA 70.8000 |
| Assumed number of occupants                                                     | N 2.2654    |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF 0.5190   |
| CO2 emissions from appliances, equation (L14)                                   | 16.6690 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.4487 ZC3  |
| Total CO2 emissions                                                             | 28.6477 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 28.6477 ZC8 |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 70.8000 (1b)              | x 2.5400 (2b)                   | = 179.8320 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 70.8000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 179.8320 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | +                    | 0                           | =               | 0 * 40 = 0.0000 (6a)    |
| Number of open flues                                                      | 0               | +                    | 0                           | =               | 0 * 20 = 0.0000 (6b)    |
| Number of intermittent fans                                               |                 |                      |                             |                 | 3 * 10 = 30.0000 (7a)   |
| Number of passive vents                                                   |                 |                      |                             |                 | 0 * 10 = 0.0000 (7b)    |
| Number of flueless gas fires                                              |                 |                      |                             |                 | 0 * 40 = 0.0000 (7c)    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 30.0000 / (5) = | 0.1668 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.4168 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 2 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.8500 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3543 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4517 | 0.4429 | 0.4340 | 0.3897 | 0.3809 | 0.3366 | 0.3366 | 0.3277 | 0.3543 | 0.3809 | 0.3986 | 0.4163 (22b) |
| Effective ac    | 0.6020 | 0.5981 | 0.5942 | 0.5759 | 0.5725 | 0.5566 | 0.5566 | 0.5537 | 0.5628 | 0.5725 | 0.5794 | 0.5867 (25)  |

#### 3. Heat losses and heat loss parameter

|                                                                     |                |                |                      |                  |                |                   |                |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------------|------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                     |
| TER Semi-glazed door                                                |                |                | 2.1000               | 1.2000           | 2.5200         |                   |                | (26a)          |                |                |                |                     |
| TER Opening Type (Uw = 1.40)                                        |                |                | 15.6000              | 1.3258           | 20.6818        |                   |                | (27)           |                |                |                |                     |
| External Wall 1                                                     | 54.1000        | 15.6000        | 38.5000              | 0.1800           | 6.9300         |                   |                | (29a)          |                |                |                |                     |
| Corridor wall                                                       | 9.1000         | 2.1000         | 7.0000               | 0.1800           | 1.2600         |                   |                | (29a)          |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 63.2000              |                  |                |                   |                | (31)           |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26)...(30) + (32) = |                  | 31.3918        |                   |                | (33)           |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                      |                  |                |                   |                | 250.0000 (35)  |                |                |                |                     |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                      |                  |                |                   |                | 3.8265 (36)    |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                      |                  |                | (33) + (36) =     |                | 35.2183 (37)   |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                      |                  |                |                   |                |                |                |                |                |                     |
| (38)m                                                               | Jan<br>35.7272 | Feb<br>35.4921 | Mar<br>35.2617       | Apr<br>34.1792   | May<br>33.9766 | Jun<br>33.0338    | Jul<br>33.0338 | Aug<br>32.8592 | Sep<br>33.3970 | Oct<br>33.9766 | Nov<br>34.3863 | Dec<br>34.8147 (38) |
| Heat transfer coeff                                                 | 70.9456        | 70.7104        | 70.4800              | 69.3975          | 69.1949        | 68.2521           | 68.2521        | 68.0775        | 68.6153        | 69.1949        | 69.6047        | 70.0330 (39)        |
| Average = Sum(39)m / 12 =                                           |                |                |                      |                  |                |                   |                |                |                |                |                | 69.3965 (39)        |
| HLP                                                                 | Jan<br>1.0021  | Feb<br>0.9987  | Mar<br>0.9955        | Apr<br>0.9802    | May<br>0.9773  | Jun<br>0.9640     | Jul<br>0.9640  | Aug<br>0.9615  | Sep<br>0.9691  | Oct<br>0.9773  | Nov<br>0.9831  | Dec<br>0.9892 (40)  |
| HLP (average)                                                       |                |                |                      |                  |                |                   |                |                |                |                |                | 0.9802 (40)         |
| Days in month                                                       | 31             | 28             | 31                   | 30               | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31 (41)             |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |          |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|----------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |          |                    |          | 2.2654 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |          |                    |          | 88.0030 (43)   |
| Daily hot water use                                         | 96.8033  | 93.2832  | 89.7631  | 86.2429  | 82.7228  | 79.2027 | 79.2027 | 82.7228 | 86.2429  | 89.7631            | 93.2832  | 96.8033 (44)   |
| Energy conte                                                | 143.5565 | 125.5554 | 129.5620 | 112.9552 | 108.3833 | 93.5265 | 86.6661 | 99.4506 | 100.6383 | 117.2843           | 128.0249 | 139.0268 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |          | Total = Sum(45)m = |          | 1384.6298 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |          |          |         |         |         |          |                    |          |                |
|                                                             | 21.5335  | 18.8333  | 19.4343  | 16.9433  | 16.2575  | 14.0290 | 12.9999 | 14.9176 | 15.0957  | 17.5926            | 19.2037  | 20.8540 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |          |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |          |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |          |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |          |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |          |                    |          | 0.1290 (55)    |
| Total storage loss                                          |          |          |          |          |          |         |         |         |          |                    |          |                |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 170.8166 | 150.1775 | 156.8221 | 139.3360 | 135.6434 | 119.9073 | 113.9262 | 126.7107 | 127.0191 | 144.5444 | 154.4057 | 166.2869 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 170.8166 | 150.1775 | 156.8221 | 139.3360 | 135.6434 | 119.9073 | 113.9262 | 126.7107 | 127.0191 | 144.5444 | 154.4057 | 166.2869 (64) |
|                                                                 | 69.5406  | 61.4448  | 64.8875  | 58.6622  | 57.8455  | 52.2022  | 50.6246  | 54.8754  | 54.5669  | 60.8051  | 63.6729  | 68.0345 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | 113.2695 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.7603  | 15.7745  | 12.8287  | 9.7121   | 7.2599   | 6.1291   | 6.6228   | 8.6085   | 11.5543  | 14.6709  | 17.1231  | 18.2539  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 199.1570 | 201.2236 | 196.0158 | 184.9289 | 170.9337 | 157.7803 | 148.9929 | 146.9263 | 152.1341 | 163.2210 | 177.2161 | 190.3696 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | 34.3269  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | -90.6156 | (71) |
| Water heating gains (Table 5)                                                       | 93.4686  | 91.4358  | 87.2143  | 81.4753  | 77.7494  | 72.5030  | 68.0438  | 73.7573  | 75.7873  | 81.7273  | 88.4346  | 91.4443  | (72) |
| Total internal gains                                                                | 370.3667 | 368.4147 | 356.0396 | 336.0972 | 315.9239 | 296.3933 | 283.6403 | 289.2729 | 299.4566 | 319.6000 | 342.7547 | 360.0486 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|
| Northeast   |          |          |          |          | 1.6700     | 11.2829                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 5.7585        |
| West        |          |          |          |          | 13.9300    | 19.6403                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 83.6123 (75)  |
| -----       |          |          |          |          |            |                                |                                   |                                    |          |          |                              |               |
| Solar gains | 89.3708  | 175.2851 | 290.4843 | 427.5366 | 528.0776   | 542.5594                       | 515.7156                          | 440.1199                           | 339.0168 | 208.4065 | 111.5004                     | 73.4614 (83)  |
| Total gains | 459.7375 | 543.6997 | 646.5239 | 763.6339 | 844.0015   | 838.9527                       | 799.3559                          | 729.3928                           | 638.4734 | 528.0066 | 454.2551                     | 433.5100 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 69.3020 | 69.5324 | 69.7598 | 70.8479 | 71.0553 | 72.0368 | 72.0368 | 72.2216 | 71.6556 | 71.0553 | 70.6370 | 70.2050 |              |
| alpha                                                                       | 5.6201  | 5.6355  | 5.6507  | 5.7232  | 5.7370  | 5.8025  | 5.8025  | 5.8148  | 5.7770  | 5.7370  | 5.7091  | 5.6803  |              |
| util living area                                                            | 0.9970  | 0.9918  | 0.9710  | 0.8885  | 0.7169  | 0.5149  | 0.3749  | 0.4275  | 0.7023  | 0.9485  | 0.9929  | 0.9978  | (86)         |
| MIT                                                                         | 20.0097 | 20.1827 | 20.4620 | 20.7793 | 20.9474 | 20.9934 | 20.9991 | 20.9982 | 20.9656 | 20.7003 | 20.2934 | 19.9833 | (87)         |
| Th 2                                                                        | 20.0816 | 20.0844 | 20.0871 | 20.0999 | 20.1023 | 20.1134 | 20.1134 | 20.1155 | 20.1091 | 20.1023 | 20.0974 | 20.0924 | (88)         |
| util rest of house                                                          | 0.9960  | 0.9892  | 0.9619  | 0.8587  | 0.6614  | 0.4462  | 0.2998  | 0.3463  | 0.6265  | 0.9275  | 0.9902  | 0.9971  | (89)         |
| MIT 2                                                                       | 18.7604 | 19.0138 | 19.4160 | 19.8562 | 20.0557 | 20.1094 | 20.1131 | 20.1148 | 20.0844 | 19.7657 | 19.1859 | 18.7299 | (90)         |
| Living area fraction                                                        | 19.2051 | 19.4298 | 19.7883 | 20.1848 | 20.3731 | 20.4241 | 20.4285 | 20.4292 | 20.3981 | 20.0984 | 19.5801 | 19.1760 | (92)         |
| Temperature adjustment                                                      | 19.2051 | 19.4298 | 19.7883 | 20.1848 | 20.3731 | 20.4241 | 20.4285 | 20.4292 | 20.3981 | 20.0984 | 19.5801 | 19.1760 | (93)         |
| adjusted MIT                                                                | 19.2051 | 19.4298 | 19.7883 | 20.1848 | 20.3731 | 20.4241 | 20.4285 | 20.4292 | 20.3981 | 20.0984 | 19.5801 | 19.1760 | (93)         |

#### 8. Space heating requirement

|                      |           |           |          |          |          |          |          |          |          |          |          |           |       |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 0.9947    | 0.9868    | 0.9583   | 0.8618   | 0.6788   | 0.4705   | 0.3266   | 0.3753   | 0.6521   | 0.9274   | 0.9881   | 0.9961    | (94)  |
| Ext temp.            | 457.3197  | 536.5045  | 619.5700 | 658.0832 | 572.8788 | 394.7450 | 261.0338 | 273.7189 | 416.3766 | 489.6704 | 448.8341 | 431.8233  | (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Month fracti         | 1057.4477 | 1027.4111 | 936.5568 | 783.1358 | 600.1338 | 397.5050 | 261.3016 | 274.2999 | 432.1429 | 657.2397 | 868.6738 | 1048.8165 | (97)  |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating per m2 | 446.4952  | 329.8893  | 235.8382 | 90.0379  | 20.2777  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 124.6716 | 302.2846 | 459.0429  | (98)  |
|                      |           |           |          |          |          |          |          |          |          |          |          | 2008.5374 | (98)  |
|                      |           |           |          |          |          |          |          |          |          |          |          | 28.3692   | (99)  |

#### 8c. Space cooling requirement

Not applicable

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#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2148.1683 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 446.4952 | 329.8893 | 235.8382 | 90.0379  | 20.2777  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 124.6716 | 302.2846 | 459.0429  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 477.5350 | 352.8227 | 252.2333 | 96.2972  | 21.6874  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 133.3386 | 323.2990 | 490.9550  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 170.8166 | 150.1775 | 156.8221 | 139.3360 | 135.6434 | 119.9073 | 113.9262 | 126.7107 | 127.0191 | 144.5444 | 154.4057 | 166.2869  | (64)            |
| Efficiency of water heater (217)m                                     | 87.2623  | 86.8568  | 85.8999  | 83.6838  | 81.0462  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.4223  | 86.5752  | 87.3842   | (216)           |
| Fuel for water heating, kWh/month                                     | 195.7507 | 172.9025 | 182.5637 | 166.5030 | 167.3656 | 150.2598 | 142.7647 | 158.7853 | 159.1718 | 171.2159 | 178.3487 | 190.2940  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2035.9255 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2148.1683 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 313.6516  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4572.7454 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2148.1683          | 0.2160                        | 464.0044 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2035.9255          | 0.2160                        | 439.7599 (264)           |
| Space and water heating                                                                           |                    |                               | 903.7643 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 313.6516           | 0.5190                        | 162.7852 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1105.4744 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.7650 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.2992 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5498 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.7650 * 1.00) + 2.2992 + 0.5498, rounded to 2 d.p. |                    |                               | 15.6100 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-2-04                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP-1-2                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 87 B                                                                    | DER           | 9.53    | TER            | 16.65      |
| Environmental                      | 94 A                                                                    | % DER<TER     | 42.75   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.41                                                                    | DFEE          | 35.89   | TFEE           | 39.15      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 8.32    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 54 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 16.65 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 9.53 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 39.1 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 35.9 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.14 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK  
Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing North East: 1.64 m<sup>2</sup>, No overhang  
Windows facing South East: 12.20 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 54.1000 (1b)              | x 2.5400 (2b)                   | = 137.4140 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.1000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 137.4140 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes    |             |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000 |             |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 | (18)        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 3      | (19)        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20)        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1163 | (21)        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1482                       | 0.1453 | 0.1424    | 0.1279 | 0.1250 | 0.1104 | 0.1104                      | 0.1075 | 0.1163      | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2487                       | 0.2458 | 0.2429    | 0.2284 | 0.2255 | 0.2109 | 0.2109                      | 0.2080 | 0.2168      | 0.2255 | 0.2313 | 0.2371 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K                         | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------------------------------|--------------------------------|-----------------|
| W05 (Uw = 1.40)                                                |                         |                            | 1.6400                    | 1.3258                        | 2.1742                               |                                | (27)            |
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364                              |                                | (27)            |
| W02 (Uw = 1.40)                                                |                         |                            | 3.8000                    | 1.3258                        | 5.0379                               |                                | (27)            |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400                               |                                | (26a)           |
| External Wall 1                                                | 31.5800                 | 13.8400                    | 17.7400                   | 0.1500                        | 2.6610                               | 140.0000                       | 2483.6000 (29a) |
| Corridor wall                                                  | 41.5500                 | 2.1000                     | 39.4500                   | 0.1409                        | 5.5589                               | 110.0000                       | 4339.5000 (29a) |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 73.1300                   |                               |                                      |                                | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 29.5084                              |                                | (33)            |
| Party Wall 1                                                   |                         |                            | 14.9000                   | 0.0000                        | 0.0000                               | 140.0000                       | 2086.0000 (32)  |
| Party Floor                                                    |                         |                            | 54.1000                   |                               |                                      | 80.0000                        | 4328.0000 (32d) |
| Party Ceilings                                                 |                         |                            | 54.1000                   |                               |                                      | 80.0000                        | 4328.0000 (32b) |
| Internal Wall                                                  |                         |                            | 82.3000                   |                               |                                      | 9.0000                         | 740.7000 (32c)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               | (28)...(30) + (32) + (32a)...(32e) = | 18305.8000                     | (34)            |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |                                      | 338.3697                       | (35)            |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |                                      | 4.1024                         | (36)            |
| Total fabric heat loss                                         |                         |                            |                           |                               |                                      | (33) + (36) =                  | 33.6108 (37)    |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 11.2786 | 11.1468 | 11.0150 | 10.3560 | 10.2242 | 9.5653  | 9.5653  | 9.4335  | 9.8289  | 10.2242 | 10.4878 | 10.7514 (38) |
| Heat transfer coeff       | 44.8894 | 44.7576 | 44.6258 | 43.9669 | 43.8351 | 43.1761 | 43.1761 | 43.0443 | 43.4397 | 43.8351 | 44.0987 | 44.3622 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 43.9339 (39) |
| HLP                       | 0.8297  | 0.8273  | 0.8249  | 0.8127  | 0.8103  | 0.7981  | 0.7981  | 0.7956  | 0.8030  | 0.8103  | 0.8151  | 0.8200 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.8121 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 1.8109 (42)  |
| Average daily hot water use (litres/day) | 81.2736 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy conte                                                    | 89.4009  | 86.1500  | 82.8991  | 79.6481  | 76.3972  | 73.1462  | 73.1462  | 76.3972  | 79.6481  | 82.8991             | 86.1500  | 89.4009 (44)   |
| Energy content (annual)                                         | 132.5790 | 115.9545 | 119.6546 | 104.3178 | 100.0954 | 86.3747  | 80.0389  | 91.8458  | 92.9427  | 108.3158            | 118.2351 | 128.3957 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1278.7499 (45) |
|                                                                 | 19.8869  | 17.3932  | 17.9482  | 15.6477  | 15.0143  | 12.9562  | 12.0058  | 13.7769  | 13.9414  | 16.2474             | 17.7353  | 19.2594 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |                     |          |                |
| Solar input                                                     | 178.7814 | 157.6857 | 165.8570 | 149.0298 | 146.2978 | 131.0867 | 126.2413 | 138.0482 | 137.6547 | 154.5182            | 162.9471 | 174.5981 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum (63)m =                       |          |          |          |          |          |          |          |          |          |                     |          | 0.0000 (63)    |
| Output from w/h                                                 | 178.7814 | 157.6857 | 165.8570 | 149.0298 | 146.2978 | 131.0867 | 126.2413 | 138.0482 | 137.6547 | 154.5182            | 162.9471 | 174.5981 (64)  |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 81.0444  | 71.9398  | 76.7471  | 70.4553  | 70.2436  | 64.4892  | 63.5748  | 67.5006  | 66.6731  | 72.9769             | 75.0828  | 79.6535 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 14.0736  | 12.5001  | 10.1657  | 7.6961   | 5.7529   | 4.8569   | 5.2480   | 6.8216   | 9.1559   | 11.6255  | 13.5687  | 14.4648 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 157.8632 | 159.5014 | 155.3733 | 146.5853 | 135.4919 | 125.0657 | 118.1003 | 116.4622 | 120.5902 | 129.3783 | 140.4717 | 150.8979 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 108.9307 | 107.0533 | 103.1547 | 97.8545  | 94.4135  | 89.5683  | 85.4501  | 90.7267  | 92.6015  | 98.0872  | 104.2816 | 107.0611 (72) |
| Total internal gains                                                                |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 331.0317 | 329.2189 | 318.8579 | 302.3001 | 285.8225 | 269.6550 | 258.9626 | 264.1746 | 272.5118 | 289.2552 | 308.4862 | 322.5880 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|----------|---------------|
| Northeast   |          |          |          | 1.6400     | 11.2829                        | 0.3700                            | 0.7900                             | 0.7700                       |          | 3.7482 (75)  |          |               |
| Southeast   |          |          |          | 8.4000     | 36.7938                        | 0.3700                            | 0.8900                             | 0.7700                       |          | 70.5309 (77) |          |               |
| Southeast   |          |          |          | 3.8000     | 36.7938                        | 0.5600                            | 0.6800                             | 0.7700                       |          | 36.8968 (77) |          |               |
| Solar gains | 111.1759 | 190.6188 | 264.1199 | 332.8004   | 377.8235                       | 377.3168                          | 362.8475                           | 328.9180                     | 287.8517 | 211.5660     | 133.3899 | 94.9967 (83)  |
| Total gains | 442.2076 | 519.8376 | 582.9778 | 635.1004   | 663.6460                       | 646.9718                          | 621.8101                           | 593.0926                     | 560.3635 | 500.8212     | 441.8761 | 417.5847 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |          |          |          |          |          |          |          |          |                           |          |          |              |
|-----------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|----------|----------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |          |          |          |          |          |          |          |          |                           |          |          | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |          |          |          |          |          |          |          |          |                           |          |          |              |
|                                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep                       | Oct      | Nov      | Dec          |
| tau                                                                         | 113.2772 | 113.6108 | 113.9463 | 115.6540 | 116.0017 | 117.7721 | 117.7721 | 118.1327 | 117.0575                  | 116.0017 | 115.3084 | 114.6233     |
| alpha                                                                       | 8.5518   | 8.5741   | 8.5964   | 8.7103   | 8.7334   | 8.8515   | 8.8515   | 8.8755   | 8.8038                    | 8.7334   | 8.6872   | 8.6416       |
| util living area                                                            | 0.9955   | 0.9823   | 0.9361   | 0.8023   | 0.6109   | 0.4270   | 0.3055   | 0.3338   | 0.5339                    | 0.8503   | 0.9830   | 0.9970 (86)  |
| MIT                                                                         | 20.5601  | 20.7014  | 20.8558  | 20.9680  | 20.9968  | 20.9999  | 21.0000  | 21.0000  | 20.9992                   | 20.9572  | 20.7456  | 20.5317 (87) |
| Th 2                                                                        | 20.2276  | 20.2297  | 20.2318  | 20.2423  | 20.2444  | 20.2550  | 20.2550  | 20.2571  | 20.2508                   | 20.2444  | 20.2402  | 20.2360 (88) |
| util rest of house                                                          | 0.9937   | 0.9759   | 0.9167   | 0.7625   | 0.5627   | 0.3773   | 0.2538   | 0.2799   | 0.4764                    | 0.8071   | 0.9757   | 0.9958 (89)  |
| MIT 2                                                                       | 19.6538  | 19.8572  | 20.0685  | 20.2123  | 20.2421  | 20.2549  | 20.2550  | 20.2571  | 20.2503                   | 20.2057  | 19.9307  | 19.6197 (90) |
| Living area fraction                                                        |          |          |          |          |          |          |          |          | fLA = Living area / (4) = |          |          | 0.5102 (91)  |
| MIT                                                                         | 20.1162  | 20.2879  | 20.4702  | 20.5978  | 20.6271  | 20.6350  | 20.6351  | 20.6361  | 20.6324                   | 20.5891  | 20.3464  | 20.0850 (92) |
| Temperature adjustment                                                      |          |          |          |          |          |          |          |          |                           |          |          | 0.0000       |
| adjusted MIT                                                                | 20.1162  | 20.2879  | 20.4702  | 20.5978  | 20.6271  | 20.6350  | 20.6351  | 20.6361  | 20.6324                   | 20.5891  | 20.3464  | 20.0850 (93) |

#### 8. Space heating requirement

|                   |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Utilisation       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| Useful gains      | 439.2668 | 507.5836 | 538.2149 | 496.4344 | 389.7194 | 260.5176 | 174.2171 | 182.3366 | 283.4138 | 414.5282 | 431.6691 | 415.7236 (95) |
| Ext temp.         | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)   |
| Heat loss rate W  | 709.9781 | 688.7252 | 623.4300 | 514.3150 | 391.3217 | 260.5672 | 174.2187 | 182.3402 | 283.7648 | 437.8717 | 584.1493 | 704.6937 (97) |
| Month fracti      | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)  |
| Space heating kWh | 201.4092 | 121.7271 | 63.4001  | 12.8740  | 1.1921   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 17.3676  | 109.7858 | 214.9937 (98) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating  
Space heating per m2 (98) / (4) = 742.7497 (98)  
13.7292 (99)

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 742.7497 (98)    |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 358.7481 (307a)  |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 421.1391 (307b)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1822.7459 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 880.3863 (310a)  |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1033.4969 (310b) |
| Electricity used for heat distribution                                                  | 26.9377 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 111.0649 (330a)  |
| Total electricity for the above, kWh/year                                               | 111.0649 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 248.5446 (332)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415        |
| Total delivered energy for all uses                                                     | 2680.7383 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 334.9012           | 0.5190                        | 173.8137 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 1549.1331          | 0.2160                        | 334.6128 (368)           |
| Electrical energy for heat distribution                                                    | 26.9377            | 0.5190                        | 13.9807 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 522.4071 (373)           |
| Space and water heating                                                                    |                    |                               | 522.4071 (376)           |
| Pumps and fans                                                                             | 111.0649           | 0.5190                        | 57.6427 (378)            |
| Energy for lighting                                                                        | 248.5446           | 0.5190                        | 128.9946 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 515.6435 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 9.5300 (384)             |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 9.5300 ZC1  |
| Total Floor Area                                                                | TFA 54.1000 |
| Assumed number of occupants                                                     | N 1.8109    |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF 0.5190   |
| CO2 emissions from appliances, equation (L14)                                   | 17.2914 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 3.0030 ZC3  |
| Total CO2 emissions                                                             | 29.8244 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 29.8244 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 54.1000 (1b)              | x 2.5400 (2b)                   | = 137.4140 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.1000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 137.4140 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1455 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3955 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 3 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.7750 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3065 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.3908 | 0.3832 | 0.3755 | 0.3372 | 0.3295 | 0.2912 | 0.2912 | 0.2836 | 0.3065 | 0.3295 | 0.3449 | 0.3602 (22b) |
| Effective ac    | 0.5764 | 0.5734 | 0.5705 | 0.5569 | 0.5543 | 0.5424 | 0.5424 | 0.5402 | 0.5470 | 0.5543 | 0.5595 | 0.5649 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K                 | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K              |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|------------------------------|--------------------------------|----------------------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200                       |                                | (26a)                      |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 11.4200                   | 1.3258                        | 15.1402                      |                                | (27)                       |
| External Wall 1                                                | 31.5800                 | 11.4200                    | 20.1600                   | 0.1800                        | 3.6288                       |                                | (29a)                      |
| Corridor wall                                                  | 41.5500                 | 2.1000                     | 39.4500                   | 0.1800                        | 7.1010                       |                                | (29a)                      |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 73.1300                   |                               |                              |                                | (31)                       |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           |                               | (26)...(30) + (32) = 28.3900 |                                | (33)                       |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |                              |                                | 250.0000 (35)              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |                              |                                | 2.4099 (36)                |
| Total fabric heat loss                                         |                         |                            |                           |                               |                              |                                | (33) + (36) = 30.7999 (37) |

|                                                                     |         |         |         |         |         |         |         |         |         |         |         |              |
|---------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |         |         |         |         |         |         |         |         |         |         |         |              |
| (38)m                                                               | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|                                                                     | 26.1369 | 26.0024 | 25.8706 | 25.2514 | 25.1355 | 24.5962 | 24.5962 | 24.4963 | 24.8040 | 25.1355 | 25.3699 | 25.6149 (38) |
| Heat transfer coeff                                                 | 56.9368 | 56.8023 | 56.6705 | 56.0512 | 55.9354 | 55.3961 | 55.3961 | 55.2962 | 55.6038 | 55.9354 | 56.1698 | 56.4148 (39) |
| Average = Sum(39)m / 12 =                                           |         |         |         |         |         |         |         |         |         |         |         | 56.0507 (39) |
| HLP                                                                 | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|                                                                     | 1.0524  | 1.0500  | 1.0475  | 1.0361  | 1.0339  | 1.0240  | 1.0240  | 1.0221  | 1.0278  | 1.0339  | 1.0383  | 1.0428 (40)  |
| HLP (average)                                                       |         |         |         |         |         |         |         |         |         |         |         | 1.0361 (40)  |
| Days in month                                                       | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |         |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |                    |          |                |
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |                    |          | 1.8109 (42)    |
|                                                             |          |          |          |         |         |         |         |         |         |                    |          | 77.2099 (43)   |
| Daily hot water use                                         | Jan      | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct                | Nov      | Dec            |
|                                                             | 84.9309  | 81.8425  | 78.7541  | 75.6657 | 72.5773 | 69.4889 | 69.4889 | 72.5773 | 75.6657 | 78.7541            | 81.8425  | 84.9309 (44)   |
| Energy conte                                                | 125.9501 | 110.1567 | 113.6719 | 99.1019 | 95.0906 | 82.0560 | 76.0369 | 87.2535 | 88.2956 | 102.9000           | 112.3234 | 121.9759 (45)  |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1214.8124 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |         |         |         |         |         |         |                    |          |                |
|                                                             | 18.8925  | 16.5235  | 17.0508  | 14.8653 | 14.2636 | 12.3084 | 11.4055 | 13.0880 | 13.2443 | 15.4350            | 16.8485  | 18.2964 (46)   |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |         |         |         |         |         |         |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |                    |          | 0.1290 (55)    |
| Total storage loss                                          |          |          |          |         |         |         |         |         |         |                    |          |                |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 153.2102 | 134.7788 | 140.9320 | 125.4827 | 122.3508 | 108.4368 | 103.2971 | 114.5136 | 114.6764 | 130.1601 | 138.7042 | 149.2361 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 153.2102 | 134.7788 | 140.9320 | 125.4827 | 122.3508 | 108.4368 | 103.2971 | 114.5136 | 114.6764 | 130.1601 | 138.7042 | 149.2361 (64) |
|                                                                 | 63.6865  | 56.3248  | 59.6040  | 54.0560  | 53.4257  | 48.3882  | 47.0904  | 50.8199  | 50.4629  | 56.0224  | 58.4521  | 62.3651 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | 90.5472  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.1072  | 12.5299  | 10.1900  | 7.7145   | 5.7667   | 4.8685   | 5.2606   | 6.8379   | 9.1778   | 11.6533  | 13.6011  | 14.4993  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 157.8632 | 159.5014 | 155.3733 | 146.5853 | 135.4919 | 125.0657 | 118.1003 | 116.4622 | 120.5902 | 129.3783 | 140.4717 | 150.8979 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | 32.0547  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | -72.4377 | (71) |
| Water heating gains (Table 5)                                                       | 85.6001  | 83.8166  | 80.1129  | 75.0778  | 71.8088  | 67.2059  | 63.2935  | 68.3063  | 70.0874  | 75.2989  | 81.1835  | 83.8241  | (72) |
| Total internal gains                                                                | 310.7348 | 309.0121 | 298.8404 | 282.5417 | 266.2315 | 250.3042 | 239.8186 | 244.7706 | 253.0195 | 269.4946 | 288.4205 | 302.3854 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          |          |          |          |          |          |          |          |          | Area<br>m2 |  | Solar flux<br>Table 6a<br>W/m2 |  | g<br>Specific data<br>or Table 6b |  | FF<br>Specific data<br>or Table 6c |  | Access<br>factor<br>Table 6d |  | Gains<br>W    |  |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------|--|--------------------------------|--|-----------------------------------|--|------------------------------------|--|------------------------------|--|---------------|--|
| Northeast   |          |          |          |          |          |          |          |          |          |          |          |          | 1.3500     |  | 11.2829                        |  | 0.6300                            |  | 0.7000                             |  | 0.7700                       |  | 4.6551 (75)   |  |
| Southeast   |          |          |          |          |          |          |          |          |          |          |          |          | 10.0700    |  | 36.7938                        |  | 0.6300                            |  | 0.7000                             |  | 0.7700                       |  | 113.2339 (77) |  |
|             |          |          |          |          |          |          |          |          |          |          |          |          |            |  |                                |  |                                   |  |                                    |  |                              |  |               |  |
| Solar gains | 117.8890 | 202.3547 | 280.9776 | 355.0290 | 403.9455 | 403.7883 | 388.1448 | 351.2283 | 306.5565 | 224.7525 | 141.4854 | 100.7062 | (83)       |  |                                |  |                                   |  |                                    |  |                              |  |               |  |
| Total gains | 428.6237 | 511.3668 | 579.8181 | 637.5707 | 670.1770 | 654.0925 | 627.9634 | 595.9989 | 559.5760 | 494.2471 | 429.9059 | 403.0916 | (84)       |  |                                |  |                                   |  |                                    |  |                              |  |               |  |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 65.9845 | 66.1407 | 66.2946 | 67.0270 | 67.1658 | 67.8197 | 67.8197 | 67.9422 | 67.5663 | 67.1658 | 66.8855 | 66.5950 |              |
| alpha                                                                       | 5.3990  | 5.4094  | 5.4196  | 5.4685  | 5.4777  | 5.5213  | 5.5213  | 5.5295  | 5.5044  | 5.4777  | 5.4590  | 5.4397  |              |
| util living area                                                            | 0.9925  | 0.9805  | 0.9502  | 0.8703  | 0.7224  | 0.5334  | 0.3869  | 0.4246  | 0.6561  | 0.9055  | 0.9823  | 0.9945  | (86)         |
| MIT                                                                         | 20.0714 | 20.2696 | 20.5210 | 20.7813 | 20.9361 | 20.9900 | 20.9986 | 20.9977 | 20.9707 | 20.7621 | 20.3648 | 20.0317 | (87)         |
| Th 2                                                                        | 20.0399 | 20.0419 | 20.0439 | 20.0534 | 20.0552 | 20.0634 | 20.0634 | 20.0649 | 20.0602 | 20.0552 | 20.0516 | 20.0478 | (88)         |
| util rest of house                                                          | 0.9902  | 0.9748  | 0.9359  | 0.8370  | 0.6649  | 0.4592  | 0.3052  | 0.3395  | 0.5783  | 0.8728  | 0.9760  | 0.9927  | (89)         |
| MIT 2                                                                       | 18.8187 | 19.1054 | 19.4613 | 19.8157 | 19.9987 | 20.0574 | 20.0629 | 20.0641 | 20.0399 | 19.8018 | 19.2525 | 18.7671 | (90)         |
| Living area fraction                                                        | 19.4578 | 19.6993 | 20.0019 | 20.3083 | 20.4769 | 20.5332 | 20.5403 | 20.5403 | 20.5147 | 20.2917 | 19.8200 | 19.4122 | (92)         |
| Temperature adjustment                                                      | 19.4578 | 19.6993 | 20.0019 | 20.3083 | 20.4769 | 20.5332 | 20.5403 | 20.5403 | 20.5147 | 20.2917 | 19.8200 | 19.4122 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 423.6362 | 497.1676 | 542.2503 | 539.7970 | 463.3996 | 324.9735 | 217.8579 | 228.2333 | 345.2285 | 435.8674 | 418.7919 | 399.5591  | (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Heat loss rate W     | 863.0340 | 840.6336 | 765.1601 | 639.4520 | 490.9397 | 328.6744 | 218.2748 | 228.9453 | 356.6840 | 542.1100 | 714.4774 | 858.1954  | (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating kWh    | 326.9120 | 230.8091 | 165.8449 | 71.7516  | 20.4898  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 79.0445  | 212.8935 | 341.2254  | (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |          |          | 1448.9708 | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 26.7832   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1549.7014 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 326.9120 | 230.8091 | 165.8449 | 71.7516  | 20.4898  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 79.0445  | 212.8935 | 341.2254  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 349.6384 | 246.8547 | 177.3742 | 76.7397  | 21.9143  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 84.5395  | 227.6936 | 364.9469  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 153.2102 | 134.7788 | 140.9320 | 125.4827 | 122.3508 | 108.4368 | 103.2971 | 114.5136 | 114.6764 | 130.1601 | 138.7042 | 149.2361  | (64)            |
| Efficiency of water heater (217)m                                     | 86.7866  | 86.2371  | 85.2488  | 83.3866  | 81.1767  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 83.5315  | 85.9534  | 86.9524   | (216)           |
| Fuel for water heating, kWh/month                                     | 176.5367 | 156.2886 | 165.3184 | 150.4831 | 150.7215 | 135.8857 | 129.4450 | 143.5008 | 143.7047 | 155.8216 | 161.3714 | 171.6295  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1840.7068 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1549.7014 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 249.1383  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3714.5465 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1549.7014          | 0.2160                        | 334.7355 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1840.7068          | 0.2160                        | 397.5927 (264)           |
| Space and water heating                                                                           |                    |                               | 732.3282 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 249.1383           | 0.5190                        | 129.3028 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 900.5560 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 13.5366 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3901 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7195 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (13.5366 * 1.00) + 2.3901 + 0.7195, rounded to 2 d.p. |                    |                               | 16.6500 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-2-06                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP-1-2                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 87 B                                                                    | DER           | 9.81    | TER            | 14.84      |
| Environmental                      | 92 A                                                                    | % DER<TER     | 33.91   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.71                                                                    | DFEE          | 39.06   | TFEE           | 42.75      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 8.62    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 94 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating:Mains gas (c), Electricity (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 14.84 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 9.81 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)42.7 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)39.1 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.18 (max. 0.20) | 0.18 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls: No cylinderstat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing South East: 7.61 m<sup>2</sup>, No overhang  
Windows facing South West: 12.20 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 93.5000 (1b)              | x 2.5400 (2b)                   | = 237.4900 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 237.4900 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |        |             |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |        |             |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)   |             |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 1                           | (19)   |             |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.9250 | (20)        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1388 | (21)        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1769                       | 0.1734 | 0.1700    | 0.1526 | 0.1492 | 0.1318 | 0.1318                      | 0.1283 | 0.1388      | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2774                       | 0.2739 | 0.2705    | 0.2531 | 0.2497 | 0.2323 | 0.2323                      | 0.2288 | 0.2393      | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364      |                                | (27)                                                 |
| W02 (Uw = 1.40)                                                |                         |                            | 11.4100                   | 1.3258                        | 15.1269      |                                | (27)                                                 |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                | (26a)                                                |
| External Wall 1                                                | 70.4000                 | 19.8100                    | 50.5900                   | 0.1500                        | 7.5885       | 140.0000                       | 7082.6000 (29a)                                      |
| Corridor wall                                                  | 3.8100                  | 2.1000                     | 1.7100                    | 0.1409                        | 0.2410       | 110.0000                       | 188.1000 (29a)                                       |
| Exposed ceiling                                                | 23.9000                 |                            | 23.9000                   | 0.1800                        | 4.3020       | 9.0000                         | 215.1000 (30)                                        |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 98.1100                   |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 41.3347      |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 42.3000                   | 0.0000                        | 0.0000       | 140.0000                       | 5922.0000 (32)                                       |
| Party Floor                                                    |                         |                            | 93.5000                   |                               |              | 80.0000                        | 7480.0000 (32d)                                      |
| Party Ceilings                                                 |                         |                            | 69.6000                   |                               |              | 80.0000                        | 5568.0000 (32b)                                      |
| Internal Wall                                                  |                         |                            | 79.7000                   |                               |              | 9.0000                         | 717.3000 (32c)                                       |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 27173.1000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 290.6214 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 16.8632 (36)                                         |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 58.1979 (37)                                         |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 21.7408 | 21.4689 | 21.1971 | 19.8378 | 19.5660 | 18.2067 | 18.2067 | 17.9349 | 18.7504 | 19.5660 | 20.1097 | 20.6534 (38) |
| Heat transfer coeff       | 79.9387 | 79.6669 | 79.3950 | 78.0358 | 77.7639 | 76.4046 | 76.4046 | 76.1328 | 76.9483 | 77.7639 | 78.3076 | 78.8513 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 77.9678 (39) |
| HLP                       | 0.8550  | 0.8521  | 0.8491  | 0.8346  | 0.8317  | 0.8172  | 0.8172  | 0.8143  | 0.8230  | 0.8317  | 0.8375  | 0.8433 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.8339 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |               |
|------------------------------------------|---------------|
| Assumed occupancy                        | 2.6707 (42)   |
| Average daily hot water use (litres/day) | 102.7665 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |                                          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|---------------------|----------|----------------|
| Energy conte                                                    | 113.0432 | 108.9325 | 104.8219 | 100.7112 | 96.6005  | 92.4899  | 92.4899  | 96.6005                                  | 100.7112 | 104.8219            | 108.9325 | 113.0432 (44)  |
| Energy content (annual)                                         | 167.6398 | 146.6188 | 151.2975 | 131.9048 | 126.5658 | 109.2167 | 101.2053 | 116.1346                                 | 117.5216 | 136.9601            | 149.5026 | 162.3502 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |                                          |          | Total = Sum (45)m = |          | 1616.9178 (45) |
|                                                                 | 25.1460  | 21.9928  | 22.6946  | 19.7857  | 18.9849  | 16.3825  | 15.1808  | 17.4202                                  | 17.6282  | 20.5440             | 22.4254  | 24.3525 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |                                          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |                                          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |                                          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |                                          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |                                          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |                                          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400                                  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |                                          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400                                  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |                                          |          |                     |          |                |
|                                                                 | 213.8422 | 188.3500 | 197.4999 | 176.6168 | 172.7682 | 153.9287 | 147.4077 | 162.3370                                 | 162.2336 | 183.1625            | 194.2146 | 208.5526 (62)  |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
|                                                                 |          |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |                     |          | 0.0000 (63)    |
| Output from w/h                                                 | 213.8422 | 188.3500 | 197.4999 | 176.6168 | 172.7682 | 153.9287 | 147.4077 | 162.3370                                 | 162.2336 | 183.1625            | 194.2146 | 208.5526 (64)  |
| Heat gains from water heating, kWh/month                        | 92.7021  | 82.1357  | 87.2683  | 79.6280  | 79.0451  | 72.0841  | 70.6127  | 75.5767                                  | 74.8455  | 82.5011             | 85.4792  | 90.9434 (65)   |
|                                                                 |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |                     |          | 2160.9138 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 21.8751   | 19.4292   | 15.8009   | 11.9623   | 8.9420    | 7.5492    | 8.1572    | 10.6030   | 14.2313   | 18.0699   | 21.0902   | 22.4830 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 245.3715  | 247.9177  | 241.5014  | 227.8418  | 210.5991  | 194.3933  | 183.5669  | 181.0207  | 187.4370  | 201.0966  | 218.3393  | 234.5451 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533 (69)   |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 (71) |
| Water heating gains (Table 5)                                                       |           |           |           |           |           |           |           |           |           |           |           |                |
|                                                                                     | 124.5997  | 122.2258  | 117.2962  | 110.5944  | 106.2434  | 100.1169  | 94.9095   | 101.5815  | 103.9521  | 110.8886  | 118.7211  | 122.2357 (72)  |
| Total internal gains                                                                | 454.9062  | 452.6327  | 437.6584  | 413.4585  | 388.8443  | 365.1193  | 349.6935  | 356.2651  | 368.6804  | 393.1150  | 421.2107  | 442.3237 (73)  |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|----------|------------------------------|---------------|
| Southwest   |          |          |          | 8.4000     | 36.7938                        | 0.3700                            | 0.8900                             |          |          |          | 0.7700                       | 70.5309 (79)  |
| Southeast   |          |          |          | 7.6100     | 36.7938                        | 0.5600                            | 0.6800                             |          |          |          | 0.7700                       | 73.8907 (77)  |
| Southwest   |          |          |          | 3.8000     | 36.7938                        | 0.5600                            | 0.6800                             |          |          |          | 0.7700                       | 36.8968 (79)  |
| -----       |          |          |          |            |                                |                                   |                                    |          |          |          |                              |               |
| Solar gains | 181.3184 | 308.8523 | 422.5852 | 523.6036   | 586.4796                       | 582.2385                          | 561.3401                           | 514.4317 | 457.5704 | 341.3476 | 217.1777                     | 155.1708 (83) |
| Total gains | 636.2246 | 761.4850 | 860.2436 | 937.0620   | 975.3239                       | 947.3578                          | 911.0335                           | 870.6968 | 826.2508 | 734.4626 | 638.3883                     | 597.4945 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 94.4234 | 94.7456 | 95.0700 | 96.7260 | 97.0641 | 98.7909 | 98.7909 | 99.1437 | 98.0929 | 97.0641 | 96.3902 | 95.7255      |
| alpha                                                                       | 7.2949  | 7.3164  | 7.3380  | 7.4484  | 7.4709  | 7.5861  | 7.5861  | 7.6096  | 7.5395  | 7.4709  | 7.4260  | 7.3817       |
| util living area                                                            | 0.9976  | 0.9909  | 0.9673  | 0.8850  | 0.7192  | 0.5145  | 0.3689  | 0.4020  | 0.6342  | 0.9198  | 0.9920  | 0.9985 (86)  |
| MIT                                                                         | 20.3455 | 20.5062 | 20.7015 | 20.8922 | 20.9796 | 20.9985 | 20.9999 | 20.9998 | 20.9935 | 20.8751 | 20.5733 | 20.3181 (87) |
| Th 2                                                                        | 20.2060 | 20.2084 | 20.2109 | 20.2234 | 20.2259 | 20.2385 | 20.2385 | 20.2410 | 20.2335 | 20.2259 | 20.2209 | 20.2159 (88) |
| util rest of house                                                          | 0.9968  | 0.9878  | 0.9566  | 0.8542  | 0.6671  | 0.4541  | 0.3051  | 0.3358  | 0.5676  | 0.8902  | 0.9887  | 0.9979 (89)  |
| MIT 2                                                                       | 19.3335 | 19.5683 | 19.8469 | 20.1091 | 20.2090 | 20.2377 | 20.2385 | 20.2409 | 20.2293 | 20.0957 | 19.6769 | 19.3016 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 19.6788 | 19.8883 | 20.1385 | 20.3763 | 20.4719 | 20.4972 | 20.4982 | 20.4998 | 20.4901 | 20.3616 | 19.9827 | 19.6484 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.6788 | 19.8883 | 20.1385 | 20.3763 | 20.4719 | 20.4972 | 20.4982 | 20.4998 | 20.4901 | 20.3616 | 19.9827 | 19.6484 (93) |

#### 8. Space heating requirement

|                   |           |           |           |          |          |          |          |          |          |          |           |                |
|-------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
|                   | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec            |
| Utilisation       | 0.9960    | 0.9862    | 0.9555    | 0.8607   | 0.6841   | 0.4747   | 0.3269   | 0.3584   | 0.5902   | 0.8960   | 0.9875    | 0.9973 (94)    |
| Useful gains      | 633.7006  | 750.9716  | 821.9471  | 806.5502 | 667.2318 | 449.7343 | 297.8020 | 312.0508 | 487.6791 | 658.0583 | 630.3805  | 595.9060 (95)  |
| Ext temp.         | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000 (96)    |
| Heat loss rate W  | 1229.3618 | 1194.0717 | 1082.8279 | 895.5615 | 682.1370 | 450.5773 | 297.8435 | 312.1323 | 491.7041 | 759.1003 | 1008.8158 | 1218.1267 (97) |
| Month fracti      | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000 (97a)   |
| Space heating kWh | 443.1719  | 297.7632  | 194.0953  | 64.0882  | 11.0894  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 75.1752  | 272.4735  | 462.9322 (98)  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating 1820.7890 (98)  
Space heating per m2 (98) / (4) = 19.4737 (99)

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1820.7890 (98)   |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 879.4411 (307a)  |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 1032.3874 (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2160.9138 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 1043.7214 (310a) |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1225.2381 (310b) |
| Electricity used for heat distribution                                                  | 41.8079 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 191.9513 (330a)  |
| Total electricity for the above, kWh/year                                               | 191.9513 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 386.3202 (332)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415 (333)  |
| Total delivered energy for all uses                                                     | 4386.4180 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 519.7736           | 0.5190                        | 269.7625 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 2404.2870          | 0.2160                        | 519.3260 (368)           |
| Electrical energy for heat distribution                                                    | 41.8079            | 0.5190                        | 21.6983 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 810.7868 (373)           |
| Space and water heating                                                                    |                    |                               | 810.7868 (376)           |
| Pumps and fans                                                                             | 191.9513           | 0.5190                        | 99.6227 (378)            |
| Energy for lighting                                                                        | 386.3202           | 0.5190                        | 200.5002 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 917.5088 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 9.8100 (384)             |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 9.8100 ZC1  |
| Total Floor Area                                                                | TFA 93.5000 |
| Assumed number of occupants                                                     | N 2.6707    |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF 0.5190   |
| CO2 emissions from appliances, equation (L14)                                   | 15.5510 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 1.9582 ZC3  |
| Total CO2 emissions                                                             | 27.3193 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 27.3193 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 93.5000 (1b)              | x 2.5400 (2b)                   | = 237.4900 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 93.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 237.4900 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 3 * 10 = 30.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 30.0000 / (5) = 0.1263 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3763 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 1 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3481 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4438 | 0.4351 | 0.4264 | 0.3829 | 0.3742 | 0.3307 | 0.3307 | 0.3220 | 0.3481 | 0.3742 | 0.3916 | 0.4090 (22b) |
|                 | 0.5985 | 0.5947 | 0.5909 | 0.5733 | 0.5700 | 0.5547 | 0.5547 | 0.5518 | 0.5606 | 0.5700 | 0.5767 | 0.5836 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K              |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|----------------------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)                      |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 19.8100                   | 1.3258                        | 26.2633      |                                | (27)                       |
| External Wall 1                                                | 70.4000                 | 19.8100                    | 50.5900                   | 0.1800                        | 9.1062       |                                | (29a)                      |
| Corridor wall                                                  | 3.8100                  | 2.1000                     | 1.7100                    | 0.1800                        | 0.3078       |                                | (29a)                      |
| Exposed ceiling                                                | 23.9000                 |                            | 23.9000                   | 0.1300                        | 3.1070       |                                | (30)                       |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 98.1100                   |                               |              |                                | (31)                       |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 41.3043      |                                | (33)                       |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35)              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 14.5507 (36)               |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 55.8550 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec           |
|---------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|----------|----------|---------------|
| (38)m                     | 46.9047  | 46.6049  | 46.3111  | 44.9312  | 44.6730  | 43.4711 | 43.4711 | 43.2485 | 43.9341 | 44.6730  | 45.1953  | 45.7413 (38)  |
| Heat transfer coeff       | 102.7596 | 102.4599 | 102.1661 | 100.7861 | 100.5280 | 99.3261 | 99.3261 | 99.1035 | 99.7890 | 100.5280 | 101.0503 | 101.5963 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |         |         |         |         |          |          | 100.7849 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.0990 | 1.0958 | 1.0927 | 1.0779 | 1.0752 | 1.0623 | 1.0623 | 1.0599 | 1.0673 | 1.0752 | 1.0808 | 1.0866 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.0779 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

| Assumed occupancy                                           |          |          |          |          |          |          |         |          |          |          |          | 2.6707 (42)                       |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|----------|-----------------------------------|
| Average daily hot water use (litres/day)                    |          |          |          |          |          |          |         |          |          |          |          | 97.6282 (43)                      |
|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov      | Dec                               |
| Daily hot water use                                         | 107.3910 | 103.4859 | 99.5808  | 95.6756  | 91.7705  | 87.8654  | 87.8654 | 91.7705  | 95.6756  | 99.5808  | 103.4859 | 107.3910 (44)                     |
| Energy conte                                                | 159.2578 | 139.2879 | 143.7326 | 125.3096 | 120.2375 | 103.7558 | 96.1450 | 110.3278 | 111.6455 | 130.1121 | 142.0275 | 154.2327 (45)                     |
| Energy content (annual)                                     |          |          |          |          |          |          |         |          |          |          |          | Total = Sum(45)m = 1536.0719 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 23.8887  | 20.8932  | 21.5599  | 18.7964  | 18.0356  | 15.5634  | 14.4218 | 16.5492  | 16.7468  | 19.5168  | 21.3041  | 23.1349 (46)                      |
| Water storage loss:                                         |          |          |          |          |          |          |         |          |          |          |          |                                   |
| Store volume                                                |          |          |          |          |          |          |         |          |          |          |          | 2.0000 (47)                       |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |          |         |          |          |          |          | 0.2388 (48)                       |
| Temperature factor from Table 2b                            |          |          |          |          |          |          |         |          |          |          |          | 0.5400 (49)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |          |         |          |          |          |          | 0.1290 (55)                       |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 186.5179 | 163.9100 | 170.9928 | 151.6904 | 147.4977 | 130.1366 | 123.4052 | 137.5880 | 138.0263 | 157.3722 | 168.4083 | 181.4928 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 186.5179 | 163.9100 | 170.9928 | 151.6904 | 147.4977 | 130.1366 | 123.4052 | 137.5880 | 138.0263 | 157.3722 | 168.4083 | 181.4928 (64) |
| Heat gains from water heating, kWh/month                        | 74.7613  | 66.0109  | 69.5992  | 62.7701  | 61.7871  | 55.6034  | 53.7763  | 58.4921  | 58.2268  | 65.0704  | 68.3288  | 73.0905 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |      |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       |      |
| (66)m                                                                               | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | 133.5331  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 21.9221   | 19.4710   | 15.8349   | 11.9880   | 8.9612    | 7.5654    | 8.1747    | 10.6258   | 14.2619   | 18.1087   | 21.1356   | 22.5313   | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 245.3715  | 247.9177  | 241.5014  | 227.8418  | 210.5991  | 194.3933  | 183.5669  | 181.0207  | 187.4370  | 201.0966  | 218.3393  | 234.5451  | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | 36.3533   | (69) |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | -106.8265 | (71) |
| Water heating gains (Table 5)                                                       | 100.4857  | 98.2305   | 93.5473   | 87.1806   | 83.0472   | 77.2270   | 72.2800   | 78.6184   | 80.8705   | 87.4602   | 94.9011   | 98.2399   | (72) |
| Total internal gains                                                                | 433.8392  | 431.6791  | 416.9435  | 393.0704  | 368.6674  | 345.2457  | 330.0815  | 336.3248  | 348.6293  | 372.7254  | 400.4359  | 421.3763  | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |           | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|----------|----------|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|
| Southeast   |          |          |          |           | 7.6100     | 36.7938                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 85.5720       |
| Southwest   |          |          |          |           | 12.2000    | 36.7938                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       | 137.1850 (77) |
|             |          |          |          |           |            |                                |                                   |                                    |          |          |                              |               |
| Solar gains | 222.7570 | 379.4376 | 519.1630 | 643.2681  | 720.5139   | 715.3035                       | 689.6289                          | 632.0001                           | 562.1437 | 419.3593 | 266.8115                     | 190.6336 (83) |
| Total gains | 656.5962 | 811.1167 | 936.1065 | 1036.3386 | 1089.1813  | 1060.5492                      | 1019.7105                         | 968.3250                           | 910.7731 | 792.0848 | 667.2474                     | 612.0098 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec     |              |
| tau                                                                         | 63.1868 | 63.3717 | 63.5539 | 64.4241 | 64.5896 | 65.3711 | 65.3711 | 65.5179 | 65.0678                   | 64.5896 | 64.2557 | 63.9104 |              |
| alpha                                                                       | 5.2125  | 5.2248  | 5.2369  | 5.2949  | 5.3060  | 5.3581  | 5.3581  | 5.3679  | 5.3379                    | 5.3060  | 5.2837  | 5.2607  |              |
| util living area                                                            | 0.9959  | 0.9874  | 0.9647  | 0.9010  | 0.7709  | 0.5833  | 0.4260  | 0.4664  | 0.7061                    | 0.9327  | 0.9896  | 0.9971  | (86)         |
| MIT                                                                         | 19.9231 | 20.1390 | 20.4130 | 20.7092 | 20.9030 | 20.9826 | 20.9973 | 20.9956 | 20.9536                   | 20.6877 | 20.2429 | 19.8857 | (87)         |
| Th 2                                                                        | 20.0016 | 20.0042 | 20.0068 | 20.0189 | 20.0212 | 20.0317 | 20.0317 | 20.0337 | 20.0277                   | 20.0212 | 20.0166 | 20.0118 | (88)         |
| util rest of house                                                          | 0.9945  | 0.9834  | 0.9537  | 0.8721  | 0.7138  | 0.5019  | 0.3336  | 0.3707  | 0.6252                    | 0.9062  | 0.9857  | 0.9961  | (89)         |
| MIT 2                                                                       | 18.5753 | 18.8900 | 19.2826 | 19.6957 | 19.9332 | 20.0210 | 20.0308 | 20.0320 | 19.9946                   | 19.6792 | 19.0518 | 18.5282 | (90)         |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3412  | (91)         |
| MIT                                                                         | 19.0351 | 19.3161 | 19.6683 | 20.0414 | 20.2641 | 20.3491 | 20.3605 | 20.3608 | 20.3218                   | 20.0233 | 19.4582 | 18.9914 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000  |              |
| adjusted MIT                                                                | 19.0351 | 19.3161 | 19.6683 | 20.0414 | 20.2641 | 20.3491 | 20.3605 | 20.3608 | 20.3218                   | 20.0233 | 19.4582 | 18.9914 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |              |           |           |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|--------------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov       | Dec       |       |
| Useful gains         | 651.7952  | 794.7654  | 888.5331  | 904.5792  | 793.9135 | 561.2855 | 372.4262 | 390.6888 | 592.8344 | 717.8486     | 655.6950  | 608.7824  | (94)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.0000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000    | 4.2000    | (96)  |
| Heat loss rate W     | 1514.1781 | 1477.0764 | 1345.3491 | 1122.9037 | 860.9273 | 571.0316 | 373.5175 | 392.5274 | 620.8659 | 947.3010     | 1248.7950 | 1502.7473 | (97)  |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000    | 1.0000    | (97a) |
| Space heating kWh    | 641.6129  | 458.5130  | 339.8711  | 157.1936  | 49.8582  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 170.7126     | 427.0320  | 665.1099  | (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |              |           | 2909.9033 | (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          | (98) / (4) = |           | 31.1220   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 3112.1961 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 641.6129 | 458.5130 | 339.8711 | 157.1936 | 49.8582  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 170.7126 | 427.0320 | 665.1099  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 686.2170 | 490.3882 | 363.4985 | 168.1215 | 53.3243  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 182.5804 | 456.7187 | 711.3475  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 186.5179 | 163.9100 | 170.9928 | 151.6904 | 147.4977 | 130.1366 | 123.4052 | 137.5880 | 138.0263 | 157.3722 | 168.4083 | 181.4928  | (64)            |
| Efficiency of water heater (217)m                                     | 87.8470  | 87.4134  | 86.6128  | 84.9089  | 82.2569  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.0311  | 87.1933  | 79.8000   | (216)           |
| Fuel for water heating, kWh/month                                     | 212.3212 | 187.5112 | 197.4220 | 178.6507 | 179.3133 | 163.0785 | 154.6431 | 172.4160 | 172.9653 | 185.0761 | 193.1435 | 206.3092  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2202.8502 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3112.1961 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 387.1505  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5777.1968 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 3112.1961          | 0.2160                        | 672.2343 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2202.8502          | 0.2160                        | 475.8156 (264)           |
| Space and water heating                                                                           |                    |                               | 1148.0500 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 387.1505           | 0.5190                        | 200.9311 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1387.9061 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 12.2786 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.1490 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.4163 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (12.2786 * 1.00) + 2.1490 + 0.4163, rounded to 2 d.p. |                    |                               | 14.8400 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-3-01                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP-1-2                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 85 B                                                                    | DER           | 12.52   | TER            | 18.55      |
| Environmental                      | 91 B                                                                    | % DER<TER     | 32.52   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.68                                                                    | DFEE          | 51.87   | TFEE           | 55.41      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 6.38    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 71 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 18.55 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.52 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 55.4 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 51.9 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.18 (max. 0.20) | 0.18 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK  
Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing North East: 1.92 m<sup>2</sup>, No overhang  
Windows facing North West: 16.01 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 71.2000 (1b)              | x 2.4000 (2b)                   | = 170.8800 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 71.2000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 170.8800 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
|                                                                                              |                              |        |           |        |        |        | Air changes per hour        |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes         |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000      |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 (18) |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 2 (19)      |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
|                                                                                              | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind speed                                                                                   | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2631                       | 0.2599 | 0.2567    | 0.2408 | 0.2376 | 0.2216 | 0.2216                      | 0.2184      | 0.2280 | 0.2376 | 0.2439 | 0.2503 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K                         | K-value<br>kJ/m2K | A x K<br>kJ/K   |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------------|------------------|--------------------------------------|-------------------|-----------------|----------------|----------------|----------------|----------------|---------------------|
| W10 (Uw = 1.40)                                                     |                |                | 1.9200               | 1.3258           | 2.5455                               |                   | (27)            |                |                |                |                |                     |
| W03 (Uw = 1.40)                                                     |                |                | 8.4000               | 1.3258           | 11.1364                              |                   | (27)            |                |                |                |                |                     |
| W02 (Uw = 1.40)                                                     |                |                | 7.6100               | 1.3258           | 10.0890                              |                   | (27)            |                |                |                |                |                     |
| door                                                                |                |                | 2.1000               | 1.4000           | 2.9400                               |                   | (26a)           |                |                |                |                |                     |
| External Wall 1                                                     | 53.7400        | 17.9300        | 35.8100              | 0.1500           | 5.3715                               | 140.0000          | 5013.4000 (29a) |                |                |                |                |                     |
| Corridor wall                                                       | 7.8000         | 2.1000         | 5.7000               | 0.1409           | 0.8032                               | 110.0000          | 627.0000 (29a)  |                |                |                |                |                     |
| Exposed ceiling                                                     | 35.8000        |                | 35.8000              | 0.1800           | 6.4440                               | 9.0000            | 322.2000 (30)   |                |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 97.3400              |                  |                                      |                   | (31)            |                |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26)...(30) + (32) = | 39.3295          |                                      |                   | (33)            |                |                |                |                |                     |
| Party Wall 1                                                        |                |                | 39.3000              | 0.0000           | 0.0000                               | 140.0000          | 5502.0000 (32)  |                |                |                |                |                     |
| Party Floor                                                         |                |                | 71.2000              |                  |                                      | 80.0000           | 5696.0000 (32d) |                |                |                |                |                     |
| Party Ceilings                                                      |                |                | 35.4000              |                  |                                      | 80.0000           | 2832.0000 (32b) |                |                |                |                |                     |
| Internal Wall                                                       |                |                | 123.8000             |                  |                                      | 9.0000            | 1114.2000 (32c) |                |                |                |                |                     |
| Heat capacity Cm = Sum(A x k)                                       |                |                |                      |                  | (28)...(30) + (32) + (32a)...(32e) = |                   | 21106.8000 (34) |                |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                      |                  |                                      |                   | 296.4438 (35)   |                |                |                |                |                     |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                      |                  |                                      |                   | 15.4420 (36)    |                |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                      |                  |                                      | (33) + (36) =     | 54.7715 (37)    |                |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                      |                  |                                      |                   |                 |                |                |                |                |                     |
| (38)m                                                               | Jan<br>14.8342 | Feb<br>14.6545 | Mar<br>14.4747       | Apr<br>13.5760   | May<br>13.3962                       | Jun<br>12.4975    | Jul<br>12.4975  | Aug<br>12.3178 | Sep<br>12.8570 | Oct<br>13.3962 | Nov<br>13.7557 | Dec<br>14.1152 (38) |
| Heat transfer coeff                                                 | 69.6057        | 69.4260        | 69.2462              | 68.3475          | 68.1678                              | 67.2690           | 67.2690         | 67.0893        | 67.6285        | 68.1678        | 68.5273        | 68.8867 (39)        |
| Average = Sum(39)m / 12 =                                           |                |                |                      |                  |                                      |                   |                 |                |                |                |                | 68.3026 (39)        |
| HLP                                                                 | Jan<br>0.9776  | Feb<br>0.9751  | Mar<br>0.9726        | Apr<br>0.9599    | May<br>0.9574                        | Jun<br>0.9448     | Jul<br>0.9448   | Aug<br>0.9423  | Sep<br>0.9498  | Oct<br>0.9574  | Nov<br>0.9625  | Dec<br>0.9675 (40)  |
| HLP (average)                                                       |                |                |                      |                  |                                      |                   |                 |                |                |                |                | 0.9593 (40)         |
| Days in month                                                       | 31             | 28             | 31                   | 30               | 31                                   | 30                | 31              | 31             | 30             | 31             | 30             | 31 (41)             |

#### 4. Water heating energy requirements (kWh/year)

|                                          |     |     |     |     |     |     |     |     |     |     |     |
|------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                                          |     |     |     |     |     |     |     |     |     |     |     |
| Assumed occupancy                        |     |     |     |     |     |     |     |     |     |     |     |
| 2.2749 (42)                              |     |     |     |     |     |     |     |     |     |     |     |
| Average daily hot water use (litres/day) |     |     |     |     |     |     |     |     |     |     |     |
| 92.8725 (43)                             |     |     |     |     |     |     |     |     |     |     |     |
| Jan                                      | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Daily hot water use                                             | 102.1598 | 98.4449  | 94.7300  | 91.0151  | 87.3002  | 83.5853  | 83.5853  | 87.3002  | 91.0151  | 94.7300  | 98.4449  | 102.1598 (44) |
| Energy conte                                                    | 151.5000 | 132.5029 | 136.7311 | 119.2055 | 114.3805 | 98.7017  | 91.4616  | 104.9536 | 106.2070 | 123.7741 | 135.1091 | 146.7197 (45) |
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          |          |          |               |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 22.7250  | 19.8754  | 20.5097  | 17.8808  | 17.1571  | 14.8053  | 13.7192  | 15.7430  | 15.9311  | 18.5661  | 20.2664  | 22.0080 (46)  |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |               |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)   |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)   |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (56)  |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (57)  |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 197.7024 | 174.2341 | 182.9335 | 163.9175 | 160.5829 | 143.4137 | 137.6640 | 151.1560 | 150.9190 | 169.9765 | 179.8211 | 192.9221 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 197.7024 | 174.2341 | 182.9335 | 163.9175 | 160.5829 | 143.4137 | 137.6640 | 151.1560 | 150.9190 | 169.9765 | 179.8211 | 192.9221 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 87.3357  | 77.4422  | 82.4250  | 75.4054  | 74.9934  | 68.5879  | 67.3729  | 71.8590  | 71.0834  | 78.1168  | 80.6934  | 85.7462 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 17.8374  | 15.8430  | 12.8844  | 9.7543   | 7.2915   | 6.1558   | 6.6515   | 8.6459   | 11.6045  | 14.7346  | 17.1975  | 18.3332 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 200.0814 | 202.1576 | 196.9256 | 185.7873 | 171.7272 | 158.5126 | 149.6845 | 147.6083 | 152.8403 | 163.9786 | 178.0388 | 191.2533 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 117.3867 | 115.2413 | 110.7863 | 104.7298 | 100.7976 | 95.2610  | 90.5550  | 96.5846  | 98.7270  | 104.9957 | 112.0741 | 115.2503 (72) |
| Total internal gains                                                                |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 392.4290 | 390.3655 | 377.7199 | 357.3949 | 336.9398 | 317.0529 | 304.0146 | 309.9624 | 320.2954 | 340.8325 | 364.4339 | 381.9603 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |  | Gains<br>W    |
|-------------|----------|----------|----------|------------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|--|---------------|
|             |          |          |          |            |                                |          |                                   |          |                                    |          |                              |  |               |
| Northeast   |          |          |          | 1.9200     | 11.2829                        |          | 0.3700                            |          | 0.6500                             |          | 0.7700                       |  | 3.6105 (75)   |
| Northwest   |          |          |          | 8.4000     | 11.2829                        |          | 0.3700                            |          | 0.8900                             |          | 0.7700                       |  | 21.6285 (81)  |
| Northwest   |          |          |          | 7.6100     | 11.2829                        |          | 0.5600                            |          | 0.6800                             |          | 0.7700                       |  | 22.6588 (81)  |
|             |          |          |          |            |                                |          |                                   |          |                                    |          |                              |  |               |
| Solar gains | 47.8979  | 97.4975  | 175.6594 | 288.4833   | 387.7781                       | 413.4125 | 386.7389                          | 308.3128 | 214.0438                           | 119.1496 | 60.2679                      |  | 39.1158 (83)  |
| Total gains | 440.3269 | 487.8630 | 553.3793 | 645.8782   | 724.7180                       | 730.4655 | 690.7535                          | 618.2752 | 534.3391                           | 459.9821 | 424.7018                     |  | 421.0761 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 84.2316 | 84.4497 | 84.6689 | 85.7822 | 86.0084 | 87.1575 | 87.1575 | 87.3910 | 86.6942 | 86.0084 | 85.5572 | 85.1107      |
| alpha                                                                       | 6.6154  | 6.6300  | 6.6446  | 6.7188  | 6.7339  | 6.8105  | 6.8105  | 6.8261  | 6.7796  | 6.7339  | 6.7038  | 6.6740       |
| util living area                                                            | 0.9990  | 0.9977  | 0.9913  | 0.9511  | 0.8057  | 0.5827  | 0.4277  | 0.4970  | 0.8055  | 0.9802  | 0.9975  | 0.9993 (86)  |
| MIT                                                                         | 20.1456 | 20.2535 | 20.4609 | 20.7478 | 20.9407 | 20.9942 | 20.9994 | 20.9984 | 20.9570 | 20.6938 | 20.3730 | 20.1276 (87) |
| Th 2                                                                        | 20.1020 | 20.1041 | 20.1063 | 20.1169 | 20.1190 | 20.1296 | 20.1296 | 20.1317 | 20.1253 | 20.1190 | 20.1147 | 20.1105 (88) |
| util rest of house                                                          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 0.9986  | 0.9968  | 0.9878  | 0.9321  | 0.7509  | 0.5067  | 0.3436  | 0.4044  | 0.7298  | 0.9691  | 0.9964  | 0.9990 (89)  |
| MIT 2                                                                       | 18.9586 | 19.1178 | 19.4206 | 19.8309 | 20.0674 | 20.1264 | 20.1294 | 20.1312 | 20.0948 | 19.7661 | 19.3009 | 18.9388 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | 19.3837 | 19.5245 | 19.7932 | 20.1593 | 20.3801 | 20.4372 | 20.4410 | 20.4418 | 20.4036 | 20.0983 | 19.6849 | 19.3646 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.3837 | 19.5245 | 19.7932 | 20.1593 | 20.3801 | 20.4372 | 20.4410 | 20.4418 | 20.4036 | 20.0983 | 19.6849 | 19.3646 (93) |

#### 8. Space heating requirement

|                   |           |           |          |          |          |          |          |          |          |          |          |                |
|-------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation       | 0.9981    | 0.9960    | 0.9862   | 0.9332   | 0.7681   | 0.5339   | 0.3738   | 0.4377   | 0.7557   | 0.9688   | 0.9956   | 0.9986 (94)    |
| Useful gains      | 439.5108  | 485.8899  | 545.7179 | 602.7303 | 556.6845 | 389.9908 | 258.1795 | 270.6102 | 403.7799 | 445.6392 | 422.8262 | 420.4912 (95)  |
| Ext temp.         | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Heat loss rate W  |           |           |          |          |          |          |          |          |          |          |          |                |
|                   | 1049.9127 | 1015.3225 | 920.5031 | 769.5455 | 591.7047 | 392.6608 | 258.3792 | 271.1595 | 426.3039 | 647.4804 | 862.4095 | 1044.6388 (97) |
| Month fracti      | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating kWh |           |           |          |          |          |          |          |          |          |          |          |                |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                      |          |          |          |          |         |        |        |        |        |          |              |                |
|----------------------|----------|----------|----------|----------|---------|--------|--------|--------|--------|----------|--------------|----------------|
|                      | 454.1390 | 355.7787 | 278.8402 | 120.1070 | 26.0550 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 150.1699 | 316.5000     | 464.3658 (98)  |
| Space heating        |          |          |          |          |         |        |        |        |        |          |              | 2165.9555 (98) |
| Space heating per m2 |          |          |          |          |         |        |        |        |        |          | (98) / (4) = | 30.4207 (99)   |

-----  
8c. Space cooling requirement  
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Not applicable

-----  
9b. Energy requirements  
-----

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 2165.9555 (98)   |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 1046.1565 (307a) |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 1228.0968 (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2005.2428 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 968.5323 (310a)  |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1136.9727 (310b) |
| Electricity used for heat distribution                                                  | 43.7976 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 138.1138 (330a)  |
| Total electricity for the above, kWh/year                                               | 138.1138 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 315.0141 (332)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415        |
| Total delivered energy for all uses                                                     | 4460.2446 (338)  |

-----  
12b. Carbon dioxide emissions - Community heating scheme  
-----

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 544.5105           | 0.5190                        | 282.6009 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 2518.7108          | 0.2160                        | 544.0415 (368)           |
| Electrical energy for heat distribution                                                    | 43.7976            | 0.5190                        | 22.7309 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 849.3734 (373)           |
| Space and water heating                                                                    |                    |                               | 849.3734 (376)           |
| Pumps and fans                                                                             | 138.1138           | 0.5190                        | 71.6810 (378)            |
| Energy for lighting                                                                        | 315.0141           | 0.5190                        | 163.4923 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 891.1459 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.5200 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 12.5200 ZC1 |
| Total Floor Area                                                                | TFA 71.2000 |
| Assumed number of occupants                                                     | N 2.2749    |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF 0.5190   |
| CO2 emissions from appliances, equation (L14)                                   | 16.6523 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.4382 ZC3  |
| Total CO2 emissions                                                             | 31.6104 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 31.6104 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 71.2000 (1b)              | x 2.4000 (2b)                   | = 170.8800 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 71.2000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 170.8800 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m3 per hour                |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 3 * 10 = 30.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour       |
| Pressure test                                                             |                 |                      |       |                             | 30.0000 / (5) = 0.1756 (8) |
| Measured/design AP50                                                      |                 |                      |       |                             | Yes                        |
| Infiltration rate                                                         |                 |                      |       |                             | 5.0000                     |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0.4256 (18)                |
|                                                                           |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3617 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4612 | 0.4522 | 0.4431 | 0.3979 | 0.3889 | 0.3436 | 0.3436 | 0.3346 | 0.3617 | 0.3889 | 0.4069 | 0.4250 (22b) |
| Effective ac    | 0.6064 | 0.6022 | 0.5982 | 0.5792 | 0.5756 | 0.5590 | 0.5590 | 0.5560 | 0.5654 | 0.5756 | 0.5828 | 0.5903 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 15.7000                   | 1.3258                        | 20.8144      |                                | (27)          |
| External Wall 1                                                | 53.7400                 | 15.7000                    | 38.0400                   | 0.1800                        | 6.8472       |                                | (29a)         |
| Corridor wall                                                  | 7.8000                  | 2.1000                     | 5.7000                    | 0.1800                        | 1.0260       |                                | (29a)         |
| Exposed ceiling                                                | 35.8000                 |                            | 35.8000                   | 0.1300                        | 4.6540       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 97.3400                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 35.8616      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 13.5745 (36)  |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 49.4361 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 34.1925 | 33.9597 | 33.7314 | 32.6592 | 32.4586 | 31.5247 | 31.5247 | 31.3518 | 31.8845 | 32.4586 | 32.8644 | 33.2887 (38) |
| Heat transfer coeff       | 83.6286 | 83.3957 | 83.1675 | 82.0953 | 81.8947 | 80.9608 | 80.9608 | 80.7879 | 81.3205 | 81.8947 | 82.3005 | 82.7248 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 82.0943 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.1746 | 1.1713 | 1.1681 | 1.1530 | 1.1502 | 1.1371 | 1.1371 | 1.1347 | 1.1421 | 1.1502 | 1.1559 | 1.1619 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.1530 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |          |          |          |                                   |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|----------|----------|----------|-----------------------------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |          |          |          | 2.2749 (42)                       |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |          |          |          | 88.2289 (43)                      |
| Daily hot water use                                         | 97.0518  | 93.5227  | 89.9935  | 86.4643  | 82.9352  | 79.4060 | 79.4060 | 82.9352 | 86.4643  | 89.9935  | 93.5227  | 97.0518 (44)                      |
| Energy conte                                                | 143.9250 | 125.8778 | 129.8946 | 113.2452 | 108.6615 | 93.7666 | 86.8885 | 99.7059 | 100.8967 | 117.5854 | 128.3536 | 139.3837 (45)                     |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |          |          |          | Total = Sum(45)m = 1388.1845 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 21.5888  | 18.8817  | 19.4842  | 16.9868  | 16.2992  | 14.0650 | 13.0333 | 14.9559 | 15.1345  | 17.6378  | 19.2530  | 20.9076 (46)                      |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |          |          |          |                                   |
| Store volume                                                |          |          |          |          |          |         |         |         |          |          |          | 2.0000 (47)                       |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |          |          |          | 0.2388 (48)                       |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |          |          |          | 0.5400 (49)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |          |          |          | 0.1290 (55)                       |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 171.1852 | 150.4998 | 157.1547 | 139.6260 | 135.9216 | 120.1474 | 114.1487 | 126.9660 | 127.2775 | 144.8455 | 154.7344 | 166.6439 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 171.1852 | 150.4998 | 157.1547 | 139.6260 | 135.9216 | 120.1474 | 114.1487 | 126.9660 | 127.2775 | 144.8455 | 154.7344 | 166.6439 (64) |
| Heat gains from water heating, kWh/month                        | 69.6632  | 61.5520  | 64.9981  | 58.7587  | 57.9381  | 52.2820  | 50.6986  | 54.9603  | 54.6528  | 60.9052  | 63.7822  | 68.1532 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.8423  | 15.8474  | 12.8879  | 9.7570   | 7.2935   | 6.1575   | 6.6533   | 8.6483   | 11.6077  | 14.7386  | 17.2022  | 18.3382 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 200.0814 | 202.1576 | 196.9256 | 185.7873 | 171.7272 | 158.5126 | 149.6845 | 147.6083 | 152.8403 | 163.9786 | 178.0388 | 191.2533 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 (71) |
| Water heating gains (Table 5)                                                       | 93.6333  | 91.5952  | 87.3630  | 81.6093  | 77.8737  | 72.6139  | 68.1432  | 73.8714  | 75.9066  | 81.8619  | 88.5864  | 91.6038 (72)  |
| Total internal gains                                                                | 371.6805 | 369.7238 | 357.3001 | 337.2771 | 317.0179 | 297.4076 | 284.6046 | 290.2515 | 300.4782 | 320.7027 | 343.9508 | 361.3188 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| Northeast   |          |          |          |          | 1.6800     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 5.7930 (75)  |               |
| Northwest   |          |          |          |          | 14.0200    | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 48.3440 (81) |               |
|             |          |          |          |          |            |                                |                                   |                                    |                              |          |              |               |
| Solar gains | 54.1370  | 110.1973 | 198.5405 | 326.0606 | 438.2894   | 467.2629                       | 437.1149                          | 348.4731                           | 241.9248                     | 134.6699 | 68.1183      | 44.2110 (83)  |
| Total gains | 425.8175 | 479.9211 | 555.8406 | 663.3377 | 755.3074   | 764.6705                       | 721.7195                          | 638.7246                           | 542.4029                     | 455.3726 | 412.0691     | 405.5297 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |                           |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |                           |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct                       | Nov     | Dec          |
| tau                                                                         | 59.1238 | 59.2889 | 59.4517 | 60.2281 | 60.3756 | 61.0720 | 61.0720 | 61.2028 | 60.8019 | 60.3756                   | 60.0779 | 59.7698      |
| alpha                                                                       | 4.9416  | 4.9526  | 4.9634  | 5.0152  | 5.0250  | 5.0715  | 5.0715  | 5.0802  | 5.0535  | 5.0250                    | 5.0052  | 4.9847       |
| util living area                                                            | 0.9980  | 0.9961  | 0.9883  | 0.9519  | 0.8375  | 0.6441  | 0.4865  | 0.5657  | 0.8486  | 0.9795                    | 0.9961  | 0.9985 (86)  |
| MIT                                                                         | 19.7241 | 19.8639 | 20.1368 | 20.5229 | 20.8298 | 20.9661 | 20.9933 | 20.9864 | 20.8668 | 20.4649                   | 20.0335 | 19.7037 (87) |
| Th 2                                                                        | 19.9404 | 19.9430 | 19.9456 | 19.9578 | 19.9600 | 19.9707 | 19.9707 | 19.9726 | 19.9666 | 19.9600                   | 19.9554 | 19.9506 (88) |
| util rest of house                                                          | 0.9974  | 0.9947  | 0.9841  | 0.9342  | 0.7849  | 0.5542  | 0.3764  | 0.4475  | 0.7770  | 0.9690                    | 0.9945  | 0.9980 (89)  |
| MIT 2                                                                       | 18.2415 | 18.4474 | 18.8456 | 19.4015 | 19.7985 | 19.9492 | 19.9683 | 19.9672 | 19.8590 | 19.3317                   | 18.7045 | 18.2190 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         | 0.3581 (91)  |
| MIT                                                                         | 18.7725 | 18.9547 | 19.3081 | 19.8031 | 20.1679 | 20.3134 | 20.3354 | 20.3322 | 20.2199 | 19.7375                   | 19.1805 | 18.7507 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |                           |         | 0.0000       |
| adjusted MIT                                                                | 18.7725 | 18.9547 | 19.3081 | 19.8031 | 20.1679 | 20.3134 | 20.3354 | 20.3322 | 20.2199 | 19.7375                   | 19.1805 | 18.7507 (93) |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|                      | 0.9963    | 0.9929    | 0.9807    | 0.9310   | 0.7965   | 0.5853   | 0.4161   | 0.4901   | 0.7969   | 0.9660       | 0.9928   | 0.9971 (94)    |
| Useful gains         | 424.2329  | 476.5016  | 545.0880  | 617.5752 | 601.5932 | 447.5745 | 300.2753 | 313.0120 | 432.2517 | 439.9051     | 409.1169 | 404.3412 (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 1210.3168 | 1172.1049 | 1065.2150 | 895.0937 | 693.4728 | 462.5635 | 302.4191 | 317.6734 | 497.6762 | 748.3153     | 994.2308 | 1203.7058 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 584.8464  | 467.4454  | 386.9745  | 199.8133 | 68.3585  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 229.4572     | 421.2820 | 594.7272 (98)  |
| Space heating        |           |           |           |          |          |          |          |          |          |              |          | 2952.9046 (98) |
| Space heating per m2 |           |           |           |          |          |          |          |          |          | (98) / (4) = |          | 41.4734 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 3158.1868 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 584.8464 | 467.4454 | 386.9745 | 199.8133 | 68.3585  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 229.4572 | 421.2820 | 594.7272  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 625.5042 | 499.9416 | 413.8765 | 213.7041 | 73.1107  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 245.4088 | 450.5690 | 636.0719  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 171.1852 | 150.4998 | 157.1547 | 139.6260 | 135.9216 | 120.1474 | 114.1487 | 126.9660 | 127.2775 | 144.8455 | 154.7344 | 166.6439  | (64)            |
| Efficiency of water heater (217)m                                     | 87.8333  | 87.6381  | 87.1259  | 85.7694  | 83.0873  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 86.0358  | 87.3536  | 79.8000   | (216)           |
| Fuel for water heating, kWh/month                                     | 194.8977 | 171.7288 | 180.3765 | 162.7924 | 163.5890 | 150.5606 | 143.0435 | 159.1053 | 159.4956 | 168.3549 | 177.1357 | 189.5408  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2020.6208 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3158.1868 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 315.1004  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5568.9079 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 3158.1868          | 0.2160                        | 682.1683 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2020.6208          | 0.2160                        | 436.4541 (264)           |
| Space and water heating                                                                           |                    |                               | 1118.6224 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 315.1004           | 0.5190                        | 163.5371 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1321.0845 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 15.7110 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.2969 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5467 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (15.7110 * 1.00) + 2.2969 + 0.5467, rounded to 2 d.p. |                    |                               | 18.5500 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                      |          |               |         |                |            |
|----------------------|----------|---------------|---------|----------------|------------|
| Property Reference   | A-3-02   |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference | ASHP-1-2 | Prop Type Ref | 2bed 3F |                |            |
| Property             |          |               |         |                |            |

|                                    |      |             |       |      |       |
|------------------------------------|------|-------------|-------|------|-------|
| SAP Rating                         | 85 B | DER         | 12.52 | TER  | 18.55 |
| Environmental                      | 91 B | % DER<TER   | 32.52 |      |       |
| CO <sub>2</sub> Emissions (t/year) | 0.68 | DFEE        | 51.87 | TFEE | 55.41 |
| General Requirements Compliance    | Fail | % DFEE<TFEE | 6.38  |      |       |

|                  |                                                                         |             |           |
|------------------|-------------------------------------------------------------------------|-------------|-----------|
| Assessor Details | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com | Assessor ID | R479-0001 |
| Client           |                                                                         |             |           |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 71 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating:Mains gas (c), Electricity (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 18.55 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.52 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)55.4 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)51.9 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.18 (max. 0.20) | 0.18 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK  
Hot water controls: No cylinderstat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing North East: 1.92 m<sup>2</sup>, No overhang  
Windows facing North West: 16.01 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 71.2000 (1b)              | x 2.4000 (2b)                   | = 170.8800 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 71.2000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 170.8800 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
|                                                                                              |                              |        |           |        |        |        | Air changes per hour        |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes         |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000      |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 (18) |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 2 (19)      |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
|                                                                                              | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind speed                                                                                   | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2631                       | 0.2599 | 0.2567    | 0.2408 | 0.2376 | 0.2216 | 0.2216                      | 0.2184      | 0.2280 | 0.2376 | 0.2439 | 0.2503 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K                         | K-value<br>kJ/m2K | A x K<br>kJ/K   |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------------|------------------|--------------------------------------|-------------------|-----------------|----------------|----------------|----------------|----------------|---------------------|
| W10 (Uw = 1.40)                                                     |                |                | 1.9200               | 1.3258           | 2.5455                               |                   | (27)            |                |                |                |                |                     |
| W03 (Uw = 1.40)                                                     |                |                | 8.4000               | 1.3258           | 11.1364                              |                   | (27)            |                |                |                |                |                     |
| W02 (Uw = 1.40)                                                     |                |                | 7.6100               | 1.3258           | 10.0890                              |                   | (27)            |                |                |                |                |                     |
| door                                                                |                |                | 2.1000               | 1.4000           | 2.9400                               |                   | (26a)           |                |                |                |                |                     |
| External Wall 1                                                     | 53.7400        | 17.9300        | 35.8100              | 0.1500           | 5.3715                               | 140.0000          | 5013.4000 (29a) |                |                |                |                |                     |
| Corridor wall                                                       | 7.8000         | 2.1000         | 5.7000               | 0.1409           | 0.8032                               | 110.0000          | 627.0000 (29a)  |                |                |                |                |                     |
| Exposed ceiling                                                     | 35.8000        |                | 35.8000              | 0.1800           | 6.4440                               | 9.0000            | 322.2000 (30)   |                |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 97.3400              |                  |                                      |                   | (31)            |                |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26)...(30) + (32) = | 39.3295          |                                      |                   | (33)            |                |                |                |                |                     |
| Party Wall 1                                                        |                |                | 39.3000              | 0.0000           | 0.0000                               | 140.0000          | 5502.0000 (32)  |                |                |                |                |                     |
| Party Floor                                                         |                |                | 71.2000              |                  |                                      | 80.0000           | 5696.0000 (32d) |                |                |                |                |                     |
| Party Ceilings                                                      |                |                | 35.4000              |                  |                                      | 80.0000           | 2832.0000 (32b) |                |                |                |                |                     |
| Internal Wall                                                       |                |                | 123.8000             |                  |                                      | 9.0000            | 1114.2000 (32c) |                |                |                |                |                     |
| Heat capacity Cm = Sum(A x k)                                       |                |                |                      |                  | (28)...(30) + (32) + (32a)...(32e) = |                   | 21106.8000 (34) |                |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                      |                  |                                      |                   | 296.4438 (35)   |                |                |                |                |                     |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                      |                  |                                      |                   | 15.4420 (36)    |                |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                      |                  |                                      | (33) + (36) =     | 54.7715 (37)    |                |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                      |                  |                                      |                   |                 |                |                |                |                |                     |
| (38)m                                                               | Jan<br>14.8342 | Feb<br>14.6545 | Mar<br>14.4747       | Apr<br>13.5760   | May<br>13.3962                       | Jun<br>12.4975    | Jul<br>12.4975  | Aug<br>12.3178 | Sep<br>12.8570 | Oct<br>13.3962 | Nov<br>13.7557 | Dec<br>14.1152 (38) |
| Heat transfer coeff                                                 | 69.6057        | 69.4260        | 69.2462              | 68.3475          | 68.1678                              | 67.2690           | 67.2690         | 67.0893        | 67.6285        | 68.1678        | 68.5273        | 68.8867 (39)        |
| Average = Sum(39)m / 12 =                                           |                |                |                      |                  |                                      |                   |                 |                |                |                |                | 68.3026 (39)        |
| HLP                                                                 | Jan<br>0.9776  | Feb<br>0.9751  | Mar<br>0.9726        | Apr<br>0.9599    | May<br>0.9574                        | Jun<br>0.9448     | Jul<br>0.9448   | Aug<br>0.9423  | Sep<br>0.9498  | Oct<br>0.9574  | Nov<br>0.9625  | Dec<br>0.9675 (40)  |
| HLP (average)                                                       |                |                |                      |                  |                                      |                   |                 |                |                |                |                | 0.9593 (40)         |
| Days in month                                                       | 31             | 28             | 31                   | 30               | 31                                   | 30                | 31              | 31             | 30             | 31             | 30             | 31 (41)             |

#### 4. Water heating energy requirements (kWh/year)

|                                          |     |     |     |     |     |     |     |     |     |     |     |
|------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                                          |     |     |     |     |     |     |     |     |     |     |     |
| Assumed occupancy                        |     |     |     |     |     |     |     |     |     |     |     |
| 2.2749 (42)                              |     |     |     |     |     |     |     |     |     |     |     |
| Average daily hot water use (litres/day) |     |     |     |     |     |     |     |     |     |     |     |
| 92.8725 (43)                             |     |     |     |     |     |     |     |     |     |     |     |
| Jan                                      | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Daily hot water use                                             | 102.1598 | 98.4449  | 94.7300  | 91.0151  | 87.3002  | 83.5853  | 83.5853  | 87.3002  | 91.0151  | 94.7300  | 98.4449  | 102.1598 (44) |
| Energy conte                                                    | 151.5000 | 132.5029 | 136.7311 | 119.2055 | 114.3805 | 98.7017  | 91.4616  | 104.9536 | 106.2070 | 123.7741 | 135.1091 | 146.7197 (45) |
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          |          |          |               |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 22.7250  | 19.8754  | 20.5097  | 17.8808  | 17.1571  | 14.8053  | 13.7192  | 15.7430  | 15.9311  | 18.5661  | 20.2664  | 22.0080 (46)  |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |               |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)   |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)   |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)   |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)   |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (56)  |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (57)  |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 197.7024 | 174.2341 | 182.9335 | 163.9175 | 160.5829 | 143.4137 | 137.6640 | 151.1560 | 150.9190 | 169.9765 | 179.8211 | 192.9221 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
|                                                                 |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)   |
| Output from w/h                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 197.7024 | 174.2341 | 182.9335 | 163.9175 | 160.5829 | 143.4137 | 137.6640 | 151.1560 | 150.9190 | 169.9765 | 179.8211 | 192.9221 (64) |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 87.3357  | 77.4422  | 82.4250  | 75.4054  | 74.9934  | 68.5879  | 67.3729  | 71.8590  | 71.0834  | 78.1168  | 80.6934  | 85.7462 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 17.8374  | 15.8430  | 12.8844  | 9.7543   | 7.2915   | 6.1558   | 6.6515   | 8.6459   | 11.6045  | 14.7346  | 17.1975  | 18.3332 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 200.0814 | 202.1576 | 196.9256 | 185.7873 | 171.7272 | 158.5126 | 149.6845 | 147.6083 | 152.8403 | 163.9786 | 178.0388 | 191.2533 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 117.3867 | 115.2413 | 110.7863 | 104.7298 | 100.7976 | 95.2610  | 90.5550  | 96.5846  | 98.7270  | 104.9957 | 112.0741 | 115.2503 (72) |
| Total internal gains                                                                |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 392.4290 | 390.3655 | 377.7199 | 357.3949 | 336.9398 | 317.0529 | 304.0146 | 309.9624 | 320.2954 | 340.8325 | 364.4339 | 381.9603 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |  | Gains<br>W    |
|-------------|----------|----------|----------|------------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|--|---------------|
|             |          |          |          |            |                                |          |                                   |          |                                    |          |                              |  |               |
| Northeast   |          |          |          | 1.9200     | 11.2829                        |          | 0.3700                            |          | 0.6500                             |          | 0.7700                       |  | 3.6105 (75)   |
| Northwest   |          |          |          | 8.4000     | 11.2829                        |          | 0.3700                            |          | 0.8900                             |          | 0.7700                       |  | 21.6285 (81)  |
| Northwest   |          |          |          | 7.6100     | 11.2829                        |          | 0.5600                            |          | 0.6800                             |          | 0.7700                       |  | 22.6588 (81)  |
|             |          |          |          |            |                                |          |                                   |          |                                    |          |                              |  |               |
| Solar gains | 47.8979  | 97.4975  | 175.6594 | 288.4833   | 387.7781                       | 413.4125 | 386.7389                          | 308.3128 | 214.0438                           | 119.1496 | 60.2679                      |  | 39.1158 (83)  |
| Total gains | 440.3269 | 487.8630 | 553.3793 | 645.8782   | 724.7180                       | 730.4655 | 690.7535                          | 618.2752 | 534.3391                           | 459.9821 | 424.7018                     |  | 421.0761 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |                           |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 84.2316 | 84.4497 | 84.6689 | 85.7822 | 86.0084 | 87.1575 | 87.1575 | 87.3910 | 86.6942                   | 86.0084 | 85.5572 | 85.1107      |
| alpha                                                                       | 6.6154  | 6.6300  | 6.6446  | 6.7188  | 6.7339  | 6.8105  | 6.8105  | 6.8261  | 6.7796                    | 6.7339  | 6.7038  | 6.6740       |
| util living area                                                            | 0.9990  | 0.9977  | 0.9913  | 0.9511  | 0.8057  | 0.5827  | 0.4277  | 0.4970  | 0.8055                    | 0.9802  | 0.9975  | 0.9993 (86)  |
| MIT                                                                         | 20.1456 | 20.2535 | 20.4609 | 20.7478 | 20.9407 | 20.9942 | 20.9994 | 20.9984 | 20.9570                   | 20.6938 | 20.3730 | 20.1276 (87) |
| Th 2                                                                        | 20.1020 | 20.1041 | 20.1063 | 20.1169 | 20.1190 | 20.1296 | 20.1296 | 20.1317 | 20.1253                   | 20.1190 | 20.1147 | 20.1105 (88) |
| util rest of house                                                          | 0.9986  | 0.9968  | 0.9878  | 0.9321  | 0.7509  | 0.5067  | 0.3436  | 0.4044  | 0.7298                    | 0.9691  | 0.9964  | 0.9990 (89)  |
| MIT 2                                                                       | 18.9586 | 19.1178 | 19.4206 | 19.8309 | 20.0674 | 20.1264 | 20.1294 | 20.1312 | 20.0948                   | 19.7661 | 19.3009 | 18.9388 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3581 (91)  |
| MIT                                                                         | 19.3837 | 19.5245 | 19.7932 | 20.1593 | 20.3801 | 20.4372 | 20.4410 | 20.4418 | 20.4036                   | 20.0983 | 19.6849 | 19.3646 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.3837 | 19.5245 | 19.7932 | 20.1593 | 20.3801 | 20.4372 | 20.4410 | 20.4418 | 20.4036                   | 20.0983 | 19.6849 | 19.3646 (93) |

#### 8. Space heating requirement

|                   |           |           |          |          |          |          |          |          |          |          |          |                |
|-------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation       | 0.9981    | 0.9960    | 0.9862   | 0.9332   | 0.7681   | 0.5339   | 0.3738   | 0.4377   | 0.7557   | 0.9688   | 0.9956   | 0.9986 (94)    |
| Useful gains      | 439.5108  | 485.8899  | 545.7179 | 602.7303 | 556.6845 | 389.9908 | 258.1795 | 270.6102 | 403.7799 | 445.6392 | 422.8262 | 420.4912 (95)  |
| Ext temp.         | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Heat loss rate W  | 1049.9127 | 1015.3225 | 920.5031 | 769.5455 | 591.7047 | 392.6608 | 258.3792 | 271.1595 | 426.3039 | 647.4804 | 862.4095 | 1044.6388 (97) |
| Month fracti      | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating kWh |           |           |          |          |          |          |          |          |          |          |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                      |          |          |          |          |         |        |        |        |        |          |              |                |
|----------------------|----------|----------|----------|----------|---------|--------|--------|--------|--------|----------|--------------|----------------|
|                      | 454.1390 | 355.7787 | 278.8402 | 120.1070 | 26.0550 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 150.1699 | 316.5000     | 464.3658 (98)  |
| Space heating        |          |          |          |          |         |        |        |        |        |          |              | 2165.9555 (98) |
| Space heating per m2 |          |          |          |          |         |        |        |        |        |          | (98) / (4) = | 30.4207 (99)   |

-----  
8c. Space cooling requirement  
-----

Not applicable

-----  
9b. Energy requirements  
-----

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 2165.9555 (98)   |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 1046.1565 (307a) |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 1228.0968 (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 2005.2428 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 968.5323 (310a)  |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1136.9727 (310b) |
| Electricity used for heat distribution                                                  | 43.7976 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 138.1138 (330a)  |
| Total electricity for the above, kWh/year                                               | 138.1138 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 315.0141 (332)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415        |
| Total delivered energy for all uses                                                     | 4460.2446 (338)  |

-----  
12b. Carbon dioxide emissions - Community heating scheme  
-----

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 544.5105           | 0.5190                        | 282.6009 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 2518.7108          | 0.2160                        | 544.0415 (368)           |
| Electrical energy for heat distribution                                                    | 43.7976            | 0.5190                        | 22.7309 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 849.3734 (373)           |
| Space and water heating                                                                    |                    |                               | 849.3734 (376)           |
| Pumps and fans                                                                             | 138.1138           | 0.5190                        | 71.6810 (378)            |
| Energy for lighting                                                                        | 315.0141           | 0.5190                        | 163.4923 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 891.1459 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.5200 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 12.5200 ZC1 |
| Total Floor Area                                                                | TFA 71.2000 |
| Assumed number of occupants                                                     | N 2.2749    |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF 0.5190   |
| CO2 emissions from appliances, equation (L14)                                   | 16.6523 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.4382 ZC3  |
| Total CO2 emissions                                                             | 31.6104 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 31.6104 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 71.2000 (1b)              | x 2.4000 (2b)                   | = 170.8800 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 71.2000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 170.8800 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m3 per hour                |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 3 * 10 = 30.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour       |
| Pressure test                                                             |                 |                      |       |                             | 30.0000 / (5) = 0.1756 (8) |
| Measured/design AP50                                                      |                 |                      |       |                             | Yes                        |
| Infiltration rate                                                         |                 |                      |       |                             | 5.0000                     |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0.4256 (18)                |
|                                                                           |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3617 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4612 | 0.4522 | 0.4431 | 0.3979 | 0.3889 | 0.3436 | 0.3436 | 0.3346 | 0.3617 | 0.3889 | 0.4069 | 0.4250 (22b) |
| Effective ac    | 0.6064 | 0.6022 | 0.5982 | 0.5792 | 0.5756 | 0.5590 | 0.5590 | 0.5560 | 0.5654 | 0.5756 | 0.5828 | 0.5903 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 15.7000                   | 1.3258                        | 20.8144      |                                | (27)          |
| External Wall 1                                                | 53.7400                 | 15.7000                    | 38.0400                   | 0.1800                        | 6.8472       |                                | (29a)         |
| Corridor wall                                                  | 7.8000                  | 2.1000                     | 5.7000                    | 0.1800                        | 1.0260       |                                | (29a)         |
| Exposed ceiling                                                | 35.8000                 |                            | 35.8000                   | 0.1300                        | 4.6540       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 97.3400                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 35.8616      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 13.5745 (36)  |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 49.4361 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 34.1925 | 33.9597 | 33.7314 | 32.6592 | 32.4586 | 31.5247 | 31.5247 | 31.3518 | 31.8845 | 32.4586 | 32.8644 | 33.2887 (38) |
| Heat transfer coeff       | 83.6286 | 83.3957 | 83.1675 | 82.0953 | 81.8947 | 80.9608 | 80.9608 | 80.7879 | 81.3205 | 81.8947 | 82.3005 | 82.7248 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 82.0943 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.1746 | 1.1713 | 1.1681 | 1.1530 | 1.1502 | 1.1371 | 1.1371 | 1.1347 | 1.1421 | 1.1502 | 1.1559 | 1.1619 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.1530 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |          |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|----------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |          |                    |          | 2.2749 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |          |                    |          | 88.2289 (43)   |
| Daily hot water use                                         | 97.0518  | 93.5227  | 89.9935  | 86.4643  | 82.9352  | 79.4060 | 79.4060 | 82.9352 | 86.4643  | 89.9935            | 93.5227  | 97.0518 (44)   |
| Energy conte                                                | 143.9250 | 125.8778 | 129.8946 | 113.2452 | 108.6615 | 93.7666 | 86.8885 | 99.7059 | 100.8967 | 117.5854           | 128.3536 | 139.3837 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |          | Total = Sum(45)m = |          | 1388.1845 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 21.5888  | 18.8817  | 19.4842  | 16.9868  | 16.2992  | 14.0650 | 13.0333 | 14.9559 | 15.1345  | 17.6378            | 19.2530  | 20.9076 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |          |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |          |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |          |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |          |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |          |                    |          | 0.1290 (55)    |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 171.1852 | 150.4998 | 157.1547 | 139.6260 | 135.9216 | 120.1474 | 114.1487 | 126.9660 | 127.2775 | 144.8455 | 154.7344 | 166.6439 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 171.1852 | 150.4998 | 157.1547 | 139.6260 | 135.9216 | 120.1474 | 114.1487 | 126.9660 | 127.2775 | 144.8455 | 154.7344 | 166.6439 (64) |
| Heat gains from water heating, kWh/month                        | 69.6632  | 61.5520  | 64.9981  | 58.7587  | 57.9381  | 52.2820  | 50.6986  | 54.9603  | 54.6528  | 60.9052  | 63.7822  | 68.1532 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 | 113.7451 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.8423  | 15.8474  | 12.8879  | 9.7570   | 7.2935   | 6.1575   | 6.6533   | 8.6483   | 11.6077  | 14.7386  | 17.2022  | 18.3382 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 200.0814 | 202.1576 | 196.9256 | 185.7873 | 171.7272 | 158.5126 | 149.6845 | 147.6083 | 152.8403 | 163.9786 | 178.0388 | 191.2533 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745  | 34.3745 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 | -90.9961 (71) |
| Water heating gains (Table 5)                                                       | 93.6333  | 91.5952  | 87.3630  | 81.6093  | 77.8737  | 72.6139  | 68.1432  | 73.8714  | 75.9066  | 81.8619  | 88.5864  | 91.6038 (72)  |
| Total internal gains                                                                | 371.6805 | 369.7238 | 357.3001 | 337.2771 | 317.0179 | 297.4076 | 284.6046 | 290.2515 | 300.4782 | 320.7027 | 343.9508 | 361.3188 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| Northeast   |          |          |          |          | 1.6800     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 5.7930 (75)  |               |
| Northwest   |          |          |          |          | 14.0200    | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 48.3440 (81) |               |
|             |          |          |          |          |            |                                |                                   |                                    |                              |          |              |               |
| Solar gains | 54.1370  | 110.1973 | 198.5405 | 326.0606 | 438.2894   | 467.2629                       | 437.1149                          | 348.4731                           | 241.9248                     | 134.6699 | 68.1183      | 44.2110 (83)  |
| Total gains | 425.8175 | 479.9211 | 555.8406 | 663.3377 | 755.3074   | 764.6705                       | 721.7195                          | 638.7246                           | 542.4029                     | 455.3726 | 412.0691     | 405.5297 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 59.1238 | 59.2889 | 59.4517 | 60.2281 | 60.3756 | 61.0720 | 61.0720 | 61.2028 | 60.8019                   | 60.3756 | 60.0779 | 59.7698      |
| alpha                                                                       | 4.9416  | 4.9526  | 4.9634  | 5.0152  | 5.0250  | 5.0715  | 5.0715  | 5.0802  | 5.0535                    | 5.0250  | 5.0052  | 4.9847       |
| util living area                                                            | 0.9980  | 0.9961  | 0.9883  | 0.9519  | 0.8375  | 0.6441  | 0.4865  | 0.5657  | 0.8486                    | 0.9795  | 0.9961  | 0.9985 (86)  |
| MIT                                                                         | 19.7241 | 19.8639 | 20.1368 | 20.5229 | 20.8298 | 20.9661 | 20.9933 | 20.9864 | 20.8668                   | 20.4649 | 20.0335 | 19.7037 (87) |
| Th 2                                                                        | 19.9404 | 19.9430 | 19.9456 | 19.9578 | 19.9600 | 19.9707 | 19.9707 | 19.9726 | 19.9666                   | 19.9600 | 19.9554 | 19.9506 (88) |
| util rest of house                                                          | 0.9974  | 0.9947  | 0.9841  | 0.9342  | 0.7849  | 0.5542  | 0.3764  | 0.4475  | 0.7770                    | 0.9690  | 0.9945  | 0.9980 (89)  |
| MIT 2                                                                       | 18.2415 | 18.4474 | 18.8456 | 19.4015 | 19.7985 | 19.9492 | 19.9683 | 19.9672 | 19.8590                   | 19.3317 | 18.7045 | 18.2190 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3581 (91)  |
| MIT                                                                         | 18.7725 | 18.9547 | 19.3081 | 19.8031 | 20.1679 | 20.3134 | 20.3354 | 20.3322 | 20.2199                   | 19.7375 | 19.1805 | 18.7507 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.7725 | 18.9547 | 19.3081 | 19.8031 | 20.1679 | 20.3134 | 20.3354 | 20.3322 | 20.2199                   | 19.7375 | 19.1805 | 18.7507 (93) |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|                      | 0.9963    | 0.9929    | 0.9807    | 0.9310   | 0.7965   | 0.5853   | 0.4161   | 0.4901   | 0.7969   | 0.9660       | 0.9928   | 0.9971 (94)    |
| Useful gains         | 424.2329  | 476.5016  | 545.0880  | 617.5752 | 601.5932 | 447.5745 | 300.2753 | 313.0120 | 432.2517 | 439.9051     | 409.1169 | 404.3412 (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 1210.3168 | 1172.1049 | 1065.2150 | 895.0937 | 693.4728 | 462.5635 | 302.4191 | 317.6734 | 497.6762 | 748.3153     | 994.2308 | 1203.7058 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 584.8464  | 467.4454  | 386.9745  | 199.8133 | 68.3585  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 229.4572     | 421.2820 | 594.7272 (98)  |
| Space heating        |           |           |           |          |          |          |          |          |          |              |          | 2952.9046 (98) |
| Space heating per m2 |           |           |           |          |          |          |          |          |          | (98) / (4) = |          | 41.4734 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 3158.1868 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 584.8464 | 467.4454 | 386.9745 | 199.8133 | 68.3585  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 229.4572 | 421.2820 | 594.7272  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 625.5042 | 499.9416 | 413.8765 | 213.7041 | 73.1107  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 245.4088 | 450.5690 | 636.0719  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 171.1852 | 150.4998 | 157.1547 | 139.6260 | 135.9216 | 120.1474 | 114.1487 | 126.9660 | 127.2775 | 144.8455 | 154.7344 | 166.6439  | (64)            |
| Efficiency of water heater (217)m                                     | 87.8333  | 87.6381  | 87.1259  | 85.7694  | 83.0873  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 86.0358  | 87.3536  | 79.8000   | (216)           |
| Fuel for water heating, kWh/month                                     | 194.8977 | 171.7288 | 180.3765 | 162.7924 | 163.5890 | 150.5606 | 143.0435 | 159.1053 | 159.4956 | 168.3549 | 177.1357 | 189.5408  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2020.6208 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3158.1868 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 315.1004  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5568.9079 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 3158.1868          | 0.2160                        | 682.1683 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2020.6208          | 0.2160                        | 436.4541 (264)           |
| Space and water heating                                                                           |                    |                               | 1118.6224 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 315.1004           | 0.5190                        | 163.5371 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1321.0845 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 15.7110 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.2969 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5467 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (15.7110 * 1.00) + 2.2969 + 0.5467, rounded to 2 d.p. |                    |                               | 18.5500 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-3-03                                                                  |               |         | Issued on Date | 08/01/2020 |
| Assessment Reference               | ASHP - be lean                                                          | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 77 C                                                                    | DER           | 28.24   | TER            | 27.50      |
| Environmental                      | 81 B                                                                    | % DER<TER     | -2.69   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 1.34                                                                    | DFEE          | 87.10   | TFEE           | 97.13      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 10.32   |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 58 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating:Mains gas (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 27.50 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 28.24 kgCO<sub>2</sub>/m<sup>2</sup>Fail  
Excess emissions =0.74 kgCO<sub>2</sub>/m<sup>2</sup> (2.7%)

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)97.1 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)87.1 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.18 (max. 0.20) | 0.18 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls:

No cylinderstat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail

Based on:

Overshading: Average  
Windows facing West: 12.20 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Thermal bridging y-value 0.033 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.3000 (1b)              | x 2.4000 (2b)                   | = 139.9200 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.3000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 139.9200 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes    |             |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000 |             |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 | (18)        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 3      | (19)        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.7750 | (20)        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1163 | (21)        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1482                       | 0.1453 | 0.1424    | 0.1279 | 0.1250 | 0.1104 | 0.1104                      | 0.1075 | 0.1163      | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2487                       | 0.2458 | 0.2429    | 0.2284 | 0.2255 | 0.2109 | 0.2109                      | 0.2080 | 0.2168      | 0.2255 | 0.2313 | 0.2371 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K                         | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K    |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------------------------------|--------------------------------|------------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364                              |                                | (27)             |
| W02 (Uw = 1.40)                                                |                         |                            | 3.8000                    | 1.3258                        | 5.0379                               |                                | (27)             |
| entrance door                                                  |                         |                            | 2.1000                    | 1.4000                        | 2.9400                               |                                | (26a)            |
| External Wall 1                                                | 41.0000                 | 12.2000                    | 28.8000                   | 0.1500                        | 4.3200                               | 140.0000                       | 4032.0000 (29a)  |
| Corridor Wall                                                  | 277.0000                | 2.1000                     | 274.9000                  | 0.1500                        | 41.2350                              | 110.0000                       | 30239.0000 (29a) |
| Exposed ceiling                                                | 6.7000                  |                            | 6.7000                    | 0.1800                        | 1.2060                               | 9.0000                         | 60.3000 (30)     |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 324.7000                  |                               |                                      |                                | (31)             |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 65.8752                              |                                | (33)             |
| Party Wall 1                                                   |                         |                            | 27.7000                   | 0.0000                        | 0.0000                               | 140.0000                       | 3878.0000 (32)   |
| Party Floor                                                    |                         |                            | 58.3000                   |                               |                                      | 80.0000                        | 4664.0000 (32d)  |
| Party Ceilings                                                 |                         |                            | 51.6000                   |                               |                                      | 80.0000                        | 4128.0000 (32b)  |
| Internal Wall                                                  |                         |                            | 74.0000                   |                               |                                      | 9.0000                         | 666.0000 (32c)   |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               | (28)...(30) + (32) + (32a)...(32e) = |                                | 47667.3000 (34)  |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |                                      |                                | 817.6209 (35)    |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |                                      |                                | 10.5848 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |                                      | (33) + (36) =                  | 76.4600 (37)     |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 11.4842 | 11.3500 | 11.2159 | 10.5449 | 10.4107 | 9.7397  | 9.7397  | 9.6056  | 10.0081 | 10.4107 | 10.6791 | 10.9475 (38) |
| Heat transfer coeff       | 87.9443 | 87.8101 | 87.6759 | 87.0049 | 86.8707 | 86.1998 | 86.1998 | 86.0656 | 86.4682 | 86.8707 | 87.1391 | 87.4075 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 86.9714 (39) |
| HLP                       | 1.5085  | 1.5062  | 1.5039  | 1.4924  | 1.4901  | 1.4786  | 1.4786  | 1.4763  | 1.4832  | 1.4901  | 1.4947  | 1.4993 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.4918 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 1.9332 (42)  |
| Average daily hot water use (litres/day) | 84.3296 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy conte                                                    | 92.7625  | 89.3893  | 86.0162  | 82.6430  | 79.2698  | 75.8966  | 75.8966  | 79.2698  | 82.6430  | 86.0162             | 89.3893  | 92.7625 (44)   |
| Energy content (annual)                                         | 137.5642 | 120.3145 | 124.1538 | 108.2403 | 103.8591 | 89.6225  | 83.0484  | 95.2993  | 96.4375  | 112.3886            | 122.6809 | 133.2235 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1326.8325 (45) |
|                                                                 | 20.6346  | 18.0472  | 18.6231  | 16.2360  | 15.5789  | 13.4434  | 12.4573  | 14.2949  | 14.4656  | 16.8583             | 18.4021  | 19.9835 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |                     |          |                |
| Solar input                                                     | 183.7666 | 162.0457 | 170.3562 | 152.9523 | 150.0615 | 134.3345 | 129.2508 | 141.5017 | 141.1495 | 158.5910            | 167.3929 | 179.4259 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum (63)m =                       |          |          |          |          |          |          |          |          |          |                     |          | 0.0000 (63)    |
| Output from w/h                                                 | 183.7666 | 162.0457 | 170.3562 | 152.9523 | 150.0615 | 134.3345 | 129.2508 | 141.5017 | 141.1495 | 158.5910            | 167.3929 | 179.4259 (64)  |
| Heat gains from water heating, kWh/month                        | 82.7020  | 73.3895  | 78.2430  | 71.7595  | 71.4951  | 65.5691  | 64.5755  | 68.6489  | 67.8351  | 74.3311             | 76.5610  | 81.2587 (65)   |
|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 15.0344  | 13.3534  | 10.8597  | 8.2215   | 6.1457   | 5.1884   | 5.6063   | 7.2873   | 9.7810   | 12.4192  | 14.4950  | 15.4522 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 168.6400 | 170.3900 | 165.9802 | 156.5922 | 144.7415 | 133.6035 | 126.1627 | 124.4127 | 128.8225 | 138.2105 | 150.0612 | 161.1992 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 111.1586 | 109.2106 | 105.1654 | 99.6660  | 96.0955  | 91.0682  | 86.7951  | 92.2701  | 94.2154  | 99.9074  | 106.3347 | 109.2187 (72) |
| Total internal gains                                                                | 346.8308 | 344.9517 | 334.0030 | 316.4774 | 298.9804 | 281.8579 | 270.5618 | 275.9678 | 284.8166 | 302.5349 | 322.8887 | 337.8679 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          |          | Gains<br>W    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|----------|---------------|
| West        |          |          |          |          | 8.4000     | 19.6403                        | 0.3700                            | 0.8900                             | 0.7700                       |          |          | 37.6488 (80)  |
| West        |          |          |          |          | 3.8000     | 19.6403                        | 0.3700                            | 0.6800                             | 0.7700                       |          |          | 13.0129 (80)  |
| -----       |          |          |          |          |            |                                |                                   |                                    |                              |          |          |               |
| Solar gains | 50.6618  | 99.1051  | 163.2121 | 238.0351 | 291.7209   | 298.6282                       | 284.3063                          | 244.2149                           | 189.8224                     | 117.5966 | 63.1693  | 41.6618 (83)  |
| Total gains | 397.4925 | 444.0569 | 497.2151 | 554.5124 | 590.7013   | 580.4861                       | 554.8680                          | 520.1827                           | 474.6390                     | 420.1315 | 386.0580 | 379.5297 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |          |          |          |          |          |          |          |          |                           |          |          |              |
|-----------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|----------|----------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |          |          |          |          |          |          |          |          |                           |          |          | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |          |          |          |          |          |          |          |          |                           |          |          |              |
|                                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep                       | Oct      | Nov      | Dec          |
| tau                                                                         | 150.5603 | 150.7904 | 151.0212 | 152.1858 | 152.4209 | 153.6073 | 153.6073 | 153.8468 | 153.1305                  | 152.4209 | 151.9514 | 151.4849     |
| alpha                                                                       | 11.0374  | 11.0527  | 11.0681  | 11.1457  | 11.1614  | 11.2405  | 11.2405  | 11.2565  | 11.2087                   | 11.1614  | 11.1301  | 11.0990      |
| util living area                                                            | 1.0000   | 1.0000   | 1.0000   | 0.9996   | 0.9917   | 0.8930   | 0.6805   | 0.7524   | 0.9832                    | 0.9999   | 1.0000   | 1.0000 (86)  |
| MIT                                                                         | 20.3967  | 20.4538  | 20.5639  | 20.7190  | 20.8747  | 20.9812  | 20.9991  | 20.9974  | 20.9267                   | 20.7274  | 20.5348  | 20.3863 (87) |
| Th 2                                                                        | 19.6811  | 19.6829  | 19.6846  | 19.6932  | 19.6950  | 19.7036  | 19.7036  | 19.7054  | 19.7002                   | 19.6950  | 19.6915  | 19.6880 (88) |
| util rest of house                                                          | 1.0000   | 1.0000   | 0.9999   | 0.9988   | 0.9715   | 0.7495   | 0.4821   | 0.5466   | 0.9270                    | 0.9996   | 1.0000   | 1.0000 (89)  |
| MIT 2                                                                       | 18.8932  | 18.9783  | 19.1410  | 19.3752  | 19.5953  | 19.6996  | 19.7036  | 19.7052  | 19.6636                   | 19.3893  | 19.1043  | 18.8839 (90) |
| Living area fraction                                                        |          |          |          |          |          |          |          |          | fLA = Living area / (4) = |          |          | 0.4837 (91)  |
| MIT                                                                         | 19.6204  | 19.6920  | 19.8293  | 20.0252  | 20.2142  | 20.3195  | 20.3302  | 20.3303  | 20.2746                   | 20.0366  | 19.7963  | 19.6106 (92) |
| Temperature adjustment                                                      |          |          |          |          |          |          |          |          |                           |          |          | 0.0000       |
| adjusted MIT                                                                | 19.6204  | 19.6920  | 19.8293  | 20.0252  | 20.2142  | 20.3195  | 20.3302  | 20.3303  | 20.2746                   | 20.0366  | 19.7963  | 19.6106 (93) |

#### 8. Space heating requirement

|                   |           |           |           |          |          |          |          |          |          |          |           |                |
|-------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Utilisation       | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec            |
|                   | 1.0000    | 1.0000    | 1.0000    | 0.9991   | 0.9825   | 0.8257   | 0.5790   | 0.6485   | 0.9611   | 0.9997   | 1.0000    | 1.0000 (94)    |
| Useful gains      | 397.4921  | 444.0548  | 497.1928  | 554.0356 | 580.3593 | 479.3155 | 321.2495 | 337.3259 | 456.1525 | 420.0136 | 386.0559  | 379.5295 (95)  |
| Ext temp.         | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000 (96)    |
| Heat loss rate W  | 1347.3458 | 1298.8850 | 1168.6547 | 967.9444 | 739.6329 | 493.0203 | 321.5434 | 338.2620 | 533.9024 | 819.7606 | 1106.3429 | 1347.0062 (97) |
| Month fracti      | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000 (97a)   |
| Space heating kWh | 706.6911  | 574.4459  | 499.5677  | 298.0144 | 118.4995 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 297.4117 | 518.6066  | 719.8027 (98)  |
| Space heating     |           |           |           |          |          |          |          |          |          |          |           | 3733.0396 (98) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 64.0316 (99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (301)  
Fraction of space heat from community system 1.0000 (302)  
Fraction of heat from community Boilers 1.0000 (303a)  
Fraction of total space heat from community Boilers 1.0000 (304a)  
Factor for control and charging method (Table 4c(3)) for community space heating 1.0000 (305)  
Factor for control and charging method (Table 4c(3)) for community water heating 1.0000 (305a)  
Distribution loss factor (Table 12c) for community heating system 1.1000 (306)  
Space heating:  
Annual space heating requirement 3733.0396 (98)  
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10 4106.3436 (307a)  
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0.0000 (308)  
Space heating fuel for secondary/supplementary system 0.0000 (309)  
Water heating  
Annual water heating requirement 1870.8285 (64)  
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10 2057.9114 (310a)  
Electricity used for heat distribution 61.6425 (313)  
Annual totals kWh/year  
Electricity for pumps and fans:  
(BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)  
mechanical ventilation fans (SFP = 0.6625) 113.0903 (330a)  
Total electricity for the above, kWh/year 113.0903 (331)  
Electricity for lighting (calculated in Appendix L) 265.5119 (332)  
Total delivered energy for all uses 6542.8572 (338)

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 6564.7018          | 0.2160                        | 1417.9756 (367)          |
| Electrical energy for heat distribution                                                    | 61.6425            | 0.5190                        | 31.9925 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 1449.9681 (373)          |
| Space and water heating                                                                    |                    |                               | 1449.9681 (376)          |
| Pumps and fans                                                                             | 113.0903           | 0.5190                        | 58.6939 (378)            |
| Energy for lighting                                                                        | 265.5119           | 0.5190                        | 137.8007 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1646.4626 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 28.2400 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

| DER                                                                             |     | 28.2400 ZC1 |
|---------------------------------------------------------------------------------|-----|-------------|
| Total Floor Area                                                                | TFA | 58.3000     |
| Assumed number of occupants                                                     | N   | 1.9332      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.1411 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.8370 ZC3  |
| Total CO2 emissions                                                             |     | 48.2181 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 48.2181 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.3000 (1b)              | x 2.4000 (2b)                   | = 139.9200 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.3000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 139.9200 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour    |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|----------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                          |                              |                      |       |       | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | Air changes per hour       |
| Pressure test                                        |                              |                      |       |       | 20.0000 / (5) = 0.1429 (8) |
| Measured/design AP50                                 |                              |                      |       |       | Yes                        |
| Infiltration rate                                    |                              |                      |       |       | 5.0000                     |
| Number of sides sheltered                            |                              |                      |       |       | 0.3929 (18)                |
|                                                      |                              |                      |       |       | 3 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.3045 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.3883 | 0.3807 | 0.3730 | 0.3350 | 0.3274 | 0.2893 | 0.2893 | 0.2817 | 0.3045 | 0.3274 | 0.3426 | 0.3578 (22b) |
|                 | 0.5754 | 0.5725 | 0.5696 | 0.5561 | 0.5536 | 0.5418 | 0.5418 | 0.5397 | 0.5464 | 0.5536 | 0.5587 | 0.5640 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 12.2000                   | 1.3258                        | 16.1742      |                                | (27)          |
| External Wall 1                                                | 41.0000                 | 12.2000                    | 28.8000                   | 0.1800                        | 5.1840       |                                | (29a)         |
| Corridor Wall                                                  | 277.0000                | 2.1000                     | 274.9000                  | 0.1800                        | 49.4820      |                                | (29a)         |
| Exposed ceiling                                                | 6.7000                  |                            | 6.7000                    | 0.1300                        | 0.8710       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 324.7000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 74.2312      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 9.3348 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 83.5660 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| (38)m                     | 26.5673  | 26.4321  | 26.2996  | 25.6774  | 25.5610  | 25.0191  | 25.0191  | 24.9187  | 25.2278  | 25.5610  | 25.7965  | 26.0427 (38)  |
| Heat transfer coeff       | 110.1333 | 109.9982 | 109.8657 | 109.2435 | 109.1270 | 108.5851 | 108.5851 | 108.4847 | 108.7938 | 109.1270 | 109.3625 | 109.6088 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 109.2429 (39) |
| HLP                       | 1.8891   | 1.8868   | 1.8845   | 1.8738   | 1.8718   | 1.8625   | 1.8625   | 1.8608   | 1.8661   | 1.8718   | 1.8759   | 1.8801 (40)   |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.8738 (40)   |
| Days in month             | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31 (41)       |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |         |         |         |         |         |          |          |                                   |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |          |          | 1.9332 (42)                       |
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |          |          | 80.1131 (43)                      |
| Daily hot water use                                         | 88.1244  | 84.9199  | 81.7154  | 78.5108  | 75.3063 | 72.1018 | 72.1018 | 75.3063 | 78.5108 | 81.7154  | 84.9199  | 88.1244 (44)                      |
| Energy conte                                                | 130.6859 | 114.2988 | 117.9461 | 102.8283 | 98.6662 | 85.1414 | 78.8960 | 90.5343 | 91.6156 | 106.7691 | 116.5469 | 126.5624 (45)                     |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         |          |          | Total = Sum(45)m = 1260.4909 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 19.6029  | 17.1448  | 17.6919  | 15.4242  | 14.7999 | 12.7712 | 11.8344 | 13.5801 | 13.7423 | 16.0154  | 17.4820  | 18.9844 (46)                      |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |          |          | 2.0000 (47)                       |
| Store volume                                                |          |          |          |          |         |         |         |         |         |          |          | 0.2388 (48)                       |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |          |          | 0.5400 (49)                       |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |          |          | 0.1290 (55)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |          |          |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 157.9461 | 138.9208 | 145.2062 | 129.2090 | 125.9263 | 111.5222 | 106.1562 | 117.7945 | 117.9964 | 134.0293 | 142.9277 | 153.8225 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 157.9461 | 138.9208 | 145.2062 | 129.2090 | 125.9263 | 111.5222 | 106.1562 | 117.7945 | 117.9964 | 134.0293 | 142.9277 | 153.8225 (64) |
| Heat gains from water heating, kWh/month                        | 65.2612  | 57.7020  | 61.0252  | 55.2950  | 54.6146  | 49.4141  | 48.0410  | 51.9108  | 51.5668  | 57.3089  | 59.8565  | 63.8901 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.0794  | 13.3934  | 10.8922  | 8.2461   | 6.1641   | 5.2040   | 5.6231   | 7.3091   | 9.8102   | 12.4564  | 14.5384  | 15.4985  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 168.6400 | 170.3900 | 165.9802 | 156.5922 | 144.7415 | 133.6035 | 126.1627 | 124.4127 | 128.8225 | 138.2105 | 150.0612 | 161.1992 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | (71) |
| Water heating gains (Table 5)                                                       | 87.7167  | 85.8661  | 82.0231  | 76.7986  | 73.4067  | 68.6308  | 64.5713  | 69.7726  | 71.6206  | 77.0280  | 83.1340  | 85.8738  | (72) |
| Total internal gains                                                                | 326.4338 | 324.6472 | 313.8933 | 296.6347 | 279.3100 | 262.4360 | 251.3548 | 256.4921 | 265.2511 | 282.6927 | 302.7314 | 317.5692 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| West        |          |          |          | 12.2000    | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       | 73.2283 (80) |          |          |               |
| Solar gains | 73.2283  | 143.2501 | 235.9125 | 344.0643   | 421.6637                       | 431.6479                          | 410.9464                           | 352.9969                     | 274.3760     | 169.9783 | 91.3071  | 60.2194 (83)  |
| Total gains | 399.6622 | 467.8973 | 549.8058 | 640.6990   | 700.9738                       | 694.0838                          | 662.3011                           | 609.4890                     | 539.6271     | 452.6710 | 394.0384 | 377.7886 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 36.7610 | 36.8062 | 36.8506 | 37.0604 | 37.1000 | 37.2851 | 37.2851 | 37.3196 | 37.2136 | 37.1000 | 37.0201 | 36.9369 |              |
| alpha                                                                       | 3.4507  | 3.4537  | 3.4567  | 3.4707  | 3.4733  | 3.4857  | 3.4857  | 3.4880  | 3.4809  | 3.4733  | 3.4680  | 3.4625  |              |
| util living area                                                            | 0.9960  | 0.9926  | 0.9833  | 0.9566  | 0.8943  | 0.7775  | 0.6376  | 0.6941  | 0.8846  | 0.9749  | 0.9931  | 0.9967  | (86)         |
| MIT                                                                         | 18.9538 | 19.1443 | 19.5047 | 19.9909 | 20.4476 | 20.7786 | 20.9209 | 20.8916 | 20.6105 | 20.0125 | 19.3939 | 18.9172 | (87)         |
| Th 2                                                                        | 19.4083 | 19.4099 | 19.4115 | 19.4188 | 19.4202 | 19.4266 | 19.4266 | 19.4277 | 19.4241 | 19.4202 | 19.4174 | 19.4145 | (88)         |
| util rest of house                                                          | 0.9945  | 0.9898  | 0.9765  | 0.9371  | 0.8418  | 0.6581  | 0.4458  | 0.5082  | 0.8035  | 0.9601  | 0.9900  | 0.9955  | (89)         |
| MIT 2                                                                       | 16.7747 | 17.0530 | 17.5768 | 18.2750 | 18.8939 | 19.2860 | 19.4022 | 19.3887 | 19.1201 | 18.3193 | 17.4232 | 16.7248 | (90)         |
| Living area fraction                                                        | 17.8287 | 18.0646 | 18.5093 | 19.1050 | 19.6454 | 20.0080 | 20.1368 | 20.1156 | 19.8410 | 19.1383 | 18.3764 | 17.7853 | (92)         |
| Temperature adjustment                                                      | 17.8287 | 18.0646 | 18.5093 | 19.1050 | 19.6454 | 20.0080 | 20.1368 | 20.1156 | 19.8410 | 19.1383 | 18.3764 | 17.7853 | (93)         |
| adjusted MIT                                                                | 17.8287 | 18.0646 | 18.5093 | 19.1050 | 19.6454 | 20.0080 | 20.1368 | 20.1156 | 19.8410 | 19.1383 | 18.3764 | 17.7853 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |          |           |           |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec       |       |
| Useful gains         | 0.9922    | 0.9862    | 0.9711    | 0.9321    | 0.8509   | 0.7082   | 0.5399   | 0.5986   | 0.8299   | 0.9564   | 0.9869    | 0.9935    | (94)  |
| Ext temp.            | 396.5341  | 461.4562  | 533.9265  | 597.1897  | 596.4385 | 491.5489 | 357.6087 | 364.8372 | 447.8242 | 432.9254 | 388.8789  | 375.3416  | (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000    | (96)  |
| Month fracti         | 1489.9660 | 1448.0808 | 1319.4110 | 1114.8299 | 867.0583 | 587.2276 | 384.0469 | 403.0911 | 624.5879 | 931.7603 | 1233.2190 | 1489.0642 | (97)  |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000    | (97a) |
| Space heating        | 813.5133  | 663.0117  | 584.4004  | 372.7009  | 201.3411 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 371.1332 | 607.9249  | 828.6096  | (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |          |           | 4442.6351 | (98)  |
|                      |           |           |           |           |          |          |          |          |          |          |           | 76.2030   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 4751.4814 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 813.5133 | 663.0117 | 584.4004 | 372.7009 | 201.3411 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 371.1332 | 607.9249 | 828.6096  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 870.0677 | 709.1034 | 625.0272 | 398.6106 | 215.3381 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 396.9339 | 650.1870 | 886.2135  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 157.9461 | 138.9208 | 145.2062 | 129.2090 | 125.9263 | 111.5222 | 106.1562 | 117.7945 | 117.9964 | 134.0293 | 142.9277 | 153.8225  | (64)            |
| Efficiency of water heater (217)m                                     | 88.5692  | 88.4456  | 88.1477  | 87.4803  | 86.0599  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 87.3910  | 88.2476  | 88.6391   | (216)           |
| Fuel for water heating, kWh/month                                     | 178.3308 | 157.0692 | 164.7305 | 147.7007 | 146.3241 | 139.7521 | 133.0278 | 147.6121 | 147.8651 | 153.3673 | 161.9621 | 173.5380  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1851.2799 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 4751.4814 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 266.3071  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 6944.0683 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 4751.4814          | 0.2160                        | 1026.3200 (261)          |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1851.2799          | 0.2160                        | 399.8765 (264)           |
| Space and water heating                                                                           |                    |                               | 1426.1964 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 266.3071           | 0.5190                        | 138.2134 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1603.3348 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 24.4631 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3707 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6677 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (24.4631 * 1.00) + 2.3707 + 0.6677, rounded to 2 d.p. |                    |                               | 27.5000 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-3-03                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP 46%                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 81 B                                                                    | DER           | 19.63   | TER            | 27.50      |
| Environmental                      | 87 B                                                                    | % DER<TER     | 28.62   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.89                                                                    | DFEE          | 87.10   | TFEE           | 97.13      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 10.32   |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 58 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating:Mains gas (c), Electricity (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 27.50 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 19.63 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)97.1 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)87.1 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.18 (max. 0.20) | 0.18 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls: No cylinderstat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing West: 12.20 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Thermal bridging y-value 0.033 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.3000 (1b)              | x 2.4000 (2b)                   | = 139.9200 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.3000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 139.9200 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                |                  | m3 per hour |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|----------------------|------------------|-------------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                      |                  |             |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =             | 0.0000           | (6a)        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =             | 0.0000           | (6b)        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =             | 0.0000           | (7a)        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =             | 0.0000           | (7b)        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =             | 0.0000           | (7c)        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                      |                  |             |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000               | / (5) =          | 0.0000      | (8)    |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                      |                  | Yes         |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                      |                  | 3.0000      |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                      |                  | 0.1500      | (18)   |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                      |                  | 3           | (19)   |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 -           | [0.075 x (19)] = | 0.7750      | (20)   |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) = |                  | 0.1163      | (21)   |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                  | Aug              | Sep         | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000               | 3.7000           | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500               | 0.9250           | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1482                       | 0.1453 | 0.1424    | 0.1279 | 0.1250 | 0.1104 | 0.1104               | 0.1075           | 0.1163      | 0.1250 | 0.1308 | 0.1366 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                      |                  |             |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                      |                  |             |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                      |                  |             |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2487                       | 0.2458 | 0.2429    | 0.2284 | 0.2255 | 0.2109 | 0.2109               | 0.2080           | 0.2168      | 0.2255 | 0.2313 | 0.2371 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K                         | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K    |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------------------------------|--------------------------------|------------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364                              |                                | (27)             |
| W02 (Uw = 1.40)                                                |                         |                            | 3.8000                    | 1.3258                        | 5.0379                               |                                | (27)             |
| entrance door                                                  |                         |                            | 2.1000                    | 1.4000                        | 2.9400                               |                                | (26a)            |
| External Wall 1                                                | 41.0000                 | 12.2000                    | 28.8000                   | 0.1500                        | 4.3200                               | 140.0000                       | 4032.0000 (29a)  |
| Corridor Wall                                                  | 277.0000                | 2.1000                     | 274.9000                  | 0.1500                        | 41.2350                              | 110.0000                       | 30239.0000 (29a) |
| Exposed ceiling                                                | 6.7000                  |                            | 6.7000                    | 0.1800                        | 1.2060                               | 9.0000                         | 60.3000 (30)     |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 324.7000                  |                               |                                      |                                | (31)             |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 65.8752                              |                                | (33)             |
| Party Wall 1                                                   |                         |                            | 27.7000                   | 0.0000                        | 0.0000                               | 140.0000                       | 3878.0000 (32)   |
| Party Floor                                                    |                         |                            | 58.3000                   |                               |                                      | 80.0000                        | 4664.0000 (32d)  |
| Party Ceilings                                                 |                         |                            | 51.6000                   |                               |                                      | 80.0000                        | 4128.0000 (32b)  |
| Internal Wall                                                  |                         |                            | 74.0000                   |                               |                                      | 9.0000                         | 666.0000 (32c)   |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               | (28)...(30) + (32) + (32a)...(32e) = |                                | 47667.3000 (34)  |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |                                      |                                | 817.6209 (35)    |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |                                      |                                | 10.5848 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |                                      | (33) + (36) =                  | 76.4600 (37)     |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 11.4842 | 11.3500 | 11.2159 | 10.5449 | 10.4107 | 9.7397  | 9.7397  | 9.6056  | 10.0081 | 10.4107 | 10.6791 | 10.9475 (38) |
| Heat transfer coeff       | 87.9443 | 87.8101 | 87.6759 | 87.0049 | 86.8707 | 86.1998 | 86.1998 | 86.0656 | 86.4682 | 86.8707 | 87.1391 | 87.4075 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 86.9714 (39) |
| HLP                       | 1.5085  | 1.5062  | 1.5039  | 1.4924  | 1.4901  | 1.4786  | 1.4786  | 1.4763  | 1.4832  | 1.4901  | 1.4947  | 1.4993 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.4918 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 1.9332 (42)  |
| Average daily hot water use (litres/day) | 84.3296 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |



|                                                                 |                      |          |          |          |          |          |          |                               |             |                     |          |           |             |
|-----------------------------------------------------------------|----------------------|----------|----------|----------|----------|----------|----------|-------------------------------|-------------|---------------------|----------|-----------|-------------|
| Energy conte                                                    | 92.7625              | 89.3893  | 86.0162  | 82.6430  | 79.2698  | 75.8966  | 75.8966  | 79.2698                       | 82.6430     | 86.0162             | 89.3893  | 92.7625   | (44)        |
| Energy content (annual)                                         | 137.5642             | 120.3145 | 124.1538 | 108.2403 | 103.8591 | 89.6225  | 83.0484  | 95.2993                       | 96.4375     | 112.3886            | 122.6809 | 133.2235  | (45)        |
| Distribution loss                                               | (46)m = 0.15 x (45)m |          |          |          |          |          |          |                               |             | Total = Sum (45)m = |          | 1326.8325 | (45)        |
|                                                                 | 20.6346              | 18.0472  | 18.6231  | 16.2360  | 15.5789  | 13.4434  | 12.4573  | 14.2949                       | 14.4656     | 16.8583             | 18.4021  | 19.9835   | (46)        |
| Water storage loss:                                             |                      |          |          |          |          |          |          |                               |             |                     |          |           |             |
| Store volume                                                    |                      |          |          |          |          |          |          |                               |             |                     |          |           |             |
| a) If manufacturer declared loss factor is known (kWh/day):     |                      |          |          |          |          |          |          |                               |             |                     |          |           | 2.0000 (47) |
| Temperature factor from Table 2b                                |                      |          |          |          |          |          |          |                               |             |                     |          |           | 0.7400 (48) |
| Enter (49) or (54) in (55)                                      |                      |          |          |          |          |          |          |                               |             |                     |          |           | 1.0000 (49) |
| Total storage loss                                              |                      |          |          |          |          |          |          |                               |             |                     |          |           | 0.7400 (55) |
|                                                                 | 22.9400              | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400                       | 22.2000     | 22.9400             | 22.2000  | 22.9400   | (56)        |
| If cylinder contains dedicated solar storage                    |                      |          |          |          |          |          |          |                               |             |                     |          |           |             |
|                                                                 | 22.9400              | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400                       | 22.2000     | 22.9400             | 22.2000  | 22.9400   | (57)        |
| Primary loss                                                    | 23.2624              | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                       | 22.5120     | 23.2624             | 22.5120  | 23.2624   | (59)        |
| Total heat required for water heating calculated for each month |                      |          |          |          |          |          |          |                               |             |                     |          |           |             |
| Solar input                                                     | 183.7666             | 162.0457 | 170.3562 | 152.9523 | 150.0615 | 134.3345 | 129.2508 | 141.5017                      | 141.1495    | 158.5910            | 167.3929 | 179.4259  | (62)        |
|                                                                 | 0.0000               | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                        | 0.0000      | 0.0000              | 0.0000   | 0.0000    | (63)        |
|                                                                 |                      |          |          |          |          |          |          | Solar input (sum of months) = | Sum (63)m = |                     |          | 0.0000    | (63)        |
| Output from w/h                                                 |                      |          |          |          |          |          |          |                               |             |                     |          |           |             |
|                                                                 | 183.7666             | 162.0457 | 170.3562 | 152.9523 | 150.0615 | 134.3345 | 129.2508 | 141.5017                      | 141.1495    | 158.5910            | 167.3929 | 179.4259  | (64)        |
|                                                                 |                      |          |          |          |          |          |          | Total per year (kWh/year) =   | Sum (64)m = |                     |          | 1870.8285 | (64)        |
| Heat gains from water heating, kWh/month                        |                      |          |          |          |          |          |          |                               |             |                     |          |           |             |
|                                                                 | 82.7020              | 73.3895  | 78.2430  | 71.7595  | 71.4951  | 65.5691  | 64.5755  | 68.6489                       | 67.8351     | 74.3311             | 76.5610  | 81.2587   | (66)        |

[illegible]

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 64.0316 (99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 3733.0396 (98)   |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 1803.0581 (307a) |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 2116.6335 (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1870.8285 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 903.6102 (310a)  |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1060.7598 (310b) |
| Electricity used for heat distribution                                                  | 58.8406 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 113.0903 (330a)  |
| Total electricity for the above, kWh/year                                               | 113.0903 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 265.5119 (332)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415 (333)  |
| Total delivered energy for all uses                                                     | 5890.0223 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 731.5320           | 0.5190                        | 379.6651 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 3383.8054          | 0.2160                        | 730.9020 (368)           |
| Electrical energy for heat distribution                                                    | 58.8406            | 0.5190                        | 30.5383 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 1141.1053 (373)          |
| Space and water heating                                                                    |                    |                               | 1141.1053 (376)          |
| Pumps and fans                                                                             | 113.0903           | 0.5190                        | 58.6939 (378)            |
| Energy for lighting                                                                        | 265.5119           | 0.5190                        | 137.8007 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 1144.1990 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 19.6300 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 19.6300 ZC1 |
| Total Floor Area                                                                | 58.3000     |
| Assumed number of occupants                                                     | 1.9332      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   | 17.1411 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.8370 ZC3  |
| Total CO2 emissions                                                             | 39.6081 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 39.6081 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.3000 (1b)              | x 2.4000 (2b)                   | = 139.9200 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.3000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 139.9200 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour       |
| Pressure test                                                             |                 |                      |       |                             | 20.0000 / (5) = 0.1429 (8) |
| Measured/design AP50                                                      |                 |                      |       |                             | Yes                        |
| Infiltration rate                                                         |                 |                      |       |                             | 5.0000                     |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0.3929 (18)                |
|                                                                           |                 |                      |       |                             | 3 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.7750 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3045 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.3883 | 0.3807 | 0.3730 | 0.3350 | 0.3274 | 0.2893 | 0.2893 | 0.2817 | 0.3045 | 0.3274 | 0.3426 | 0.3578 (22b) |
|                 | 0.5754 | 0.5725 | 0.5696 | 0.5561 | 0.5536 | 0.5418 | 0.5418 | 0.5397 | 0.5464 | 0.5536 | 0.5587 | 0.5640 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 12.2000                   | 1.3258                        | 16.1742      |                                | (27)          |
| External Wall 1                                                | 41.0000                 | 12.2000                    | 28.8000                   | 0.1800                        | 5.1840       |                                | (29a)         |
| Corridor Wall                                                  | 277.0000                | 2.1000                     | 274.9000                  | 0.1800                        | 49.4820      |                                | (29a)         |
| Exposed ceiling                                                | 6.7000                  |                            | 6.7000                    | 0.1300                        | 0.8710       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 324.7000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 74.2312      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 9.3348 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 83.5660 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| (38)m                     | 26.5673  | 26.4321  | 26.2996  | 25.6774  | 25.5610  | 25.0191  | 25.0191  | 24.9187  | 25.2278  | 25.5610  | 25.7965  | 26.0427 (38)  |
| Heat transfer coeff       | 110.1333 | 109.9982 | 109.8657 | 109.2435 | 109.1270 | 108.5851 | 108.5851 | 108.4847 | 108.7938 | 109.1270 | 109.3625 | 109.6088 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 109.2429 (39) |
| HLP                       | 1.8891   | 1.8868   | 1.8845   | 1.8738   | 1.8718   | 1.8625   | 1.8625   | 1.8608   | 1.8661   | 1.8718   | 1.8759   | 1.8801 (40)   |
| HLP (average)             |          |          |          |          |          |          |          |          |          |          |          | 1.8738 (40)   |
| Days in month             | 31       | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30       | 31       | 30       | 31 (41)       |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |                    |          | 1.9332 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |                    |          | 80.1131 (43)   |
| Daily hot water use                                         | 88.1244  | 84.9199  | 81.7154  | 78.5108  | 75.3063 | 72.1018 | 72.1018 | 75.3063 | 78.5108 | 81.7154            | 84.9199  | 88.1244 (44)   |
| Energy conte                                                | 130.6859 | 114.2988 | 117.9461 | 102.8283 | 98.6662 | 85.1414 | 78.8960 | 90.5343 | 91.6156 | 106.7691           | 116.5469 | 126.5624 (45)  |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         | Total = Sum(45)m = |          | 1260.4909 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 19.6029  | 17.1448  | 17.6919  | 15.4242  | 14.7999 | 12.7712 | 11.8344 | 13.5801 | 13.7423 | 16.0154            | 17.4820  | 18.9844 (46)   |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |                    |          | 2.0000 (47)    |
| Store volume                                                |          |          |          |          |         |         |         |         |         |                    |          | 0.2388 (48)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |                    |          | 0.1290 (55)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 157.9461 | 138.9208 | 145.2062 | 129.2090 | 125.9263 | 111.5222 | 106.1562 | 117.7945 | 117.9964 | 134.0293 | 142.9277 | 153.8225 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 157.9461 | 138.9208 | 145.2062 | 129.2090 | 125.9263 | 111.5222 | 106.1562 | 117.7945 | 117.9964 | 134.0293 | 142.9277 | 153.8225 (64) |
| Heat gains from water heating, kWh/month                        | 65.2612  | 57.7020  | 61.0252  | 55.2950  | 54.6146  | 49.4141  | 48.0410  | 51.9108  | 51.5668  | 57.3089  | 59.8565  | 63.8901 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.0794  | 13.3934  | 10.8922  | 8.2461   | 6.1641   | 5.2040   | 5.6231   | 7.3091   | 9.8102   | 12.4564  | 14.5384  | 15.4985  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 168.6400 | 170.3900 | 165.9802 | 156.5922 | 144.7415 | 133.6035 | 126.1627 | 124.4127 | 128.8225 | 138.2105 | 150.0612 | 161.1992 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | (71) |
| Water heating gains (Table 5)                                                       | 87.7167  | 85.8661  | 82.0231  | 76.7986  | 73.4067  | 68.6308  | 64.5713  | 69.7726  | 71.6206  | 77.0280  | 83.1340  | 85.8738  | (72) |
| Total internal gains                                                                | 326.4338 | 324.6472 | 313.8933 | 296.6347 | 279.3100 | 262.4360 | 251.3548 | 256.4921 | 265.2511 | 282.6927 | 302.7314 | 317.5692 | (73) |

#### 6. Solar gains

| [Jan]       |  |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d |          |          | Gains<br>W   |
|-------------|--|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|----------|----------|--------------|
| -----       |  |          |          |          |            |                                |                                   |                                    |          |          |                              |          |          |              |
| West        |  |          |          |          | 12.2000    | 19.6403                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       |          |          | 73.2283 (80) |
| -----       |  |          |          |          |            |                                |                                   |                                    |          |          |                              |          |          |              |
| Solar gains |  | 73.2283  | 143.2501 | 235.9125 | 344.0643   | 421.6637                       | 431.6479                          | 410.9464                           | 352.9969 | 274.3760 | 169.9783                     | 91.3071  | 60.2194  | (83)         |
| Total gains |  | 399.6622 | 467.8973 | 549.8058 | 640.6990   | 700.9738                       | 694.0838                          | 662.3011                           | 609.4890 | 539.6271 | 452.6710                     | 394.0384 | 377.7886 | (84)         |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 36.7610 | 36.8062 | 36.8506 | 37.0604 | 37.1000 | 37.2851 | 37.2851 | 37.3196 | 37.2136 | 37.1000 | 37.0201 | 36.9369 |              |
| alpha                                                                       | 3.4507  | 3.4537  | 3.4567  | 3.4707  | 3.4733  | 3.4857  | 3.4857  | 3.4880  | 3.4809  | 3.4733  | 3.4680  | 3.4625  |              |
| util living area                                                            | 0.9960  | 0.9926  | 0.9833  | 0.9566  | 0.8943  | 0.7775  | 0.6376  | 0.6941  | 0.8846  | 0.9749  | 0.9931  | 0.9967  | (86)         |
| MIT                                                                         | 18.9538 | 19.1443 | 19.5047 | 19.9909 | 20.4476 | 20.7786 | 20.9209 | 20.8916 | 20.6105 | 20.0125 | 19.3939 | 18.9172 | (87)         |
| Th 2                                                                        | 19.4083 | 19.4099 | 19.4115 | 19.4188 | 19.4202 | 19.4266 | 19.4266 | 19.4277 | 19.4241 | 19.4202 | 19.4174 | 19.4145 | (88)         |
| util rest of house                                                          | 0.9945  | 0.9898  | 0.9765  | 0.9371  | 0.8418  | 0.6581  | 0.4458  | 0.5082  | 0.8035  | 0.9601  | 0.9900  | 0.9955  | (89)         |
| MIT 2                                                                       | 16.7747 | 17.0530 | 17.5768 | 18.2750 | 18.8939 | 19.2860 | 19.4022 | 19.3887 | 19.1201 | 18.3193 | 17.4232 | 16.7248 | (90)         |
| Living area fraction                                                        | 17.8287 | 18.0646 | 18.5093 | 19.1050 | 19.6454 | 20.0080 | 20.1368 | 20.1156 | 19.8410 | 19.1383 | 18.3764 | 17.7853 | (92)         |
| Temperature adjustment                                                      | 17.8287 | 18.0646 | 18.5093 | 19.1050 | 19.6454 | 20.0080 | 20.1368 | 20.1156 | 19.8410 | 19.1383 | 18.3764 | 17.7853 | (93)         |
| adjusted MIT                                                                | 17.8287 | 18.0646 | 18.5093 | 19.1050 | 19.6454 | 20.0080 | 20.1368 | 20.1156 | 19.8410 | 19.1383 | 18.3764 | 17.7853 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |          |           |           |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec       |       |
|                      | 0.9922    | 0.9862    | 0.9711    | 0.9321    | 0.8509   | 0.7082   | 0.5399   | 0.5986   | 0.8299   | 0.9564   | 0.9869    | 0.9935    | (94)  |
| Useful gains         | 396.5341  | 461.4562  | 533.9265  | 597.1897  | 596.4385 | 491.5489 | 357.6087 | 364.8372 | 447.8242 | 432.9254 | 388.8789  | 375.3416  | (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000    | (96)  |
| Heat loss rate W     | 1489.9660 | 1448.0808 | 1319.4110 | 1114.8299 | 867.0583 | 587.2276 | 384.0469 | 403.0911 | 624.5879 | 931.7603 | 1233.2190 | 1489.0642 | (97)  |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000    | (97a) |
| Space heating kWh    | 813.5133  | 663.0117  | 584.4004  | 372.7009  | 201.3411 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 371.1332 | 607.9249  | 828.6096  | (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |          |           | 4442.6351 | (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |          |           | 76.2030   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 4751.4814 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 813.5133 | 663.0117 | 584.4004 | 372.7009 | 201.3411 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 371.1332 | 607.9249 | 828.6096  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 870.0677 | 709.1034 | 625.0272 | 398.6106 | 215.3381 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 396.9339 | 650.1870 | 886.2135  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 157.9461 | 138.9208 | 145.2062 | 129.2090 | 125.9263 | 111.5222 | 106.1562 | 117.7945 | 117.9964 | 134.0293 | 142.9277 | 153.8225  | (64)            |
| Efficiency of water heater (217)m                                     | 88.5692  | 88.4456  | 88.1477  | 87.4803  | 86.0599  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 87.3910  | 88.2476  | 88.6391   | (216)           |
| Fuel for water heating, kWh/month                                     | 178.3308 | 157.0692 | 164.7305 | 147.7007 | 146.3241 | 139.7521 | 133.0278 | 147.6121 | 147.8651 | 153.3673 | 161.9621 | 173.5380  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1851.2799 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 4751.4814 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 266.3071  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 6944.0683 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 4751.4814          | 0.2160                        | 1026.3200 (261)          |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1851.2799          | 0.2160                        | 399.8765 (264)           |
| Space and water heating                                                                           |                    |                               | 1426.1964 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 266.3071           | 0.5190                        | 138.2134 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1603.3348 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 24.4631 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3707 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6677 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (24.4631 * 1.00) + 2.3707 + 0.6677, rounded to 2 d.p. |                    |                               | 27.5000 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-3-03                                                                  |               |         | Issued on Date | 14/01/2020 |
| Assessment Reference               | ASHP 50%                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 80 C                                                                    | DER           | 20.79   | TER            | 27.50      |
| Environmental                      | 86 B                                                                    | % DER<TER     | 24.40   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.94                                                                    | DFEE          | 87.10   | TFEE           | 97.13      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 10.32   |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 58 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 27.50 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 20.79 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 97.1 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 87.1 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.18 (max. 0.20) | 0.18 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK  
Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing West: 12.20 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Thermal bridging y-value 0.033 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.3000 (1b)              | x 2.4000 (2b)                   | = 139.9200 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.3000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 139.9200 (5)              |

#### 2. Ventilation rate

|                                                                                              |        |        |        |        | main    | secondary | other   |        |        | total                       | m3 per hour |              |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|---------|-----------|---------|--------|--------|-----------------------------|-------------|--------------|
|                                                                                              |        |        |        |        | heating |           | heating |        |        |                             |             |              |
| Number of chimneys                                                                           |        |        |        |        | 0       | +         | 0       | +      | 0      | =                           | 0 * 40 =    | 0.0000 (6a)  |
| Number of open flues                                                                         |        |        |        |        | 0       | +         | 0       | +      | 0      | =                           | 0 * 20 =    | 0.0000 (6b)  |
| Number of intermittent fans                                                                  |        |        |        |        |         |           |         |        |        |                             | 0 * 10 =    | 0.0000 (7a)  |
| Number of passive vents                                                                      |        |        |        |        |         |           |         |        |        |                             | 0 * 10 =    | 0.0000 (7b)  |
| Number of flueless gas fires                                                                 |        |        |        |        |         |           |         |        |        |                             | 0 * 40 =    | 0.0000 (7c)  |
| Air changes per hour                                                                         |        |        |        |        |         |           |         |        |        |                             |             |              |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =                    |        |        |        |        |         |           |         |        |        | 0.0000 / (5) =              | 0.0000 (8)  |              |
| Pressure test                                                                                |        |        |        |        |         |           |         |        |        |                             |             |              |
| Measured/design AP50                                                                         |        |        |        |        |         |           |         |        |        |                             |             |              |
| Infiltration rate                                                                            |        |        |        |        |         |           |         |        |        |                             |             |              |
| Number of sides sheltered                                                                    |        |        |        |        |         |           |         |        |        |                             |             |              |
| Shelter factor                                                                               |        |        |        |        |         |           |         |        |        | (20) = 1 - [0.075 x (19)] = | 0.7750 (20) |              |
| Infiltration rate adjusted to include shelter factor                                         |        |        |        |        |         |           |         |        |        | (21) = (18) x (20) =        | 0.1163 (21) |              |
|                                                                                              | Jan    | Feb    | Mar    | Apr    | May     | Jun       | Jul     | Aug    | Sep    | Oct                         | Nov         | Dec          |
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000  | 3.8000    | 3.8000  | 3.7000 | 4.0000 | 4.3000                      | 4.5000      | 4.7000 (22)  |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750  | 0.9500    | 0.9500  | 0.9250 | 1.0000 | 1.0750                      | 1.1250      | 1.1750 (22a) |
| Adj infilt rate                                                                              | 0.1482 | 0.1453 | 0.1424 | 0.1279 | 0.1250  | 0.1104    | 0.1104  | 0.1075 | 0.1163 | 0.1250                      | 0.1308      | 0.1366 (22b) |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |         |           |         |        |        |                             |             |              |
| If mechanical ventilation:                                                                   |        |        |        |        |         |           |         |        |        |                             |             |              |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |         |           |         |        |        |                             |             |              |
| Effective ac                                                                                 | 0.2487 | 0.2458 | 0.2429 | 0.2284 | 0.2255  | 0.2109    | 0.2109  | 0.2080 | 0.2168 | 0.2255                      | 0.2313      | 0.2371 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364      |                                | (27)                                                 |
| W02 (Uw = 1.40)                                                |                         |                            | 3.8000                    | 1.3258                        | 5.0379       |                                | (27)                                                 |
| entrance door                                                  |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                | (26a)                                                |
| External Wall 1                                                | 41.0000                 | 12.2000                    | 28.8000                   | 0.1500                        | 4.3200       | 140.0000                       | 4032.0000 (29a)                                      |
| Corridor Wall                                                  | 277.0000                | 2.1000                     | 274.9000                  | 0.1500                        | 41.2350      | 110.0000                       | 30239.0000 (29a)                                     |
| Exposed ceiling                                                | 6.7000                  |                            | 6.7000                    | 0.1800                        | 1.2060       | 9.0000                         | 60.3000 (30)                                         |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 324.7000                  |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 65.8752      |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 27.7000                   | 0.0000                        | 0.0000       | 140.0000                       | 3878.0000 (32)                                       |
| Party Floor                                                    |                         |                            | 58.3000                   |                               |              | 80.0000                        | 4664.0000 (32d)                                      |
| Party Ceilings                                                 |                         |                            | 51.6000                   |                               |              | 80.0000                        | 4128.0000 (32b)                                      |
| Internal Wall                                                  |                         |                            | 74.0000                   |                               |              | 9.0000                         | 666.0000 (32c)                                       |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 47667.3000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 817.6209 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 10.5848 (36)                                         |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 76.4600 (37)                                         |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 11.4842 | 11.3500 | 11.2159 | 10.5449 | 10.4107 | 9.7397  | 9.7397  | 9.6056  | 10.0081 | 10.4107 | 10.6791 | 10.9475 (38) |
| Heat transfer coeff       | 87.9443 | 87.8101 | 87.6759 | 87.0049 | 86.8707 | 86.1998 | 86.1998 | 86.0656 | 86.4682 | 86.8707 | 87.1391 | 87.4075 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 86.9714 (39) |
| HLP                       | 1.5085  | 1.5062  | 1.5039  | 1.4924  | 1.4901  | 1.4786  | 1.4786  | 1.4763  | 1.4832  | 1.4901  | 1.4947  | 1.4993 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.4918 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 1.9332 (42)  |
| Average daily hot water use (litres/day) | 84.3296 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

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|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy conte                                                    | 92.7625  | 89.3893  | 86.0162  | 82.6430  | 79.2698  | 75.8966  | 75.8966  | 79.2698  | 82.6430  | 86.0162             | 89.3893  | 92.7625 (44)   |
| Energy content (annual)                                         | 137.5642 | 120.3145 | 124.1538 | 108.2403 | 103.8591 | 89.6225  | 83.0484  | 95.2993  | 96.4375  | 112.3886            | 122.6809 | 133.2235 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1326.8325 (45) |
|                                                                 | 20.6346  | 18.0472  | 18.6231  | 16.2360  | 15.5789  | 13.4434  | 12.4573  | 14.2949  | 14.4656  | 16.8583             | 18.4021  | 19.9835 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |                     |          |                |
| Solar input                                                     | 183.7666 | 162.0457 | 170.3562 | 152.9523 | 150.0615 | 134.3345 | 129.2508 | 141.5017 | 141.1495 | 158.5910            | 167.3929 | 179.4259 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum (63)m =                       |          |          |          |          |          |          |          |          |          |                     |          | 0.0000 (63)    |
| Output from w/h                                                 | 183.7666 | 162.0457 | 170.3562 | 152.9523 | 150.0615 | 134.3345 | 129.2508 | 141.5017 | 141.1495 | 158.5910            | 167.3929 | 179.4259 (64)  |
| Heat gains from water heating, kWh/month                        | 82.7020  | 73.3895  | 78.2430  | 71.7595  | 71.4951  | 65.5691  | 64.5755  | 68.6489  | 67.8351  | 74.3311             | 76.5610  | 81.2587 (65)   |
|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 15.0344  | 13.3534  | 10.8597  | 8.2215   | 6.1457   | 5.1884   | 5.6063   | 7.2873   | 9.7810   | 12.4192  | 14.4950  | 15.4522 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 168.6400 | 170.3900 | 165.9802 | 156.5922 | 144.7415 | 133.6035 | 126.1627 | 124.4127 | 128.8225 | 138.2105 | 150.0612 | 161.1992 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 111.1586 | 109.2106 | 105.1654 | 99.6660  | 96.0955  | 91.0682  | 86.7951  | 92.2701  | 94.2154  | 99.9074  | 106.3347 | 109.2187 (72) |
| Total internal gains                                                                | 346.8308 | 344.9517 | 334.0030 | 316.4774 | 298.9804 | 281.8579 | 270.5618 | 275.9678 | 284.8166 | 302.5349 | 322.8887 | 337.8679 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          |          | Gains<br>W    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|----------|---------------|
| West        |          |          |          |          | 8.4000     | 19.6403                        | 0.3700                            | 0.8900                             | 0.7700                       |          |          | 37.6488 (80)  |
| West        |          |          |          |          | 3.8000     | 19.6403                        | 0.3700                            | 0.6800                             | 0.7700                       |          |          | 13.0129 (80)  |
| -----       |          |          |          |          |            |                                |                                   |                                    |                              |          |          |               |
| Solar gains | 50.6618  | 99.1051  | 163.2121 | 238.0351 | 291.7209   | 298.6282                       | 284.3063                          | 244.2149                           | 189.8224                     | 117.5966 | 63.1693  | 41.6618 (83)  |
| Total gains | 397.4925 | 444.0569 | 497.2151 | 554.5124 | 590.7013   | 580.4861                       | 554.8680                          | 520.1827                           | 474.6390                     | 420.1315 | 386.0580 | 379.5297 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |          |          |          |          |          |          |          |          |                           |          |          |              |
|-----------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|----------|----------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |          |          |          |          |          |          |          |          |                           |          |          | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |          |          |          |          |          |          |          |          |                           |          |          |              |
|                                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep                       | Oct      | Nov      | Dec          |
| tau                                                                         | 150.5603 | 150.7904 | 151.0212 | 152.1858 | 152.4209 | 153.6073 | 153.6073 | 153.8468 | 153.1305                  | 152.4209 | 151.9514 | 151.4849     |
| alpha                                                                       | 11.0374  | 11.0527  | 11.0681  | 11.1457  | 11.1614  | 11.2405  | 11.2405  | 11.2565  | 11.2087                   | 11.1614  | 11.1301  | 11.0990      |
| util living area                                                            | 1.0000   | 1.0000   | 1.0000   | 0.9996   | 0.9917   | 0.8930   | 0.6805   | 0.7524   | 0.9832                    | 0.9999   | 1.0000   | 1.0000 (86)  |
| MIT                                                                         | 20.3967  | 20.4538  | 20.5639  | 20.7190  | 20.8747  | 20.9812  | 20.9991  | 20.9974  | 20.9267                   | 20.7274  | 20.5348  | 20.3863 (87) |
| Th 2                                                                        | 19.6811  | 19.6829  | 19.6846  | 19.6932  | 19.6950  | 19.7036  | 19.7036  | 19.7054  | 19.7002                   | 19.6950  | 19.6915  | 19.6880 (88) |
| util rest of house                                                          | 1.0000   | 1.0000   | 0.9999   | 0.9988   | 0.9715   | 0.7495   | 0.4821   | 0.5466   | 0.9270                    | 0.9996   | 1.0000   | 1.0000 (89)  |
| MIT 2                                                                       | 18.8932  | 18.9783  | 19.1410  | 19.3752  | 19.5953  | 19.6996  | 19.7036  | 19.7052  | 19.6636                   | 19.3893  | 19.1043  | 18.8839 (90) |
| Living area fraction                                                        |          |          |          |          |          |          |          |          | fLA = Living area / (4) = |          |          | 0.4837 (91)  |
| MIT                                                                         | 19.6204  | 19.6920  | 19.8293  | 20.0252  | 20.2142  | 20.3195  | 20.3302  | 20.3303  | 20.2746                   | 20.0366  | 19.7963  | 19.6106 (92) |
| Temperature adjustment                                                      |          |          |          |          |          |          |          |          |                           |          |          | 0.0000       |
| adjusted MIT                                                                | 19.6204  | 19.6920  | 19.8293  | 20.0252  | 20.2142  | 20.3195  | 20.3302  | 20.3303  | 20.2746                   | 20.0366  | 19.7963  | 19.6106 (93) |

#### 8. Space heating requirement

|                   |           |           |           |          |          |          |          |          |          |          |           |                |
|-------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Utilisation       | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec            |
|                   | 1.0000    | 1.0000    | 1.0000    | 0.9991   | 0.9825   | 0.8257   | 0.5790   | 0.6485   | 0.9611   | 0.9997   | 1.0000    | 1.0000 (94)    |
| Useful gains      | 397.4921  | 444.0548  | 497.1928  | 554.0356 | 580.3593 | 479.3155 | 321.2495 | 337.3259 | 456.1525 | 420.0136 | 386.0559  | 379.5295 (95)  |
| Ext temp.         | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000 (96)    |
| Heat loss rate W  | 1347.3458 | 1298.8850 | 1168.6547 | 967.9444 | 739.6329 | 493.0203 | 321.5434 | 338.2620 | 533.9024 | 819.7606 | 1106.3429 | 1347.0062 (97) |
| Month fracti      | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000 (97a)   |
| Space heating kWh | 706.6911  | 574.4459  | 499.5677  | 298.0144 | 118.4995 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 297.4117 | 518.6066  | 719.8027 (98)  |
| Space heating     |           |           |           |          |          |          |          |          |          |          |           | 3733.0396 (98) |

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Space heating per m2 (98) / (4) = 64.0316 (99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.5000 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5000 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.5000 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5000 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 3733.0396 (98)   |
| Space heat from Heat pump = (98) x 0.50 x 1.00 x 1.10                                   | 2053.1718 (307a) |
| Space heat from Boilers = (98) x 0.50 x 1.00 x 1.10                                     | 2053.1718 (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1870.8285 (64)   |
| Water heat from Heat pump = (64) x 0.50 x 1.00 x 1.10                                   | 1028.9557 (310a) |
| Water heat from Boilers = (64) x 0.50 x 1.00 x 1.10                                     | 1028.9557 (310b) |
| Electricity used for heat distribution                                                  | 61.6425 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 113.0903 (330a)  |
| Total electricity for the above, kWh/year                                               | 113.0903 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 265.5119 (332)   |
| Energy saving/generation technologies (Appendices M, N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415 (333)  |
| Total delivered energy for all uses                                                     | 6170.2157 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 342.0000 (367a)          |
| Space heating from Heat pump                                                               | 901.2069           | 0.5190                        | 467.7264 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 3282.3509          | 0.2160                        | 708.9878 (368)           |
| Electrical energy for heat distribution                                                    | 61.6425            | 0.5190                        | 31.9925 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 1208.7066 (373)          |
| Space and water heating                                                                    |                    |                               | 1208.7066 (376)          |
| Pumps and fans                                                                             | 113.0903           | 0.5190                        | 58.6939 (378)            |
| Energy for lighting                                                                        | 265.5119           | 0.5190                        | 137.8007 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 1211.8003 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 20.7900 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 20.7900 ZC1 |
| Total Floor Area                                                                | 58.3000 TFA |
| Assumed number of occupants                                                     | N 1.9332    |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF 0.5190   |
| CO2 emissions from appliances, equation (L14)                                   | 17.1411 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 2.8370 ZC3  |
| Total CO2 emissions                                                             | 40.7681 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 40.7681 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 58.3000 (1b)              | x 2.4000 (2b)                   | = 139.9200 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 58.3000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 139.9200 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour    |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|----------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                          |                              |                      |       |       | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | Air changes per hour       |
| Pressure test                                        |                              |                      |       |       | 20.0000 / (5) = 0.1429 (8) |
| Measured/design AP50                                 |                              |                      |       |       | Yes                        |
| Infiltration rate                                    |                              |                      |       |       | 5.0000                     |
| Number of sides sheltered                            |                              |                      |       |       | 0.3929 (18)                |
|                                                      |                              |                      |       |       | 3 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.7750 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.3045 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.3883 | 0.3807 | 0.3730 | 0.3350 | 0.3274 | 0.2893 | 0.2893 | 0.2817 | 0.3045 | 0.3274 | 0.3426 | 0.3578 (22b) |
| Effective ac    | 0.5754 | 0.5725 | 0.5696 | 0.5561 | 0.5536 | 0.5418 | 0.5418 | 0.5397 | 0.5464 | 0.5536 | 0.5587 | 0.5640 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 12.2000                   | 1.3258                        | 16.1742      |                                | (27)          |
| External Wall 1                                                | 41.0000                 | 12.2000                    | 28.8000                   | 0.1800                        | 5.1840       |                                | (29a)         |
| Corridor Wall                                                  | 277.0000                | 2.1000                     | 274.9000                  | 0.1800                        | 49.4820      |                                | (29a)         |
| Exposed ceiling                                                | 6.7000                  |                            | 6.7000                    | 0.1300                        | 0.8710       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 324.7000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 74.2312      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 9.3348 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 83.5660 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|---------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| (38)m                     | 26.5673  | 26.4321  | 26.2996  | 25.6774  | 25.5610  | 25.0191  | 25.0191  | 24.9187  | 25.2278  | 25.5610  | 25.7965  | 26.0427 (38)  |
| Heat transfer coeff       | 110.1333 | 109.9982 | 109.8657 | 109.2435 | 109.1270 | 108.5851 | 108.5851 | 108.4847 | 108.7938 | 109.1270 | 109.3625 | 109.6088 (39) |
| Average = Sum(39)m / 12 = |          |          |          |          |          |          |          |          |          |          |          | 109.2429 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.8891 | 1.8868 | 1.8845 | 1.8738 | 1.8718 | 1.8625 | 1.8625 | 1.8608 | 1.8661 | 1.8718 | 1.8759 | 1.8801 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.8738 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |                    |          | 1.9332 (42)    |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |                    |          | 80.1131 (43)   |
|                                                             | Jan      | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct                | Nov      | Dec            |
| Daily hot water use                                         | 88.1244  | 84.9199  | 81.7154  | 78.5108  | 75.3063 | 72.1018 | 72.1018 | 75.3063 | 78.5108 | 81.7154            | 84.9199  | 88.1244 (44)   |
| Energy conte                                                | 130.6859 | 114.2988 | 117.9461 | 102.8283 | 98.6662 | 85.1414 | 78.8960 | 90.5343 | 91.6156 | 106.7691           | 116.5469 | 126.5624 (45)  |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         | Total = Sum(45)m = |          | 1260.4909 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 19.6029  | 17.1448  | 17.6919  | 15.4242  | 14.7999 | 12.7712 | 11.8344 | 13.5801 | 13.7423 | 16.0154            | 17.4820  | 18.9844 (46)   |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |                    |          | 2.0000 (47)    |
| Store volume                                                |          |          |          |          |         |         |         |         |         |                    |          | 0.2388 (48)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |                    |          | 0.1290 (55)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |                    |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 157.9461 | 138.9208 | 145.2062 | 129.2090 | 125.9263 | 111.5222 | 106.1562 | 117.7945 | 117.9964 | 134.0293 | 142.9277 | 153.8225 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 157.9461 | 138.9208 | 145.2062 | 129.2090 | 125.9263 | 111.5222 | 106.1562 | 117.7945 | 117.9964 | 134.0293 | 142.9277 | 153.8225 (64) |
| Heat gains from water heating, kWh/month                        | 65.2612  | 57.7020  | 61.0252  | 55.2950  | 54.6146  | 49.4141  | 48.0410  | 51.9108  | 51.5668  | 57.3089  | 59.8565  | 63.8901 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | 96.6591  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 15.0794  | 13.3934  | 10.8922  | 8.2461   | 6.1641   | 5.2040   | 5.6231   | 7.3091   | 9.8102   | 12.4564  | 14.5384  | 15.4985  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 168.6400 | 170.3900 | 165.9802 | 156.5922 | 144.7415 | 133.6035 | 126.1627 | 124.4127 | 128.8225 | 138.2105 | 150.0612 | 161.1992 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | 32.6659  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | -77.3273 | (71) |
| Water heating gains (Table 5)                                                       | 87.7167  | 85.8661  | 82.0231  | 76.7986  | 73.4067  | 68.6308  | 64.5713  | 69.7726  | 71.6206  | 77.0280  | 83.1340  | 85.8738  | (72) |
| Total internal gains                                                                | 326.4338 | 324.6472 | 313.8933 | 296.6347 | 279.3100 | 262.4360 | 251.3548 | 256.4921 | 265.2511 | 282.6927 | 302.7314 | 317.5692 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d | Gains<br>W   |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|------------------------------|--------------|----------|---------------|
| West        |          |          |          | 12.2000    | 19.6403                        | 0.6300                            | 0.7000                             |          | 0.7700                       | 73.2283 (80) |          |               |
| Solar gains | 73.2283  | 143.2501 | 235.9125 | 344.0643   | 421.6637                       | 431.6479                          | 410.9464                           | 352.9969 | 274.3760                     | 169.9783     | 91.3071  | 60.2194 (83)  |
| Total gains | 399.6622 | 467.8973 | 549.8058 | 640.6990   | 700.9738                       | 694.0838                          | 662.3011                           | 609.4890 | 539.6271                     | 452.6710     | 394.0384 | 377.7886 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 36.7610 | 36.8062 | 36.8506 | 37.0604 | 37.1000 | 37.2851 | 37.2851 | 37.3196 | 37.2136 | 37.1000 | 37.0201 | 36.9369 |              |
| alpha                                                                       | 3.4507  | 3.4537  | 3.4567  | 3.4707  | 3.4733  | 3.4857  | 3.4857  | 3.4880  | 3.4809  | 3.4733  | 3.4680  | 3.4625  |              |
| util living area                                                            | 0.9960  | 0.9926  | 0.9833  | 0.9566  | 0.8943  | 0.7775  | 0.6376  | 0.6941  | 0.8846  | 0.9749  | 0.9931  | 0.9967  | (86)         |
| MIT                                                                         | 18.9538 | 19.1443 | 19.5047 | 19.9909 | 20.4476 | 20.7786 | 20.9209 | 20.8916 | 20.6105 | 20.0125 | 19.3939 | 18.9172 | (87)         |
| Th 2                                                                        | 19.4083 | 19.4099 | 19.4115 | 19.4188 | 19.4202 | 19.4266 | 19.4266 | 19.4277 | 19.4241 | 19.4202 | 19.4174 | 19.4145 | (88)         |
| util rest of house                                                          | 0.9945  | 0.9898  | 0.9765  | 0.9371  | 0.8418  | 0.6581  | 0.4458  | 0.5082  | 0.8035  | 0.9601  | 0.9900  | 0.9955  | (89)         |
| MIT 2                                                                       | 16.7747 | 17.0530 | 17.5768 | 18.2750 | 18.8939 | 19.2860 | 19.4022 | 19.3887 | 19.1201 | 18.3193 | 17.4232 | 16.7248 | (90)         |
| Living area fraction                                                        | 17.8287 | 18.0646 | 18.5093 | 19.1050 | 19.6454 | 20.0080 | 20.1368 | 20.1156 | 19.8410 | 19.1383 | 18.3764 | 17.7853 | (92)         |
| Temperature adjustment                                                      | 17.8287 | 18.0646 | 18.5093 | 19.1050 | 19.6454 | 20.0080 | 20.1368 | 20.1156 | 19.8410 | 19.1383 | 18.3764 | 17.7853 | (93)         |
| adjusted MIT                                                                | 17.8287 | 18.0646 | 18.5093 | 19.1050 | 19.6454 | 20.0080 | 20.1368 | 20.1156 | 19.8410 | 19.1383 | 18.3764 | 17.7853 | (93)         |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |              |           |           |       |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|--------------|-----------|-----------|-------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov       | Dec       |       |
| Useful gains         | 0.9922    | 0.9862    | 0.9711    | 0.9321    | 0.8509   | 0.7082   | 0.5399   | 0.5986   | 0.8299   | 0.9564       | 0.9869    | 0.9935    | (94)  |
| Ext temp.            | 396.5341  | 461.4562  | 533.9265  | 597.1897  | 596.4385 | 491.5489 | 357.6087 | 364.8372 | 447.8242 | 432.9254     | 388.8789  | 375.3416  | (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000    | 4.2000    | (96)  |
| Month fracti         | 1489.9660 | 1448.0808 | 1319.4110 | 1114.8299 | 867.0583 | 587.2276 | 384.0469 | 403.0911 | 624.5879 | 931.7603     | 1233.2190 | 1489.0642 | (97)  |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000    | 1.0000    | (97a) |
| Space heating        | 813.5133  | 663.0117  | 584.4004  | 372.7009  | 201.3411 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 371.1332     | 607.9249  | 828.6096  | (98)  |
| Space heating per m2 |           |           |           |           |          |          |          |          |          |              |           | 4442.6351 | (98)  |
|                      |           |           |           |           |          |          |          |          |          | (98) / (4) = |           | 76.2030   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 4751.4814 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 813.5133 | 663.0117 | 584.4004 | 372.7009 | 201.3411 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 371.1332 | 607.9249 | 828.6096  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 870.0677 | 709.1034 | 625.0272 | 398.6106 | 215.3381 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 396.9339 | 650.1870 | 886.2135  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 157.9461 | 138.9208 | 145.2062 | 129.2090 | 125.9263 | 111.5222 | 106.1562 | 117.7945 | 117.9964 | 134.0293 | 142.9277 | 153.8225  | (64)            |
| Efficiency of water heater (217)m                                     | 88.5692  | 88.4456  | 88.1477  | 87.4803  | 86.0599  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 87.3910  | 88.2476  | 88.6391   | (216)           |
| Fuel for water heating, kWh/month                                     | 178.3308 | 157.0692 | 164.7305 | 147.7007 | 146.3241 | 139.7521 | 133.0278 | 147.6121 | 147.8651 | 153.3673 | 161.9621 | 173.5380  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1851.2799 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 4751.4814 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 266.3071  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 6944.0683 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 4751.4814          | 0.2160                        | 1026.3200 (261)          |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1851.2799          | 0.2160                        | 399.8765 (264)           |
| Space and water heating                                                                           |                    |                               | 1426.1964 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 266.3071           | 0.5190                        | 138.2134 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1603.3348 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 24.4631 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3707 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6677 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (24.4631 * 1.00) + 2.3707 + 0.6677, rounded to 2 d.p. |                    |                               | 27.5000 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-3-05                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP-1-2                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 86 B                                                                    | DER           | 11.44   | TER            | 17.36      |
| Environmental                      | 92 A                                                                    | % DER<TER     | 34.09   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.60                                                                    | DFEE          | 45.21   | TFEE           | 48.34      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 6.46    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 68 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 17.36 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 11.44 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 48.3 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 45.2 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.18 (max. 0.20) | 0.18 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK  
Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing South East: 7.61 m<sup>2</sup>, No overhang  
Windows facing South: 3.80 m<sup>2</sup>, No overhang  
Windows facing West: 8.40 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 68.1000 (1b)              | x 2.4000 (2b)                   | = 163.4400 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.1000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 163.4400 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes    |             |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000 |             |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 | (18)        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 1      | (19)        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.9250 | (20)        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1388 | (21)        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1769                       | 0.1734 | 0.1700    | 0.1526 | 0.1492 | 0.1318 | 0.1318                      | 0.1283 | 0.1388      | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2774                       | 0.2739 | 0.2705    | 0.2531 | 0.2497 | 0.2323 | 0.2323                      | 0.2288 | 0.2393      | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2        | U-value<br>W/m2K | A x U<br>W/K                         | K-value<br>kJ/m2K | A x K<br>kJ/K   |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------------|------------------|--------------------------------------|-------------------|-----------------|----------------|----------------|----------------|----------------|---------------------|
| W03 (Uw = 1.40)                                                     |                |                | 8.4000               | 1.3258           | 11.1364                              |                   | (27)            |                |                |                |                |                     |
| W02 (Uw = 1.40)                                                     |                |                | 11.4100              | 1.3258           | 15.1269                              |                   | (27)            |                |                |                |                |                     |
| door                                                                |                |                | 2.1000               | 1.4000           | 2.9400                               |                   | (26a)           |                |                |                |                |                     |
| External Wall 1                                                     | 62.2000        | 19.8100        | 42.3900              | 0.1500           | 6.3585                               | 140.0000          | 5934.6000 (29a) |                |                |                |                |                     |
| Corridor wall                                                       | 4.1500         | 2.1000         | 2.0500               | 0.1409           | 0.2889                               | 110.0000          | 225.5000 (29a)  |                |                |                |                |                     |
| Exposed ceiling                                                     | 9.6000         |                | 9.6000               | 0.1800           | 1.7280                               | 9.0000            | 86.4000 (30)    |                |                |                |                |                     |
| Total net area of external elements Aum(A, m2)                      |                |                | 75.9500              |                  |                                      |                   | (31)            |                |                |                |                |                     |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                | (26)...(30) + (32) = |                  | 37.5786                              |                   | (33)            |                |                |                |                |                     |
| Party Wall 1                                                        |                |                | 31.9000              | 0.0000           | 0.0000                               | 140.0000          | 4466.0000 (32)  |                |                |                |                |                     |
| Party Floor                                                         |                |                | 68.1000              |                  |                                      | 80.0000           | 5448.0000 (32d) |                |                |                |                |                     |
| Party Ceilings                                                      |                |                | 58.5000              |                  |                                      | 80.0000           | 4680.0000 (32b) |                |                |                |                |                     |
| Internal Wall                                                       |                |                | 109.6000             |                  |                                      | 9.0000            | 986.4000 (32c)  |                |                |                |                |                     |
| Heat capacity Cm = Sum(A x k)                                       |                |                |                      |                  | (28)...(30) + (32) + (32a)...(32e) = |                   | 21826.9000 (34) |                |                |                |                |                     |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                      |                  |                                      |                   | 320.5125 (35)   |                |                |                |                |                     |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                      |                  |                                      |                   | 18.3210 (36)    |                |                |                |                |                     |
| Total fabric heat loss                                              |                |                |                      |                  |                                      | (33) + (36) =     | 55.8996 (37)    |                |                |                |                |                     |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                      |                  |                                      |                   |                 |                |                |                |                |                     |
| (38)m                                                               | Jan<br>14.9620 | Feb<br>14.7749 | Mar<br>14.5878       | Apr<br>13.6523   | May<br>13.4653                       | Jun<br>12.5298    | Jul<br>12.5298  | Aug<br>12.3427 | Sep<br>12.9040 | Oct<br>13.4653 | Nov<br>13.8394 | Dec<br>14.2136 (38) |
| Heat transfer coeff                                                 | 70.8616        | 70.6745        | 70.4874              | 69.5520          | 69.3649                              | 68.4294           | 68.4294         | 68.2424        | 68.8036        | 69.3649        | 69.7391        | 70.1132 (39)        |
| Average = Sum(39)m / 12 =                                           |                |                |                      |                  |                                      |                   |                 |                |                |                |                | 69.5052 (39)        |
| HLP                                                                 | Jan<br>1.0406  | Feb<br>1.0378  | Mar<br>1.0351        | Apr<br>1.0213    | May<br>1.0186                        | Jun<br>1.0048     | Jul<br>1.0048   | Aug<br>1.0021  | Sep<br>1.0103  | Oct<br>1.0186  | Nov<br>1.0241  | Dec<br>1.0296 (40)  |
| HLP (average)                                                       |                |                |                      |                  |                                      |                   |                 |                |                |                |                | 1.0206 (40)         |
| Days in month                                                       | 31             | 28             | 31                   | 30               | 31                                   | 30                | 31              | 31             | 30             | 31             | 30             | 31 (41)             |

#### 4. Water heating energy requirements (kWh/year)

|                                          |     |     |     |     |     |     |     |     |     |     |     |              |
|------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------------|
| Assumed occupancy                        |     |     |     |     |     |     |     |     |     |     |     | 2.1991 (42)  |
| Average daily hot water use (litres/day) |     |     |     |     |     |     |     |     |     |     |     | 90.9782 (43) |
| Jan                                      | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |              |
| Daily hot water use                      |     |     |     |     |     |     |     |     |     |     |     |              |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy conte                                                    | 100.0760 | 96.4369  | 92.7978  | 89.1586  | 85.5195  | 81.8804  | 81.8804  | 85.5195  | 89.1586  | 92.7978             | 96.4369  | 100.0760 (44)  |
| Energy content (annual)                                         | 148.4098 | 129.8002 | 133.9422 | 116.7740 | 112.0475 | 96.6884  | 89.5960  | 102.8128 | 104.0407 | 121.2494            | 132.3532 | 143.7270 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1431.4411 (45) |
|                                                                 | 22.2615  | 19.4700  | 20.0913  | 17.5161  | 16.8071  | 14.5033  | 13.4394  | 15.4219  | 15.6061  | 18.1874             | 19.8530  | 21.5590 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |                     |          |                |
| Solar input                                                     | 194.6122 | 171.5314 | 180.1446 | 161.4860 | 158.2499 | 141.4004 | 135.7984 | 149.0152 | 148.7527 | 167.4518            | 177.0652 | 189.9294 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |                     |          | 0.0000 (63)    |
| Output from w/h                                                 | 194.6122 | 171.5314 | 180.1446 | 161.4860 | 158.2499 | 141.4004 | 135.7984 | 149.0152 | 148.7527 | 167.4518            | 177.0652 | 189.9294 (64)  |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 86.3082  | 76.5435  | 81.4977  | 74.5970  | 74.2177  | 67.9185  | 66.7526  | 71.1472  | 70.3631  | 77.2773             | 79.7770  | 84.7511 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 17.1903  | 15.2682  | 12.4170  | 9.4004   | 7.0269   | 5.9324   | 6.4102   | 8.3322   | 11.1835  | 14.2000  | 16.5735  | 17.6680 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 192.8226 | 194.8235 | 189.7813 | 179.0470 | 165.4970 | 152.7619 | 144.2540 | 142.2532 | 147.2953 | 158.0296 | 171.5796 | 184.3147 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 116.0056 | 113.9040 | 109.5399 | 103.6069 | 99.7550  | 94.3313  | 89.7212  | 95.6279  | 97.7266  | 103.8674 | 110.8014 | 113.9128 (72) |
| Total internal gains                                                                |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 382.0054 | 379.9827 | 367.7251 | 348.0413 | 328.2658 | 309.0125 | 296.3724 | 302.2002 | 312.1923 | 332.0839 | 354.9415 | 371.8825 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| West        |          |          |          | 8.4000     | 19.6403                        | 0.3700                            | 0.8900                             | 0.7700                       | 37.6488 (80) |          |          |               |
| Southeast   |          |          |          | 7.6100     | 36.7938                        | 0.5600                            | 0.6800                             | 0.7700                       | 73.8907 (77) |          |          |               |
| South       |          |          |          | 3.8000     | 46.7521                        | 0.5600                            | 0.6800                             | 0.7700                       | 46.8829 (78) |          |          |               |
| Solar gains | 158.4225 | 276.2945 | 391.3080 | 500.8150   | 570.9840                       | 570.0534                          | 548.3507                           | 496.3150                     | 429.7043     | 309.3133 | 191.0200 | 134.7068 (83) |
| Total gains | 540.4278 | 656.2771 | 759.0330 | 848.8563   | 899.2499                       | 879.0659                          | 844.7231                           | 798.5152                     | 741.8966     | 641.3972 | 545.9614 | 506.5893 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 85.5616 | 85.7881 | 86.0158 | 87.1726 | 87.4077 | 88.6026 | 88.6026 | 88.8455 | 88.1208 | 87.4077 | 86.9388 | 86.4748      |
| alpha                                                                       | 6.7041  | 6.7192  | 6.7344  | 6.8115  | 6.8272  | 6.9068  | 6.9068  | 6.9230  | 6.8747  | 6.8272  | 6.7959  | 6.7650       |
| util living area                                                            | 0.9972  | 0.9894  | 0.9614  | 0.8682  | 0.6947  | 0.4962  | 0.3563  | 0.3928  | 0.6289  | 0.9174  | 0.9911  | 0.9981 (86)  |
| MIT                                                                         | 20.2612 | 20.4397 | 20.6646 | 20.8797 | 20.9765 | 20.9979 | 20.9998 | 20.9997 | 20.9906 | 20.8470 | 20.5078 | 20.2281 (87) |
| Th 2                                                                        | 20.0497 | 20.0519 | 20.0542 | 20.0656 | 20.0679 | 20.0793 | 20.0793 | 20.0816 | 20.0747 | 20.0679 | 20.0633 | 20.0588 (88) |
| util rest of house                                                          | 0.9960  | 0.9852  | 0.9475  | 0.8301  | 0.6336  | 0.4258  | 0.2818  | 0.3146  | 0.5498  | 0.8823  | 0.9869  | 0.9973 (89)  |
| MIT 2                                                                       | 19.0796 | 19.3393 | 19.6573 | 19.9444 | 20.0498 | 20.0783 | 20.0793 | 20.0815 | 20.0693 | 19.9149 | 19.4485 | 19.0385 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 19.6209 | 19.8435 | 20.1188 | 20.3729 | 20.4744 | 20.4996 | 20.5010 | 20.5022 | 20.4914 | 20.3419 | 19.9338 | 19.5835 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.6209 | 19.8435 | 20.1188 | 20.3729 | 20.4744 | 20.4996 | 20.5010 | 20.5022 | 20.4914 | 20.3419 | 19.9338 | 19.5835 (93) |

#### 8. Space heating requirement

|                   |           |           |          |          |          |          |          |          |          |          |          |                |
|-------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation       | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
|                   | 0.9953    | 0.9841    | 0.9486   | 0.8435   | 0.6608   | 0.4581   | 0.3159   | 0.3504   | 0.5860   | 0.8938   | 0.9861   | 0.9968 (94)    |
| Useful gains      | 537.8893  | 645.8521  | 720.0142 | 715.9934 | 594.2683 | 402.6947 | 266.8802 | 279.8121 | 434.7547 | 573.2870 | 538.3992 | 504.9669 (95)  |
| Ext temp.         | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Heat loss rate W  | 1085.6659 | 1056.1215 | 959.9541 | 797.9637 | 608.6360 | 403.7081 | 266.9442 | 279.9404 | 439.7517 | 675.7485 | 895.0202 | 1078.5859 (97) |
| Month fracti      | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating kWh | 407.5457  | 275.7010  | 178.5153 | 59.0186  | 10.6896  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 76.2314  | 256.7671 | 426.7725 (98)  |

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### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating 1691.2413 (98)  
Space heating per m2 (98) / (4) = 24.8347 (99)

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1691.2413 (98)   |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 816.8696 (307a)  |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 958.9338 (307b)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1975.4371 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 954.1361 (310a)  |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1120.0729 (310b) |
| Electricity used for heat distribution                                                  | 38.5001 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 132.1004 (330a)  |
| Total electricity for the above, kWh/year                                               | 132.1004 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 303.5856 (332)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415        |
| Total delivered energy for all uses                                                     | 3913.0569 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 478.6502           | 0.5190                        | 248.4194 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 2214.0646          | 0.2160                        | 478.2380 (368)           |
| Electrical energy for heat distribution                                                    | 38.5001            | 0.5190                        | 19.9816 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 746.6390 (373)           |
| Space and water heating                                                                    |                    |                               | 746.6390 (376)           |
| Pumps and fans                                                                             | 132.1004           | 0.5190                        | 68.5601 (378)            |
| Energy for lighting                                                                        | 303.5856           | 0.5190                        | 157.5609 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 779.3591 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 11.4400 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 11.4400 ZC1 |
| Total Floor Area                                                                | TFA | 68.1000     |
| Assumed number of occupants                                                     | N   | 2.1991      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 16.7786 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.5225 ZC3  |
| Total CO2 emissions                                                             |     | 30.7411 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 30.7411 ZC8 |

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### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 68.1000 (1b)              | x 2.4000 (2b)                   | = 163.4400 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.1000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 163.4400 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour    |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|----------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                          |                              |                      |       |       | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | Air changes per hour       |
| Pressure test                                        |                              |                      |       |       | 20.0000 / (5) = 0.1224 (8) |
| Measured/design AP50                                 |                              |                      |       |       | Yes                        |
| Infiltration rate                                    |                              |                      |       |       | 5.0000                     |
| Number of sides sheltered                            |                              |                      |       |       | 0.3724 (18)                |
|                                                      |                              |                      |       |       | 1 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.9250 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.3444 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4392 | 0.4306 | 0.4219 | 0.3789 | 0.3703 | 0.3272 | 0.3272 | 0.3186 | 0.3444 | 0.3703 | 0.3875 | 0.4047 (22b) |
|                 | 0.5964 | 0.5927 | 0.5890 | 0.5718 | 0.5686 | 0.5535 | 0.5535 | 0.5508 | 0.5593 | 0.5686 | 0.5751 | 0.5819 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 14.9200                   | 1.3258                        | 19.7803      |                                | (27)          |
| External Wall 1                                                | 62.2000                 | 14.9200                    | 47.2800                   | 0.1800                        | 8.5104       |                                | (29a)         |
| Corridor wall                                                  | 4.1500                  | 2.1000                     | 2.0500                    | 0.1800                        | 0.3690       |                                | (29a)         |
| Exposed ceiling                                                | 9.6000                  |                            | 9.6000                    | 0.1300                        | 1.2480       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 75.9500                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 32.4277      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 16.0085 (36)  |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 48.4362 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 32.1687 | 31.9667 | 31.7687 | 30.8389 | 30.6649 | 29.8551 | 29.8551 | 29.7051 | 30.1670 | 30.6649 | 31.0169 | 31.3848 (38) |
| Heat transfer coeff       | 80.6049 | 80.4029 | 80.2050 | 79.2751 | 79.1011 | 78.2913 | 78.2913 | 78.1413 | 78.6032 | 79.1011 | 79.4531 | 79.8210 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 79.2743 (39) |
|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                       | 1.1836  | 1.1807  | 1.1778  | 1.1641  | 1.1615  | 1.1497  | 1.1497  | 1.1474  | 1.1542  | 1.1615  | 1.1667  | 1.1721 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.1641 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

| Assumed occupancy                                           |          |          |          |          |          |         |         |         |         |                    |          | 2.1991 (42)    |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|--------------------|----------|----------------|
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |         |                    |          | 86.4293 (43)   |
|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep     | Oct                | Nov      | Dec            |
| Daily hot water use                                         | 95.0722  | 91.6150  | 88.1579  | 84.7007  | 81.2435  | 77.7863 | 77.7863 | 81.2435 | 84.7007 | 88.1579            | 91.6150  | 95.0722 (44)   |
| Energy conte                                                | 140.9893 | 123.3102 | 127.2451 | 110.9353 | 106.4451 | 91.8540 | 85.1162 | 97.6721 | 98.8386 | 115.1869           | 125.7355 | 136.5406 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |         | Total = Sum(45)m = |          | 1359.8691 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 21.1484  | 18.4965  | 19.0868  | 16.6403  | 15.9668  | 13.7781 | 12.7674 | 14.6508 | 14.8258 | 17.2780            | 18.8603  | 20.4811 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |         |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |                    |          | 0.1290 (55)    |

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|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 168.2495 | 147.9322 | 154.5052 | 137.3161 | 133.7052 | 118.2348 | 112.3764 | 124.9323 | 125.2194 | 142.4471 | 152.1163 | 163.8008 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 168.2495 | 147.9322 | 154.5052 | 137.3161 | 133.7052 | 118.2348 | 112.3764 | 124.9323 | 125.2194 | 142.4471 | 152.1163 | 163.8008 (64) |
| Heat gains from water heating, kWh/month                        | 68.6871  | 60.6983  | 64.1171  | 57.9906  | 57.2011  | 51.6461  | 50.1093  | 54.2841  | 53.9685  | 60.1078  | 62.9117  | 67.2079 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.1986  | 15.2756  | 12.4230  | 9.4050   | 7.0303   | 5.9353   | 6.4133   | 8.3363   | 11.1889  | 14.2069  | 16.5816  | 17.6766 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 192.8226 | 194.8235 | 189.7813 | 179.0470 | 165.4970 | 152.7619 | 144.2540 | 142.2532 | 147.2953 | 158.0296 | 171.5796 | 184.3147 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 (71) |
| Water heating gains (Table 5)                                                       | 92.3213  | 90.3248  | 86.1789  | 80.5425  | 76.8832  | 71.7307  | 67.3512  | 72.9625  | 74.9562  | 80.7900  | 87.3773  | 90.3332 (72)  |
| Total internal gains                                                                | 361.3294 | 359.4108 | 347.3701 | 327.9815 | 308.3975 | 289.4148 | 277.0054 | 282.5388 | 292.4274 | 312.0134 | 334.5254 | 351.3114 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| Southeast   |          |          |          | 5.7300     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       | 64.4320 (77) |          |          |               |
| South       |          |          |          | 2.8600     | 46.7521                        | 0.6300                            | 0.7000                             | 0.7700                       | 40.8638 (78) |          |          |               |
| West        |          |          |          | 6.3300     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       | 37.9947 (80) |          |          |               |
|             |          |          |          |            |                                |                                   |                                    |                              |              |          |          |               |
| Solar gains | 143.2905 | 251.0015 | 357.8203 | 460.9333   | 527.5918                       | 527.4862                          | 507.1024                           | 457.6414                     | 394.0130     | 281.6767 | 172.9871 | 121.6954 (83) |
| Total gains | 504.6199 | 610.4124 | 705.1904 | 788.9148   | 835.9893                       | 816.9010                          | 784.1078                           | 740.1802                     | 686.4404     | 593.6901 | 507.5125 | 473.0068 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |              |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|--------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) | 21.0000 (85) |         |         |         |         |         |         |         |         |         |         |              |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan          | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 58.6710      | 58.8183 | 58.9635 | 59.6551 | 59.7863 | 60.4048 | 60.4048 | 60.5207 | 60.1650 | 59.7863 | 59.5215 | 59.2471      |
| alpha                                                                       | 4.9114       | 4.9212  | 4.9309  | 4.9770  | 4.9858  | 5.0270  | 5.0270  | 5.0347  | 5.0110  | 4.9858  | 4.9681  | 4.9498       |
| util living area                                                            | 0.9949       | 0.9868  | 0.9648  | 0.9026  | 0.7756  | 0.5919  | 0.4354  | 0.4790  | 0.7229  | 0.9362  | 0.9885  | 0.9963 (86)  |
| MIT                                                                         | 19.8431      | 20.0508 | 20.3378 | 20.6600 | 20.8799 | 20.9758 | 20.9957 | 20.9932 | 20.9364 | 20.6328 | 20.1713 | 19.8053 (87) |
| Th 2                                                                        | 19.9331      | 19.9355 | 19.9378 | 19.9488 | 19.9509 | 19.9605 | 19.9605 | 19.9623 | 19.9568 | 19.9509 | 19.9467 | 19.9424 (88) |
| util rest of house                                                          | 0.9933       | 0.9825  | 0.9536  | 0.8731  | 0.7162  | 0.5048  | 0.3346  | 0.3744  | 0.6378  | 0.9099  | 0.9841  | 0.9950 (89)  |
| MIT 2                                                                       | 18.4096      | 18.7119 | 19.1232 | 19.5718 | 19.8422 | 19.9457 | 19.9590 | 19.9597 | 19.9113 | 19.5488 | 18.8971 | 18.3613 (90) |
| Living area fraction                                                        | 19.0664      | 19.3253 | 19.6797 | 20.0704 | 20.3176 | 20.4177 | 20.4340 | 20.4332 | 20.3810 | 20.0454 | 19.4809 | 19.0229 (92) |
| Temperature adjustment                                                      | 19.0664      | 19.3253 | 19.6797 | 20.0704 | 20.3176 | 20.4177 | 20.4340 | 20.4332 | 20.3810 | 20.0454 | 19.4809 | 19.0229 (93) |
| adjusted MIT                                                                | 19.0664      | 19.3253 | 19.6797 | 20.0704 | 20.3176 | 20.4177 | 20.4340 | 20.4332 | 20.3810 | 20.0454 | 19.4809 | 19.0229 (93) |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 0.9914    | 0.9794    | 0.9503    | 0.8769   | 0.7382   | 0.5441   | 0.3809   | 0.4224   | 0.6743   | 0.9127       | 0.9816   | 0.9936 (94)    |
| Ext temp.            | 500.2966  | 597.8508  | 670.1137  | 691.7893 | 617.1611 | 444.4586 | 298.6788 | 312.6867 | 462.8706 | 541.8395     | 498.1606 | 469.9581 (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Month fracti         | 1190.2402 | 1159.8384 | 1057.0747 | 885.5330 | 681.6656 | 455.4733 | 300.1674 | 315.1596 | 493.7039 | 747.1442     | 983.6980 | 1183.1778 (97) |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating        | 513.3180  | 377.6556  | 287.8990  | 139.4955 | 47.9913  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 152.7467     | 349.5869 | 530.6354 (98)  |
| Space heating per m2 |           |           |           |          |          |          |          |          |          |              |          | 2399.3285 (98) |
|                      |           |           |           |          |          |          |          |          |          | (98) / (4) = |          | 35.2324 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |          | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |          | 2566.1267 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |                 |
| Space heating requirement                                             | 513.3180 | 377.6556 | 287.8990 | 139.4955 | 47.9913  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 152.7467 | 349.5869 | 530.6354 | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000  | (210)           |
| Space heating fuel (main heating system)                              | 549.0032 | 403.9098 | 307.9134 | 149.1930 | 51.3276  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 163.3654 | 373.8897 | 567.5245 | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (215)           |
| Water heating requirement                                             | 168.2495 | 147.9322 | 154.5052 | 137.3161 | 133.7052 | 118.2348 | 112.3764 | 124.9323 | 125.2194 | 142.4471 | 152.1163 | 163.8008 | (64)            |
| Efficiency of water heater (217)m                                     | 87.6004  | 87.2088  | 86.4517  | 84.8558  | 82.3724  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.0002  | 86.9645  | 87.7255  | (216)           |
| Fuel for water heating, kWh/month                                     | 192.0646 | 169.6300 | 178.7186 | 161.8228 | 162.3181 | 148.1639 | 140.8225 | 156.5567 | 156.9166 | 167.5844 | 174.9177 | 186.7198 | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          |          | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          |          | 2566.1267 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |          |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          |          | 30.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          |          | 75.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          |          | 303.7325 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          |          | 4941.0950 (238) |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2566.1267          | 0.2160                        | 554.2834 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1996.2358          | 0.2160                        | 431.1869 (264)           |
| Space and water heating                                                                           |                    |                               | 985.4703 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 303.7325           | 0.5190                        | 157.6372 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1182.0325 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 14.4709 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3148 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5716 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (14.4709 * 1.00) + 2.3148 + 0.5716, rounded to 2 d.p. |                    |                               | 17.3600 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-3-06                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP-1-2                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 86 B                                                                    | DER           | 11.44   | TER            | 17.36      |
| Environmental                      | 92 A                                                                    | % DER<TER     | 34.09   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.60                                                                    | DFEE          | 45.21   | TFEE           | 48.34      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 6.46    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 68 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 17.36 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 11.44 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 48.3 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 45.2 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.18 (max. 0.20) | 0.18 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK  
Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing South East: 7.61 m<sup>2</sup>, No overhang  
Windows facing South: 3.80 m<sup>2</sup>, No overhang  
Windows facing West: 8.40 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 68.1000 (1b)              | x 2.4000 (2b)                   | = 163.4400 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.1000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 163.4400 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour                           |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|---------------------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)                              |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)                              |
| Number of intermittent fans                                               |                 |                      |       |                             | 0 * 10 = 0.0000 (7a)                              |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)                              |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)                              |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour<br>0.0000 / (5) = 0.0000 (8) |
| Pressure test                                                             |                 |                      |       |                             | Yes                                               |
| Measured/design AP50                                                      |                 |                      |       |                             | 3.0000                                            |
| Infiltration rate                                                         |                 |                      |       |                             | 0.1500 (18)                                       |
| Number of sides sheltered                                                 |                 |                      |       |                             | 1 (19)                                            |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.9250 (20)                                       |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.1388 (21)                                       |

|                                                                                              | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec           |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------------|
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1769 | 0.1734 | 0.1700 | 0.1526 | 0.1492 | 0.1318 | 0.1318 | 0.1283 | 0.1388 | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |        |        |        |        |        |        |        | 0.5000 (23a)  |
| If mechanical ventilation:                                                                   |        |        |        |        |        |        |        |        |        |        |        | 79.9000 (23c) |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |        |        |        |        |        |        |        |               |
| Effective ac                                                                                 | 0.2774 | 0.2739 | 0.2705 | 0.2531 | 0.2497 | 0.2323 | 0.2323 | 0.2288 | 0.2393 | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364      |                                | (27)                                                 |
| W02 (Uw = 1.40)                                                |                         |                            | 11.4100                   | 1.3258                        | 15.1269      |                                | (27)                                                 |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                | (26a)                                                |
| External Wall 1                                                | 62.2000                 | 19.8100                    | 42.3900                   | 0.1500                        | 6.3585       | 140.0000                       | 5934.6000 (29a)                                      |
| Corridor wall                                                  | 4.1500                  | 2.1000                     | 2.0500                    | 0.1409                        | 0.2889       | 110.0000                       | 225.5000 (29a)                                       |
| Exposed ceiling                                                | 9.6000                  |                            | 9.6000                    | 0.1800                        | 1.7280       | 9.0000                         | 86.4000 (30)                                         |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 75.9500                   |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 37.5786      |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 31.9000                   | 0.0000                        | 0.0000       | 140.0000                       | 4466.0000 (32)                                       |
| Party Floor                                                    |                         |                            | 68.1000                   |                               |              | 80.0000                        | 5448.0000 (32d)                                      |
| Party Ceilings                                                 |                         |                            | 58.5000                   |                               |              | 80.0000                        | 4680.0000 (32b)                                      |
| Internal Wall                                                  |                         |                            | 109.6000                  |                               |              | 9.0000                         | 986.4000 (32c)                                       |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 21826.9000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 320.5125 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 18.3210 (36)                                         |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 55.8996 (37)                           |

|                                                                     |         |         |         |         |         |         |         |         |         |         |         |              |
|---------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |         |         |         |         |         |         |         |         |         |         |         |              |
| (38)m                                                               | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| Heat transfer coeff                                                 | 14.9620 | 14.7749 | 14.5878 | 13.6523 | 13.4653 | 12.5298 | 12.5298 | 12.3427 | 12.9040 | 13.4653 | 13.8394 | 14.2136 (38) |
| Average = Sum(39)m / 12 =                                           | 70.8616 | 70.6745 | 70.4874 | 69.5520 | 69.3649 | 68.4294 | 68.4294 | 68.2424 | 68.8036 | 69.3649 | 69.7391 | 70.1132 (39) |
|                                                                     | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| HLP                                                                 | 1.0406  | 1.0378  | 1.0351  | 1.0213  | 1.0186  | 1.0048  | 1.0048  | 1.0021  | 1.0103  | 1.0186  | 1.0241  | 1.0296 (40)  |
| HLP (average)                                                       |         |         |         |         |         |         |         |         |         |         |         | 1.0206 (40)  |
| Days in month                                                       | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |
|------------------------------------------|--------------|
| Assumed occupancy                        | 2.1991 (42)  |
| Average daily hot water use (litres/day) | 90.9782 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy conte                                                    | 100.0760 | 96.4369  | 92.7978  | 89.1586  | 85.5195  | 81.8804  | 81.8804  | 85.5195  | 89.1586  | 92.7978             | 96.4369  | 100.0760 (44)  |
| Energy content (annual)                                         | 148.4098 | 129.8002 | 133.9422 | 116.7740 | 112.0475 | 96.6884  | 89.5960  | 102.8128 | 104.0407 | 121.2494            | 132.3532 | 143.7270 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1431.4411 (45) |
|                                                                 | 22.2615  | 19.4700  | 20.0913  | 17.5161  | 16.8071  | 14.5033  | 13.4394  | 15.4219  | 15.6061  | 18.1874             | 19.8530  | 21.5590 (46)   |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |                     |          |                |
| Solar input                                                     | 194.6122 | 171.5314 | 180.1446 | 161.4860 | 158.2499 | 141.4004 | 135.7984 | 149.0152 | 148.7527 | 167.4518            | 177.0652 | 189.9294 (62)  |
|                                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |                     |          | 0.0000 (63)    |
| Output from w/h                                                 | 194.6122 | 171.5314 | 180.1446 | 161.4860 | 158.2499 | 141.4004 | 135.7984 | 149.0152 | 148.7527 | 167.4518            | 177.0652 | 189.9294 (64)  |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 86.3082  | 76.5435  | 81.4977  | 74.5970  | 74.2177  | 67.9185  | 66.7526  | 71.1472  | 70.3631  | 77.2773             | 79.7770  | 84.7511 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 17.1903  | 15.2682  | 12.4170  | 9.4004   | 7.0269   | 5.9324   | 6.4102   | 8.3322   | 11.1835  | 14.2000  | 16.5735  | 17.6680 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 192.8226 | 194.8235 | 189.7813 | 179.0470 | 165.4970 | 152.7619 | 144.2540 | 142.2532 | 147.2953 | 158.0296 | 171.5796 | 184.3147 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 116.0056 | 113.9040 | 109.5399 | 103.6069 | 99.7550  | 94.3313  | 89.7212  | 95.6279  | 97.7266  | 103.8674 | 110.8014 | 113.9128 (72) |
| Total internal gains                                                                |          |          |          |          |          |          |          |          |          |          |          |               |
|                                                                                     | 382.0054 | 379.9827 | 367.7251 | 348.0413 | 328.2658 | 309.0125 | 296.3724 | 302.2002 | 312.1923 | 332.0839 | 354.9415 | 371.8825 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| West        |          |          |          | 8.4000     | 19.6403                        | 0.3700                            | 0.8900                             | 0.7700                       | 37.6488 (80) |          |          |               |
| Southeast   |          |          |          | 7.6100     | 36.7938                        | 0.5600                            | 0.6800                             | 0.7700                       | 73.8907 (77) |          |          |               |
| South       |          |          |          | 3.8000     | 46.7521                        | 0.5600                            | 0.6800                             | 0.7700                       | 46.8829 (78) |          |          |               |
| Solar gains | 158.4225 | 276.2945 | 391.3080 | 500.8150   | 570.9840                       | 570.0534                          | 548.3507                           | 496.3150                     | 429.7043     | 309.3133 | 191.0200 | 134.7068 (83) |
| Total gains | 540.4278 | 656.2771 | 759.0330 | 848.8563   | 899.2499                       | 879.0659                          | 844.7231                           | 798.5152                     | 741.8966     | 641.3972 | 545.9614 | 506.5893 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 85.5616 | 85.7881 | 86.0158 | 87.1726 | 87.4077 | 88.6026 | 88.6026 | 88.8455 | 88.1208 | 87.4077 | 86.9388 | 86.4748      |
| alpha                                                                       | 6.7041  | 6.7192  | 6.7344  | 6.8115  | 6.8272  | 6.9068  | 6.9068  | 6.9230  | 6.8747  | 6.8272  | 6.7959  | 6.7650       |
| util living area                                                            | 0.9972  | 0.9894  | 0.9614  | 0.8682  | 0.6947  | 0.4962  | 0.3563  | 0.3928  | 0.6289  | 0.9174  | 0.9911  | 0.9981 (86)  |
| MIT                                                                         | 20.2612 | 20.4397 | 20.6646 | 20.8797 | 20.9765 | 20.9979 | 20.9998 | 20.9997 | 20.9906 | 20.8470 | 20.5078 | 20.2281 (87) |
| Th 2                                                                        | 20.0497 | 20.0519 | 20.0542 | 20.0656 | 20.0679 | 20.0793 | 20.0793 | 20.0816 | 20.0747 | 20.0679 | 20.0633 | 20.0588 (88) |
| util rest of house                                                          | 0.9960  | 0.9852  | 0.9475  | 0.8301  | 0.6336  | 0.4258  | 0.2818  | 0.3146  | 0.5498  | 0.8823  | 0.9869  | 0.9973 (89)  |
| MIT 2                                                                       | 19.0796 | 19.3393 | 19.6573 | 19.9444 | 20.0498 | 20.0783 | 20.0793 | 20.0815 | 20.0693 | 19.9149 | 19.4485 | 19.0385 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 19.6209 | 19.8435 | 20.1188 | 20.3729 | 20.4744 | 20.4996 | 20.5010 | 20.5022 | 20.4914 | 20.3419 | 19.9338 | 19.5835 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.6209 | 19.8435 | 20.1188 | 20.3729 | 20.4744 | 20.4996 | 20.5010 | 20.5022 | 20.4914 | 20.3419 | 19.9338 | 19.5835 (93) |

#### 8. Space heating requirement

|                   |           |           |          |          |          |          |          |          |          |          |          |                |
|-------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation       | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
|                   | 0.9953    | 0.9841    | 0.9486   | 0.8435   | 0.6608   | 0.4581   | 0.3159   | 0.3504   | 0.5860   | 0.8938   | 0.9861   | 0.9968 (94)    |
| Useful gains      | 537.8893  | 645.8521  | 720.0142 | 715.9934 | 594.2683 | 402.6947 | 266.8802 | 279.8121 | 434.7547 | 573.2870 | 538.3992 | 504.9669 (95)  |
| Ext temp.         | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Heat loss rate W  | 1085.6659 | 1056.1215 | 959.9541 | 797.9637 | 608.6360 | 403.7081 | 266.9442 | 279.9404 | 439.7517 | 675.7485 | 895.0202 | 1078.5859 (97) |
| Month fracti      | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating kWh | 407.5457  | 275.7010  | 178.5153 | 59.0186  | 10.6896  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 76.2314  | 256.7671 | 426.7725 (98)  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating 1691.2413 (98)  
Space heating per m2 (98) / (4) = 24.8347 (99)

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 1691.2413 (98)   |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 816.8696 (307a)  |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 958.9338 (307b)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1975.4371 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 954.1361 (310a)  |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1120.0729 (310b) |
| Electricity used for heat distribution                                                  | 38.5001 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 132.1004 (330a)  |
| Total electricity for the above, kWh/year                                               | 132.1004 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 303.5856 (332)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415        |
| Total delivered energy for all uses                                                     | 3913.0569 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 478.6502           | 0.5190                        | 248.4194 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 2214.0646          | 0.2160                        | 478.2380 (368)           |
| Electrical energy for heat distribution                                                    | 38.5001            | 0.5190                        | 19.9816 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 746.6390 (373)           |
| Space and water heating                                                                    |                    |                               | 746.6390 (376)           |
| Pumps and fans                                                                             | 132.1004           | 0.5190                        | 68.5601 (378)            |
| Energy for lighting                                                                        | 303.5856           | 0.5190                        | 157.5609 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 779.3591 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 11.4400 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 11.4400 ZC1 |
| Total Floor Area                                                                | TFA | 68.1000     |
| Assumed number of occupants                                                     | N   | 2.1991      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 16.7786 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.5225 ZC3  |
| Total CO2 emissions                                                             |     | 30.7411 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 30.7411 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 68.1000 (1b)              | x 2.4000 (2b)                   | = 163.4400 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 68.1000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 163.4400 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m <sup>3</sup> per hour    |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|----------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                          |                              |                      |       |       | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | Air changes per hour       |
| Pressure test                                        |                              |                      |       |       | 20.0000 / (5) = 0.1224 (8) |
| Measured/design AP50                                 |                              |                      |       |       | Yes                        |
| Infiltration rate                                    |                              |                      |       |       | 5.0000                     |
| Number of sides sheltered                            |                              |                      |       |       | 0.3724 (18)                |
|                                                      |                              |                      |       |       | 1 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.9250 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.3444 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4392 | 0.4306 | 0.4219 | 0.3789 | 0.3703 | 0.3272 | 0.3272 | 0.3186 | 0.3444 | 0.3703 | 0.3875 | 0.4047 (22b) |
|                 | 0.5964 | 0.5927 | 0.5890 | 0.5718 | 0.5686 | 0.5535 | 0.5535 | 0.5508 | 0.5593 | 0.5686 | 0.5751 | 0.5819 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 14.9200                   | 1.3258                        | 19.7803      |                                | (27)          |
| External Wall 1                                                | 62.2000                 | 14.9200                    | 47.2800                   | 0.1800                        | 8.5104       |                                | (29a)         |
| Corridor wall                                                  | 4.1500                  | 2.1000                     | 2.0500                    | 0.1800                        | 0.3690       |                                | (29a)         |
| Exposed ceiling                                                | 9.6000                  |                            | 9.6000                    | 0.1300                        | 1.2480       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 75.9500                   |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 32.4277      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 16.0085 (36)  |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 48.4362 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 32.1687 | 31.9667 | 31.7687 | 30.8389 | 30.6649 | 29.8551 | 29.8551 | 29.7051 | 30.1670 | 30.6649 | 31.0169 | 31.3848 (38) |
| Heat transfer coeff       | 80.6049 | 80.4029 | 80.2050 | 79.2751 | 79.1011 | 78.2913 | 78.2913 | 78.1413 | 78.6032 | 79.1011 | 79.4531 | 79.8210 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 79.2743 (39) |
| HLP                       | 1.1836  | 1.1807  | 1.1778  | 1.1641  | 1.1615  | 1.1497  | 1.1497  | 1.1474  | 1.1542  | 1.1615  | 1.1667  | 1.1721 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.1641 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |          |          |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |          |          |         |         |         |         |                    |          | 2.1991 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |          |          |         |         |         |         |                    |          | 86.4293 (43)   |
| Daily hot water use                                         | 95.0722  | 91.6150  | 88.1579  | 84.7007  | 81.2435  | 77.7863 | 77.7863 | 81.2435 | 84.7007 | 88.1579            | 91.6150  | 95.0722 (44)   |
| Energy conte                                                | 140.9893 | 123.3102 | 127.2451 | 110.9353 | 106.4451 | 91.8540 | 85.1162 | 97.6721 | 98.8386 | 115.1869           | 125.7355 | 136.5406 (45)  |
| Energy content (annual)                                     |          |          |          |          |          |         |         |         |         | Total = Sum(45)m = |          | 1359.8691 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 21.1484  | 18.4965  | 19.0868  | 16.6403  | 15.9668  | 13.7781 | 12.7674 | 14.6508 | 14.8258 | 17.2780            | 18.8603  | 20.4811 (46)   |
| Water storage loss:                                         |          |          |          |          |          |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |          |          |         |         |         |         |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |         |         |         |         |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |          |          |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |         |         |         |         |                    |          | 0.1290 (55)    |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 168.2495 | 147.9322 | 154.5052 | 137.3161 | 133.7052 | 118.2348 | 112.3764 | 124.9323 | 125.2194 | 142.4471 | 152.1163 | 163.8008 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 168.2495 | 147.9322 | 154.5052 | 137.3161 | 133.7052 | 118.2348 | 112.3764 | 124.9323 | 125.2194 | 142.4471 | 152.1163 | 163.8008 (64) |
| Heat gains from water heating, kWh/month                        | 68.6871  | 60.6983  | 64.1171  | 57.9906  | 57.2011  | 51.6461  | 50.1093  | 54.2841  | 53.9685  | 60.1078  | 62.9117  | 67.2079 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 | 109.9564 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 17.1986  | 15.2756  | 12.4230  | 9.4050   | 7.0303   | 5.9353   | 6.4133   | 8.3363   | 11.1889  | 14.2069  | 16.5816  | 17.6766 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 192.8226 | 194.8235 | 189.7813 | 179.0470 | 165.4970 | 152.7619 | 144.2540 | 142.2532 | 147.2953 | 158.0296 | 171.5796 | 184.3147 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956  | 33.9956 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 | -87.9651 (71) |
| Water heating gains (Table 5)                                                       | 92.3213  | 90.3248  | 86.1789  | 80.5425  | 76.8832  | 71.7307  | 67.3512  | 72.9625  | 74.9562  | 80.7900  | 87.3773  | 90.3332 (72)  |
| Total internal gains                                                                | 361.3294 | 359.4108 | 347.3701 | 327.9815 | 308.3975 | 289.4148 | 277.0054 | 282.5388 | 292.4274 | 312.0134 | 334.5254 | 351.3114 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| Southeast   |          |          |          | 5.7300     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       | 64.4320 (77) |          |          |               |
| South       |          |          |          | 2.8600     | 46.7521                        | 0.6300                            | 0.7000                             | 0.7700                       | 40.8638 (78) |          |          |               |
| West        |          |          |          | 6.3300     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       | 37.9947 (80) |          |          |               |
|             |          |          |          |            |                                |                                   |                                    |                              |              |          |          |               |
| Solar gains | 143.2905 | 251.0015 | 357.8203 | 460.9333   | 527.5918                       | 527.4862                          | 507.1024                           | 457.6414                     | 394.0130     | 281.6767 | 172.9871 | 121.6954 (83) |
| Total gains | 504.6199 | 610.4124 | 705.1904 | 788.9148   | 835.9893                       | 816.9010                          | 784.1078                           | 740.1802                     | 686.4404     | 593.6901 | 507.5125 | 473.0068 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |              |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|--------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Thl (C) | 21.0000 (85) |         |         |         |         |         |         |         |         |         |         |              |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan          | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 58.6710      | 58.8183 | 58.9635 | 59.6551 | 59.7863 | 60.4048 | 60.4048 | 60.5207 | 60.1650 | 59.7863 | 59.5215 | 59.2471      |
| alpha                                                                       | 4.9114       | 4.9212  | 4.9309  | 4.9770  | 4.9858  | 5.0270  | 5.0270  | 5.0347  | 5.0110  | 4.9858  | 4.9681  | 4.9498       |
| util living area                                                            | 0.9949       | 0.9868  | 0.9648  | 0.9026  | 0.7756  | 0.5919  | 0.4354  | 0.4790  | 0.7229  | 0.9362  | 0.9885  | 0.9963 (86)  |
| MIT                                                                         | 19.8431      | 20.0508 | 20.3378 | 20.6600 | 20.8799 | 20.9758 | 20.9957 | 20.9932 | 20.9364 | 20.6328 | 20.1713 | 19.8053 (87) |
| Th 2                                                                        | 19.9331      | 19.9355 | 19.9378 | 19.9488 | 19.9509 | 19.9605 | 19.9605 | 19.9623 | 19.9568 | 19.9509 | 19.9467 | 19.9424 (88) |
| util rest of house                                                          | 0.9933       | 0.9825  | 0.9536  | 0.8731  | 0.7162  | 0.5048  | 0.3346  | 0.3744  | 0.6378  | 0.9099  | 0.9841  | 0.9950 (89)  |
| MIT 2                                                                       | 18.4096      | 18.7119 | 19.1232 | 19.5718 | 19.8422 | 19.9457 | 19.9590 | 19.9597 | 19.9113 | 19.5488 | 18.8971 | 18.3613 (90) |
| Living area fraction                                                        | 19.0664      | 19.3253 | 19.6797 | 20.0704 | 20.3176 | 20.4177 | 20.4340 | 20.4332 | 20.3810 | 20.0454 | 19.4809 | 19.0229 (92) |
| Temperature adjustment                                                      | 19.0664      | 19.3253 | 19.6797 | 20.0704 | 20.3176 | 20.4177 | 20.4340 | 20.4332 | 20.3810 | 20.0454 | 19.4809 | 19.0229 (93) |
| adjusted MIT                                                                | 19.0664      | 19.3253 | 19.6797 | 20.0704 | 20.3176 | 20.4177 | 20.4340 | 20.4332 | 20.3810 | 20.0454 | 19.4809 | 19.0229 (93) |

#### 8. Space heating requirement

|                      |           |           |           |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 0.9914    | 0.9794    | 0.9503    | 0.8769   | 0.7382   | 0.5441   | 0.3809   | 0.4224   | 0.6743   | 0.9127       | 0.9816   | 0.9936 (94)    |
| Ext temp.            | 500.2966  | 597.8508  | 670.1137  | 691.7893 | 617.1611 | 444.4586 | 298.6788 | 312.6867 | 462.8706 | 541.8395     | 498.1606 | 469.9581 (95)  |
| Heat loss rate W     | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Month fracti         | 1190.2402 | 1159.8384 | 1057.0747 | 885.5330 | 681.6656 | 455.4733 | 300.1674 | 315.1596 | 493.7039 | 747.1442     | 983.6980 | 1183.1778 (97) |
| Space heating kWh    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating        | 513.3180  | 377.6556  | 287.8990  | 139.4955 | 47.9913  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 152.7467     | 349.5869 | 530.6354 (98)  |
| Space heating per m2 |           |           |           |          |          |          |          |          |          |              |          | 2399.3285 (98) |
|                      |           |           |           |          |          |          |          |          |          | (98) / (4) = |          | 35.2324 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |          | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |          | 2566.1267 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |                 |
| Space heating requirement                                             | 513.3180 | 377.6556 | 287.8990 | 139.4955 | 47.9913  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 152.7467 | 349.5869 | 530.6354 | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000  | (210)           |
| Space heating fuel (main heating system)                              | 549.0032 | 403.9098 | 307.9134 | 149.1930 | 51.3276  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 163.3654 | 373.8897 | 567.5245 | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (215)           |
| Water heating requirement                                             | 168.2495 | 147.9322 | 154.5052 | 137.3161 | 133.7052 | 118.2348 | 112.3764 | 124.9323 | 125.2194 | 142.4471 | 152.1163 | 163.8008 | (64)            |
| Efficiency of water heater (217)m                                     | 87.6004  | 87.2088  | 86.4517  | 84.8558  | 82.3724  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.0002  | 86.9645  | 87.7255  | (216)           |
| Fuel for water heating, kWh/month                                     | 192.0646 | 169.6300 | 178.7186 | 161.8228 | 162.3181 | 148.1639 | 140.8225 | 156.5567 | 156.9166 | 167.5844 | 174.9177 | 186.7198 | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          |          | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          |          | 2566.1267 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |          |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          |          | 30.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          |          | 75.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          |          | 303.7325 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          |          | 4941.0950 (238) |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2566.1267          | 0.2160                        | 554.2834 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1996.2358          | 0.2160                        | 431.1869 (264)           |
| Space and water heating                                                                           |                    |                               | 985.4703 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 303.7325           | 0.5190                        | 157.6372 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1182.0325 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 14.4709 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3148 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.5716 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (14.4709 * 1.00) + 2.3148 + 0.5716, rounded to 2 d.p. |                    |                               | 17.3600 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-4-01                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP-1-2                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 87 B                                                                    | DER           | 10.78   | TER            | 16.29      |
| Environmental                      | 92 A                                                                    | % DER<TER     | 33.84   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.77                                                                    | DFEE          | 46.01   | TFEE           | 49.65      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 7.32    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Top-floor flat, total floor area 92 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 16.29 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 10.78 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 49.6 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 46.0 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.11 (max. 0.20) | 0.11 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage: Nominal cylinder loss: 0.09 kWh/day  
Permitted by DBSCG 0.32 OK  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK  
Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing North East: 12.22 m<sup>2</sup>, No overhang  
Windows facing North West: 16.76 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Roof U-value 0.11 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 91.9000 (1b)              | x 2.5000 (2b)                   | = 229.7500 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 91.9000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 229.7500 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |         |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|---------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |         |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |         |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |         |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |         |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |         |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |         |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |         |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |         |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes    |             |        |        |         |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000 |             |        |        |         |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 | (18)        |        |        |         |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 2      | (19)        |        |        |         |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 | (20)        |        |        |         |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 | (21)        |        |        |         |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec     |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000  |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179 | 0.1275      | 0.1371 | 0.1434 | 0.1498  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |         |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        | 0.5000  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        | 79.9000 |
| Effective ac                                                                                 | 0.2631                       | 0.2599 | 0.2567    | 0.2408 | 0.2376 | 0.2216 | 0.2216                      | 0.2184 | 0.2280      | 0.2376 | 0.2439 | 0.2503  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.4000                    | 1.3258                        | 11.1364      |                                      | (27)            |
| W02 (Uw = 1.40)                                                |                         |                            | 16.7600                   | 1.3258                        | 22.2197      |                                      | (27)            |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                      | (26a)           |
| W31 (Uw = 1.40)                                                |                         |                            | 3.8200                    | 1.3258                        | 5.0644       |                                      | (27)            |
| External Wall 1                                                | 54.9000                 | 28.9800                    | 25.9200                   | 0.1500                        | 3.8880       | 140.0000                             | 3628.8000 (29a) |
| Corridor wall                                                  | 7.6000                  | 2.1000                     | 5.5000                    | 0.1409                        | 0.7750       | 110.0000                             | 605.0000 (29a)  |
| roof                                                           | 91.9000                 |                            | 91.9000                   | 0.1100                        | 10.1090      | 9.0000                               | 827.1000 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 154.4000                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 56.1325      |                                      | (33)            |
| Party Wall 1                                                   |                         |                            | 38.9000                   | 0.0000                        | 0.0000       | 140.0000                             | 5446.0000 (32)  |
| Party Floor                                                    |                         |                            | 91.9000                   |                               |              | 80.0000                              | 7352.0000 (32d) |
| Internal Wall                                                  |                         |                            | 163.4000                  |                               |              | 9.0000                               | 1470.6000 (32c) |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 19329.5000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 210.3319 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 6.4040 (36)     |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 62.5365 (37)    |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 19.9447 | 19.7031 | 19.4614 | 18.2531 | 18.0114 | 16.8031 | 16.8031 | 16.5614 | 17.2864 | 18.0114 | 18.4947 | 18.9781 (38) |
| Heat transfer coeff       | 82.4812 | 82.2395 | 81.9979 | 80.7895 | 80.5479 | 79.3395 | 79.3395 | 79.0979 | 79.8229 | 80.5479 | 81.0312 | 81.5145 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 80.7291 (39) |
| HLP                       | 0.8975  | 0.8949  | 0.8923  | 0.8791  | 0.8765  | 0.8633  | 0.8633  | 0.8607  | 0.8686  | 0.8765  | 0.8817  | 0.8870 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.8784 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |               |
|------------------------------------------|---------------|
| Assumed occupancy                        | 2.6508 (42)   |
| Average daily hot water use (litres/day) | 102.2711 (43) |

|                     | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Daily hot water use |     |     |     |     |     |     |     |     |     |     |     |     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |                                                       |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|-------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Energy conte                                                    | 112.4982                                              | 108.4074 | 104.3165 | 100.2257 | 96.1348  | 92.0440  | 92.0440  | 96.1348  | 100.2257 | 104.3165 | 108.4074 | 112.4982 (44) |
| Energy content (annual)                                         | 166.8316                                              | 145.9120 | 150.5681 | 131.2689 | 125.9556 | 108.6901 | 100.7174 | 115.5747 | 116.9550 | 136.2998 | 148.7819 | 161.5675 (45) |
| Distribution loss (46)m = 0.15 x (45)m                          | Total = Sum(45)m = 1609.1225 (45)                     |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 25.0247                                               | 21.8868  | 22.5852  | 19.6903  | 18.8933  | 16.3035  | 15.1076  | 17.3362  | 17.5433  | 20.4450  | 22.3173  | 24.2351 (46)  |
| Water storage loss:                                             |                                                       |          |          |          |          |          |          |          |          |          |          |               |
| Store volume                                                    |                                                       |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)   |
| b) If manufacturer declared loss factor is not known :          |                                                       |          |          |          |          |          |          |          |          |          |          |               |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |                                                       |          |          |          |          |          |          |          |          |          |          | 0.0115 (51)   |
| Volume factor from Table 2a                                     |                                                       |          |          |          |          |          |          |          |          |          |          | 3.9149 (52)   |
| Temperature factor from Table 2b                                |                                                       |          |          |          |          |          |          |          |          |          |          | 1.0000 (53)   |
| Enter (49) or (54) in (55)                                      |                                                       |          |          |          |          |          |          |          |          |          |          | 0.0904 (55)   |
| Total storage loss                                              |                                                       |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 2.8029                                                | 2.5316   | 2.8029   | 2.7124   | 2.8029   | 2.7124   | 2.8029   | 2.8029   | 2.7124   | 2.8029   | 2.7124   | 2.8029 (56)   |
| If cylinder contains dedicated solar storage                    |                                                       |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 2.8029                                                | 2.5316   | 2.8029   | 2.7124   | 2.8029   | 2.7124   | 2.8029   | 2.8029   | 2.7124   | 2.8029   | 2.7124   | 2.8029 (57)   |
| Primary loss                                                    | 23.2624                                               | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month |                                                       |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 192.8968                                              | 169.4548 | 176.6333 | 156.4933 | 152.0209 | 133.9146 | 126.7826 | 141.6399 | 142.1794 | 162.3650 | 174.0063 | 187.6327 (62) |
| Solar input                                                     | 0.0000                                                | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
|                                                                 | Solar input (sum of months) = Sum(63)m = 0.0000 (63)  |          |          |          |          |          |          |          |          |          |          |               |
| Output from w/h                                                 |                                                       |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 192.8968                                              | 169.4548 | 176.6333 | 156.4933 | 152.0209 | 133.9146 | 126.7826 | 141.6399 | 142.1794 | 162.3650 | 174.0063 | 187.6327 (64) |
|                                                                 | Total per year (kWh/year) = Sum(64)m = 1916.0199 (64) |          |          |          |          |          |          |          |          |          |          |               |
| Heat gains from water heating, kWh/month                        |                                                       |          |          |          |          |          |          |          |          |          |          |               |
|                                                                 | 76.3237                                               | 67.3500  | 70.9161  | 63.8265  | 62.7325  | 56.3190  | 54.3407  | 59.2808  | 59.0671  | 66.1719  | 69.6495  | 74.5734 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
|                                                                                     | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 21.6217   | 19.2042   | 15.6179   | 11.8238   | 8.8384    | 7.4618    | 8.0627    | 10.4802   | 14.0665   | 17.8607   | 20.8460   | 22.2227 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 242.5301  | 245.0468  | 238.7048  | 225.2034  | 208.1603  | 192.1422  | 181.4412  | 178.9245  | 185.2665  | 198.7679  | 215.8110  | 231.8290 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542 (69)   |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 (71) |
| Water heating gains (Table 5)                                                       | 102.5856  | 100.2232  | 95.3173   | 88.6479   | 84.3178   | 78.2209   | 73.0386   | 79.6785   | 82.0376   | 88.9407   | 96.7355   | 100.2331 (72)  |
| Total internal gains                                                                | 429.5001  | 427.2369  | 412.4027  | 388.4377  | 364.0792  | 340.5875  | 325.3051  | 331.8458  | 344.1333  | 368.3319  | 396.1551  | 417.0474 (73)  |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |           | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W    |
|-------------|----------|----------|----------|------------|--------------------------------|-----------|-----------------------------------|------------------------------------|----------|------------------------------|----------|---------------|
| <hr/>       |          |          |          |            |                                |           |                                   |                                    |          |                              |          |               |
| Northeast   |          |          |          | 8.4000     | 11.2829                        |           | 0.3700                            | 0.8900                             |          | 0.7700                       |          | 21.6285 (75)  |
| Northwest   |          |          |          | 16.7600    | 11.2829                        |           | 0.5600                            | 0.6800                             |          | 0.7700                       |          | 49.9030 (81)  |
| Northeast   |          |          |          | 3.8200     | 11.2829                        |           | 0.3700                            | 0.8800                             |          | 0.7700                       |          | 9.7253 (75)   |
| <hr/>       |          |          |          |            |                                |           |                                   |                                    |          |                              |          |               |
| Solar gains | 81.2568  | 165.4006 | 297.9992 | 489.4003   | 657.8501                       | 701.3378  | 656.0871                          | 523.0403                           | 363.1167 | 202.1326                     | 102.2421 | 66.3584 (83)  |
| Total gains | 510.7569 | 592.6375 | 710.4019 | 877.8380   | 1021.9293                      | 1041.9253 | 981.3923                          | 854.8861                           | 707.2500 | 570.4645                     | 498.3972 | 483.4058 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |                           |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |                           |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |                           |         |         |         |         |         |         |         |         |         |         |              |
|                                                                             | Jan                       | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 65.0973                   | 65.2886 | 65.4810 | 66.4604 | 66.6598 | 67.6750 | 67.6750 | 67.8818 | 67.2653 | 66.6598 | 66.2622 | 65.8693      |
| alpha                                                                       | 5.3398                    | 5.3526  | 5.3654  | 5.4307  | 5.4440  | 5.5117  | 5.5117  | 5.5255  | 5.4844  | 5.4440  | 5.4175  | 5.3913       |
| util living area                                                            | 0.9968                    | 0.9925  | 0.9736  | 0.8861  | 0.6913  | 0.4825  | 0.3549  | 0.4234  | 0.7243  | 0.9570  | 0.9932  | 0.9976 (86)  |
| MIT                                                                         | 19.9291                   | 20.0919 | 20.3859 | 20.7527 | 20.9472 | 20.9938 | 20.9991 | 20.9977 | 20.9522 | 20.6385 | 20.2187 | 19.9032 (87) |
| Th 2                                                                        | 20.1696                   | 20.1719 | 20.1741 | 20.1853 | 20.1875 | 20.1988 | 20.1988 | 20.2010 | 20.1943 | 20.1875 | 20.1831 | 20.1786 (88) |
| util rest of house                                                          | 0.9960                    | 0.9904  | 0.9665  | 0.8600  | 0.6421  | 0.4241  | 0.2907  | 0.3510  | 0.6576  | 0.9414  | 0.9910  | 0.9970 (89)  |
| MIT 2                                                                       | 18.7240                   | 18.9627 | 19.3880 | 19.9010 | 20.1378 | 20.1945 | 20.1984 | 20.1999 | 20.1554 | 19.7607 | 19.1567 | 18.6929 (90) |
| Living area fraction                                                        | fLA = Living area / (4) = |         |         |         |         |         |         |         |         |         |         |              |
| MIT                                                                         | 19.1213                   | 19.3350 | 19.7170 | 20.1818 | 20.4046 | 20.4581 | 20.4624 | 20.4630 | 20.4181 | 20.0501 | 19.5068 | 0.3297 (91)  |
| Temperature adjustment                                                      | 0.0000                    |         |         |         |         |         |         |         |         |         |         |              |
| adjusted MIT                                                                | 19.1213                   | 19.3350 | 19.7170 | 20.1818 | 20.4046 | 20.4581 | 20.4624 | 20.4630 | 20.4181 | 20.0501 | 19.5068 | 19.0919 (93) |

#### 8. Space heating requirement

|                  | Jan       | Feb       | Mar       | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec            |
|------------------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|-----------|----------------|
| Utilisation      | 0.9945    | 0.9877    | 0.9617    | 0.8599   | 0.6557   | 0.4432   | 0.3119   | 0.3749   | 0.6770   | 0.9383   | 0.9886    | 0.9958 (94)    |
| Useful gains     | 507.9317  | 585.3460  | 683.1694  | 754.8636 | 670.0946 | 461.7515 | 306.0934 | 320.4689 | 478.8344 | 535.2426 | 492.7198  | 481.3682 (95)  |
| Ext temp.        | 4.3000    | 4.9000    | 6.5000    | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000 (96)    |
| Heat loss rate W |           |           |           |          |          |          |          |          |          |          |           |                |
|                  | 1222.4820 | 1187.1261 | 1083.7689 | 911.4508 | 701.1401 | 464.7757 | 306.4384 | 321.3709 | 504.3283 | 761.1856 | 1005.3398 | 1213.9101 (97) |
| Month fracti     | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000 (97a)   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                      |          |          |          |          |         |        |        |        |        |          |          |                           |
|----------------------|----------|----------|----------|----------|---------|--------|--------|--------|--------|----------|----------|---------------------------|
| Space heating kWh    | 531.6254 | 404.3963 | 298.0461 | 112.7428 | 23.0979 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 168.1016 | 369.0864 | 545.0111 (98)             |
| Space heating        |          |          |          |          |         |        |        |        |        |          |          | 2452.1076 (98)            |
| Space heating per m2 |          |          |          |          |         |        |        |        |        |          |          | (98) / (4) = 26.6823 (99) |

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 2452.1076 (98)   |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 1184.3680 (307a) |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 1390.3450 (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1916.0199 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 925.4376 (310a)  |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1086.3833 (310b) |
| Electricity used for heat distribution                                                  | 45.8653 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 185.6954 (330a)  |
| Total electricity for the above, kWh/year                                               | 185.6954 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 381.8466 (332)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |                  |
| PV Unit 0 (0.80 + 0.49 + 951 + 1.00) =                                                  | -372.6415        |
| Total delivered energy for all uses                                                     | 4781.4345 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 570.2177           | 0.5190                        | 295.9430 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 2637.6233          | 0.2160                        | 569.7266 (368)           |
| Electrical energy for heat distribution                                                    | 45.8653            | 0.5190                        | 23.8041 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 889.4737 (373)           |
| Space and water heating                                                                    |                    |                               | 889.4737 (376)           |
| Pumps and fans                                                                             | 185.6954           | 0.5190                        | 96.3759 (378)            |
| Energy for lighting                                                                        | 381.8466           | 0.5190                        | 198.1784 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 990.6272 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 10.7800 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 10.7800 ZC1 |
| Total Floor Area                                                                | TFA 91.9000 |
| Assumed number of occupants                                                     | N 2.6508    |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF 0.5190   |
| CO2 emissions from appliances, equation (L14)                                   | 15.6385 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      | 1.9872 ZC3  |
| Total CO2 emissions                                                             | 28.4057 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC7  |
| Net CO2 emissions                                                               | 28.4057 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 91.9000 (1b)              | x 2.5000 (2b)                   | = 229.7500 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 91.9000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 229.7500 (5)              |

#### 2. Ventilation rate

|                                                      | main<br>heating              | secondary<br>heating | other | total | m3 per hour                |
|------------------------------------------------------|------------------------------|----------------------|-------|-------|----------------------------|
| Number of chimneys                                   | 0                            | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                 | 0                            | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                          |                              |                      |       |       | 3 * 10 = 30.0000 (7a)      |
| Number of passive vents                              |                              |                      |       |       | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                         |                              |                      |       |       | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(7a)+(7b)+(7c) = |                      |       |       | 30.0000 / (5) = 0.1306 (8) |
| Pressure test                                        |                              |                      |       |       | Yes                        |
| Measured/design AP50                                 |                              |                      |       |       | 5.0000                     |
| Infiltration rate                                    |                              |                      |       |       | 0.3806 (18)                |
| Number of sides sheltered                            |                              |                      |       |       | 2 (19)                     |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =  |                      |       |       | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =         |                      |       |       | 0.3235 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4125 | 0.4044 | 0.3963 | 0.3558 | 0.3478 | 0.3073 | 0.3073 | 0.2992 | 0.3235 | 0.3478 | 0.3639 | 0.3801 (22b) |
| Effective ac    | 0.5851 | 0.5818 | 0.5785 | 0.5633 | 0.5605 | 0.5472 | 0.5472 | 0.5448 | 0.5523 | 0.5605 | 0.5662 | 0.5722 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 20.8700                   | 1.3258                        | 27.6686      |                                | (27)          |
| External Wall 1                                                | 54.9000                 | 20.8700                    | 34.0300                   | 0.1800                        | 6.1254       |                                | (29a)         |
| Corridor wall                                                  | 7.6000                  | 2.1000                     | 5.5000                    | 0.1800                        | 0.9900       |                                | (29a)         |
| roof                                                           | 91.9000                 |                            | 91.9000                   | 0.1300                        | 11.9470      |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 154.4000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 49.2510      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 4.1715 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 53.4225 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 44.3576 | 44.1072 | 43.8617 | 42.7088 | 42.4931 | 41.4890 | 41.4890 | 41.3030 | 41.8757 | 42.4931 | 42.9295 | 43.3857 (38) |
| Heat transfer coeff       | 97.7801 | 97.5296 | 97.2842 | 96.1313 | 95.9156 | 94.9114 | 94.9114 | 94.7255 | 95.2982 | 95.9156 | 96.3519 | 96.8081 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 96.1302 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.0640 | 1.0613 | 1.0586 | 1.0460 | 1.0437 | 1.0328 | 1.0328 | 1.0307 | 1.0370 | 1.0437 | 1.0484 | 1.0534 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.0460 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

| Assumed occupancy                                           |          |          |          |          |          |          |         |          |          |          |          | 2.6508 (42)                       |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|----------|-----------------------------------|
| Average daily hot water use (litres/day)                    |          |          |          |          |          |          |         |          |          |          |          | 97.1575 (43)                      |
|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov      | Dec                               |
| Daily hot water use                                         | 106.8733 | 102.9870 | 99.1007  | 95.2144  | 91.3281  | 87.4418  | 87.4418 | 91.3281  | 95.2144  | 99.1007  | 102.9870 | 106.8733 (44)                     |
| Energy conte                                                | 158.4900 | 138.6164 | 143.0397 | 124.7055 | 119.6579 | 103.2556 | 95.6815 | 109.7959 | 111.1073 | 129.4848 | 141.3428 | 153.4891 (45)                     |
| Energy content (annual)                                     |          |          |          |          |          |          |         |          |          |          |          | Total = Sum(45)m = 1528.6664 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 23.7735  | 20.7925  | 21.4560  | 18.7058  | 17.9487  | 15.4883  | 14.3522 | 16.4694  | 16.6661  | 19.4227  | 21.2014  | 23.0234 (46)                      |
| Water storage loss:                                         |          |          |          |          |          |          |         |          |          |          |          | 2.0000 (47)                       |
| Store volume                                                |          |          |          |          |          |          |         |          |          |          |          | 0.2388 (48)                       |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |          |         |          |          |          |          | 0.5400 (49)                       |
| Temperature factor from Table 2b                            |          |          |          |          |          |          |         |          |          |          |          | 0.1290 (55)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |          |         |          |          |          |          |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 185.7501 | 163.2384 | 170.2998 | 151.0862 | 146.9180 | 129.6364 | 122.9417 | 137.0561 | 137.4880 | 156.7449 | 167.7236 | 180.7492 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 185.7501 | 163.2384 | 170.2998 | 151.0862 | 146.9180 | 129.6364 | 122.9417 | 137.0561 | 137.4880 | 156.7449 | 167.7236 | 180.7492 (64) |
| Heat gains from water heating, kWh/month                        | 74.5060  | 65.7876  | 69.3688  | 62.5692  | 61.5944  | 55.4371  | 53.6222  | 58.3153  | 58.0478  | 64.8618  | 68.1011  | 72.8432 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 21.6173   | 19.2003   | 15.6148   | 11.8214   | 8.8366    | 7.4602    | 8.0611    | 10.4781   | 14.0636   | 17.8570   | 20.8418   | 22.2182 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 242.5301  | 245.0468  | 238.7048  | 225.2034  | 208.1603  | 192.1422  | 181.4412  | 178.9245  | 185.2665  | 198.7679  | 215.8110  | 231.8290 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542 (69)   |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 (71) |
| Water heating gains (Table 5)                                                       | 100.1425  | 97.8982   | 93.2376   | 86.9017   | 82.7881   | 76.9960   | 72.0729   | 78.3807   | 80.6219   | 87.1799   | 94.5849   | 97.9076 (72)   |
| Total internal gains                                                                | 430.0526  | 427.9080  | 413.3199  | 389.6891  | 365.5477  | 342.3611  | 327.3378  | 333.5459  | 345.7147  | 369.5674  | 397.0003  | 417.7174 (73)  |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|----------|----------|---------------|
| Northeast   |          |          |          | 8.8000     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 30.3443 (75) |          |          |               |
| Northwest   |          |          |          | 12.0700    | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 41.6199 (81) |          |          |               |
|             |          |          |          |            |                                |                                   |                                    |                              |              |          |          |               |
| Solar gains | 71.9642  | 146.4852 | 263.9198 | 433.4322   | 582.6179                       | 621.1323                          | 581.0565                           | 463.2250                     | 321.5904     | 179.0166 | 90.5496  | 58.7696 (83)  |
| Total gains | 502.0169 | 574.3933 | 677.2397 | 823.1213   | 948.1656                       | 963.4935                          | 908.3943                           | 796.7709                     | 667.3051     | 548.5840 | 487.5499 | 476.4870 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 65.2684 | 65.4359 | 65.6010 | 66.3878 | 66.5371 | 67.2411 | 67.2411 | 67.3731 | 66.9681                   | 66.5371 | 66.2358 | 65.9236      |
| alpha                                                                       | 5.3512  | 5.3624  | 5.3734  | 5.4259  | 5.4358  | 5.4827  | 5.4827  | 5.4915  | 5.4645                    | 5.4358  | 5.4157  | 5.3949       |
| util living area                                                            | 0.9987  | 0.9971  | 0.9898  | 0.9498  | 0.8177  | 0.6109  | 0.4562  | 0.5377  | 0.8390                    | 0.9822  | 0.9973  | 0.9991 (86)  |
| MIT                                                                         | 19.8252 | 19.9639 | 20.2307 | 20.6027 | 20.8784 | 20.9803 | 20.9967 | 20.9923 | 20.8981                   | 20.5220 | 20.1118 | 19.8034 (87) |
| Th 2                                                                        | 20.0304 | 20.0326 | 20.0348 | 20.0451 | 20.0471 | 20.0561 | 20.0561 | 20.0578 | 20.0526                   | 20.0471 | 20.0432 | 20.0391 (88) |
| util rest of house                                                          | 0.9983  | 0.9961  | 0.9862  | 0.9321  | 0.7654  | 0.5291  | 0.3602  | 0.4323  | 0.7694                    | 0.9731  | 0.9962  | 0.9987 (89)  |
| MIT 2                                                                       | 18.4536 | 18.6577 | 19.0472 | 19.5811 | 19.9328 | 20.0437 | 20.0549 | 20.0547 | 19.9703                   | 19.4789 | 18.8821 | 18.4279 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3297 (91)  |
| MIT                                                                         | 18.9058 | 19.0884 | 19.4374 | 19.9179 | 20.2446 | 20.3525 | 20.3654 | 20.3638 | 20.2762                   | 19.8228 | 19.2875 | 18.8814 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.9058 | 19.0884 | 19.4374 | 19.9179 | 20.2446 | 20.3525 | 20.3654 | 20.3638 | 20.2762                   | 19.8228 | 19.2875 | 18.8814 (93) |

#### 8. Space heating requirement

|                      |           |           |           |           |          |          |          |          |          |              |           |                |
|----------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|--------------|-----------|----------------|
| Utilisation          | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov       | Dec            |
| Useful gains         | 500.8051  | 571.3717  | 665.8236  | 764.8955  | 736.8584 | 535.1999 | 356.0749 | 372.2644 | 525.6682 | 532.3126     | 485.1003  | 475.6150 (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000    | 4.2000 (96)    |
| Heat loss rate W     | 1428.1580 | 1383.7862 | 1258.6020 | 1059.1653 | 819.5555 | 545.9803 | 357.3803 | 375.4764 | 588.5820 | 884.6090     | 1174.2904 | 1421.2815 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000    | 1.0000 (97a)   |
| Space heating kWh    | 689.9505  | 545.9426  | 441.0271  | 211.8743  | 61.5266  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 262.1085     | 496.2169  | 703.5758 (98)  |
| Space heating        |           |           |           |           |          |          |          |          |          |              |           | 3412.2225 (98) |
| Space heating per m2 |           |           |           |           |          |          |          |          |          | (98) / (4) = |           | 37.1297 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 3649.4358 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 689.9505 | 545.9426 | 441.0271 | 211.8743 | 61.5266  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 262.1085 | 496.2169 | 703.5758  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 737.9150 | 583.8958 | 471.6868 | 226.6035 | 65.8039  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 280.3300 | 530.7133 | 752.4875  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 185.7501 | 163.2384 | 170.2998 | 151.0862 | 146.9180 | 129.6364 | 122.9417 | 137.0561 | 137.4880 | 156.7449 | 167.7236 | 180.7492  | (64)            |
| Efficiency of water heater (217)m                                     | 87.9972  | 87.7905  | 87.2413  | 85.7158  | 82.6856  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 86.1759  | 87.5350  | 79.8000   | (216)           |
| Fuel for water heating, kWh/month                                     | 211.0864 | 185.9409 | 195.2055 | 176.2641 | 177.6827 | 162.4516 | 154.0622 | 171.7495 | 172.2908 | 181.8896 | 191.6075 | 205.1965  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2185.4273 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 3649.4358 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 381.7691  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 6291.6322 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 3649.4358          | 0.2160                        | 788.2781 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2185.4273          | 0.2160                        | 472.0523 (264)           |
| Space and water heating                                                                           |                    |                               | 1260.3304 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 381.7691           | 0.5190                        | 198.1382 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1497.3936 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 13.7142 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.1560 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.4236 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (13.7142 * 1.00) + 2.1560 + 0.4236, rounded to 2 d.p. |                    |                               | 16.2900 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-4-02                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP-1-2                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 88 B                                                                    | DER           | 8.46    | TER            | 14.37      |
| Environmental                      | 93 A                                                                    | % DER<TER     | 41.14   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.60                                                                    | DFEE          | 33.48   | TFEE           | 39.37      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 14.97   |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Top-floor flat, total floor area 92 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 14.37 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 8.46 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 39.4 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 33.5 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.11 (max. 0.20) | 0.11 (max. 0.35) | OK |
| Openings      | 1.38 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage: Nominal cylinder loss: 0.09 kWh/day  
Permitted by DBSCG 0.32 OK  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK  
Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing South East: 16.76 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Roof U-value 0.11 W/m<sup>2</sup>K  
Thermal bridging y-value 0.039 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 91.9000 (1b)              | x 2.5000 (2b)                   | = 229.7500 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 91.9000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 229.7500 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 2                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2631                       | 0.2599 | 0.2567    | 0.2408 | 0.2376 | 0.2216 | 0.2216                      | 0.2184      | 0.2280 | 0.2376 | 0.2439 | 0.2503 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W02 (Uw = 1.40)                                                |                         |                            | 16.7600                   | 1.3258                        | 22.2197      |                                | (27)                                                 |
| door                                                           |                         |                            | 2.1000                    | 1.2500                        | 2.6250       |                                | (26a)                                                |
| External Wall 1                                                | 63.4000                 | 16.7600                    | 46.6400                   | 0.1500                        | 6.9960       | 140.0000                       | 6529.6000 (29a)                                      |
| Corridor wall                                                  | 3.5000                  | 2.1000                     | 1.4000                    | 0.1409                        | 0.1973       | 110.0000                       | 154.0000 (29a)                                       |
| roof                                                           | 91.9000                 |                            | 91.9000                   | 0.1100                        | 10.1090      | 9.0000                         | 827.1000 (30)                                        |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 158.8000                  |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      | 42.1470                       |              |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 52.3000                   | 0.0000                        | 0.0000       | 140.0000                       | 7322.0000 (32)                                       |
| Party Floor                                                    |                         |                            | 91.9000                   |                               |              | 80.0000                        | 7352.0000 (32d)                                      |
| Internal Wall                                                  |                         |                            | 163.4000                  |                               |              | 9.0000                         | 1470.6000 (32c)                                      |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 23655.3000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 257.4026 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 6.1640 (36)                                          |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 48.3110 (37)                           |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 19.9447 | 19.7031 | 19.4614 | 18.2531 | 18.0114 | 16.8031 | 16.8031 | 16.5614 | 17.2864 | 18.0114 | 18.4947 | 18.9781 (38) |
| Heat transfer coeff       | 68.2557 | 68.0140 | 67.7724 | 66.5640 | 66.3224 | 65.1140 | 65.1140 | 64.8724 | 65.5974 | 66.3224 | 66.8057 | 67.2890 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 66.5036 (39) |
| HLP                       | 0.7427  | 0.7401  | 0.7375  | 0.7243  | 0.7217  | 0.7085  | 0.7085  | 0.7059  | 0.7138  | 0.7217  | 0.7269  | 0.7322 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.7237 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |              |              |              |              |             |             |             |             |              |              |              |                   |
|------------------------------------------|--------------|--------------|--------------|--------------|-------------|-------------|-------------|-------------|--------------|--------------|--------------|-------------------|
| Assumed occupancy                        |              |              |              |              |             |             |             |             |              |              |              | 2.6508 (42)       |
| Average daily hot water use (litres/day) |              |              |              |              |             |             |             |             |              |              |              | 102.2711 (43)     |
| Daily hot water use                      | Jan 112.4982 | Feb 108.4074 | Mar 104.3165 | Apr 100.2257 | May 96.1348 | Jun 92.0440 | Jul 92.0440 | Aug 96.1348 | Sep 100.2257 | Oct 104.3165 | Nov 108.4074 | Dec 112.4982 (44) |
| Energy conte                             | 166.8316     | 145.9120     | 150.5681     | 131.2689     | 125.9556    | 108.6901    | 100.7174    | 115.5747    | 116.9550     | 136.2998     | 148.7819     | 161.5675 (45)     |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |                                    |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Energy content (annual)                                         | Total = Sum (45)m = 1609.1225 (45) |          |          |          |          |          |          |          |          |          |               |
| Distribution loss (46)m = 0.15 x (45)m                          |                                    |          |          |          |          |          |          |          |          |          |               |
| 25.0247                                                         | 21.8868                            | 22.5852  | 19.6903  | 18.8933  | 16.3035  | 15.1076  | 17.3362  | 17.5433  | 20.4450  | 22.3173  | 24.2351 (46)  |
| Water storage loss:                                             |                                    |          |          |          |          |          |          |          |          |          |               |
| Store volume                                                    | 2.0000 (47)                        |          |          |          |          |          |          |          |          |          |               |
| b) If manufacturer declared loss factor is not known :          |                                    |          |          |          |          |          |          |          |          |          |               |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      | 0.0115 (51)                        |          |          |          |          |          |          |          |          |          |               |
| Volume factor from Table 2a                                     | 3.9149 (52)                        |          |          |          |          |          |          |          |          |          |               |
| Temperature factor from Table 2b                                | 1.0000 (53)                        |          |          |          |          |          |          |          |          |          |               |
| Enter (49) or (54) in (55)                                      | 0.0904 (55)                        |          |          |          |          |          |          |          |          |          |               |
| Total storage loss                                              |                                    |          |          |          |          |          |          |          |          |          |               |
| 2.8029                                                          | 2.5316                             | 2.8029   | 2.7124   | 2.8029   | 2.7124   | 2.8029   | 2.8029   | 2.7124   | 2.8029   | 2.7124   | 2.8029 (56)   |
| If cylinder contains dedicated solar storage                    |                                    |          |          |          |          |          |          |          |          |          |               |
| 2.8029                                                          | 2.5316                             | 2.8029   | 2.7124   | 2.8029   | 2.7124   | 2.8029   | 2.8029   | 2.7124   | 2.8029   | 2.7124   | 2.8029 (57)   |
| Primary loss                                                    | 23.2624                            | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month |                                    |          |          |          |          |          |          |          |          |          |               |
| 192.8968                                                        | 169.4548                           | 176.6333 | 156.4933 | 152.0209 | 133.9146 | 126.7826 | 141.6399 | 142.1794 | 162.3650 | 174.0063 | 187.6327 (62) |
| Solar input                                                     | 0.0000                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 192.8968                           | 169.4548 | 176.6333 | 156.4933 | 152.0209 | 133.9146 | 126.7826 | 141.6399 | 142.1794 | 162.3650 | 174.0063 (64) |
| Heat gains from water heating, kWh/month                        | 76.3237                            | 67.3500  | 70.9161  | 63.8265  | 62.7325  | 56.3190  | 54.3407  | 59.2808  | 59.0671  | 66.1719  | 69.6495 (65)  |
| Total per year (kWh/year) = Sum (64)m =                         | 1916.0199 (64)                     |          |          |          |          |          |          |          |          |          |               |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |                |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------------|
| Metabolic gains (Table 5), Watts                                                    |           |           |           |           |           |           |           |           |           |           |                |
| Jan                                                                                 | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec            |
| (66)m                                                                               | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |           |           |           |           |           |           |           |           |           |           |                |
| 22.1407                                                                             | 19.6652   | 15.9928   | 12.1076   | 9.0506    | 7.6409    | 8.2562    | 10.7318   | 14.4042   | 18.2894   | 21.3464   | 22.7561 (67)   |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |           |           |           |           |           |           |           |           |           |           |                |
| 242.5301                                                                            | 245.0468  | 238.7048  | 225.2034  | 208.1603  | 192.1422  | 181.4412  | 178.9245  | 185.2665  | 198.7679  | 215.8110  | 231.8290 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |           |           |           |           |           |           |           |           |           |           |                |
| 36.2542                                                                             | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542 (69)   |
| Pumps, fans                                                                         | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000    | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 |           |           |           |           |           |           |           |           |           |           |                |
| -106.0337                                                                           | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 (71) |
| Water heating gains (Table 5)                                                       |           |           |           |           |           |           |           |           |           |           |                |
| 102.5856                                                                            | 100.2232  | 95.3173   | 88.6479   | 84.3178   | 78.2209   | 73.0386   | 79.6785   | 82.0376   | 88.9407   | 96.7355   | 100.2331 (72)  |
| Total internal gains                                                                | 430.0191  | 427.6979  | 412.7776  | 388.7215  | 364.2914  | 340.7666  | 325.4987  | 332.0974  | 344.4709  | 368.7606  | 396.6555 (73)  |

#### 6. Solar gains

|               |             |          |          |          |          |          |          |          |          |          |               |
|---------------|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| [Jan]         |             |          |          |          |          |          |          |          |          |          |               |
| Area          | m2          |          |          |          |          |          |          |          |          |          |               |
| Solar flux    | Table 6a    |          |          |          |          |          |          |          |          |          |               |
| Specific data | or Table 6b |          |          |          |          |          |          |          |          |          |               |
| Specific data | or Table 6c |          |          |          |          |          |          |          |          |          |               |
| Access factor | Table 6d    |          |          |          |          |          |          |          |          |          |               |
| Gains         | W           |          |          |          |          |          |          |          |          |          |               |
| Southeast     | 16.7600     |          |          |          |          |          |          |          |          |          |               |
| Solar gains   | 162.7343    | 277.1968 | 379.2727 | 469.9373 | 526.3690 | 522.5625 | 503.8060 | 461.7055 | 410.6722 | 306.3615 | 194.9182 (83) |
| Total gains   | 592.7535    | 704.8947 | 792.0504 | 858.6589 | 890.6603 | 863.3292 | 829.3047 | 793.8029 | 755.1431 | 675.1221 | 591.5737 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |          |          |          |          |         |         |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|----------|----------|----------|----------|---------|---------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |          |          |          |          |         |         |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          |         |         |         |         |         |          |          |          |          |         |         |
| Jan                                                                         | Feb     | Mar     | Apr     | May     | Jun     | Jul      | Aug      | Sep      | Oct      | Nov     | Dec     |
| tau                                                                         | 96.2691 | 96.6112 | 96.9557 | 98.7157 | 99.0754 | 100.9140 | 100.9140 | 101.2899 | 100.1704 | 99.0754 | 98.3586 |
| alpha                                                                       | 7.4179  | 7.4407  | 7.4637  | 7.5810  | 7.6050  | 7.7276   | 7.7276   | 7.7527   | 7.6780   | 7.6050  | 7.5572  |
| util living area                                                            | 0.9962  | 0.9862  | 0.9538  | 0.8533  | 0.6789  | 0.4818   | 0.3454   | 0.3758   | 0.5946   | 0.8930  | 0.9877  |
| MIT                                                                         | 20.4086 | 20.5693 | 20.7551 | 20.9214 | 20.9869 | 20.9992  | 20.9999  | 20.9999  | 20.9961  | 20.9061 | 20.6282 |
| Th 2                                                                        | 20.3033 | 20.3056 | 20.3079 | 20.3194 | 20.3217 | 20.3333  | 20.3333  | 20.3356  | 20.3287  | 20.3217 | 20.3171 |
| util rest of house                                                          | 0.9951  | 0.9822  | 0.9415  | 0.8231  | 0.6339  | 0.4320   | 0.2931   | 0.3216   | 0.5388   | 0.8625  | 0.9835  |
| MIT 2                                                                       | 19.5109 | 19.7448 | 20.0078 | 20.2349 | 20.3103 | 20.3328  | 20.3333  | 20.3356  | 20.3260  | 20.2228 | 19.8407 |
| Living area fraction                                                        | 19.7854 | 19.9969 | 20.2363 | 20.4448 | 20.5172 | 20.5365  | 20.5371  | 20.5387  | 20.5309  | 20.4317 | 20.0815 |
| MIT                                                                         | 19.7854 | 19.9969 | 20.2363 | 20.4448 | 20.5172 | 20.5365  | 20.5371  | 20.5387  | 20.5309  | 20.4317 | 20.0815 |
| Temperature adjustment                                                      |         |         |         |         |         |          |          |          |          |         |         |
| adjusted MIT                                                                | 19.7854 | 19.9969 | 20.2363 | 20.4448 | 20.5172 | 20.5365  | 20.5371  | 20.5387  | 20.5309  | 20.4317 | 20.0815 |

#### 8. Space heating requirement

|                      |                           |           |          |          |          |          |          |          |          |          |          |                |
|----------------------|---------------------------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation          | Jan                       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Useful gains         | 589.1594                  | 690.8547  | 744.5746 | 711.8022 | 576.3635 | 386.1225 | 256.3418 | 268.4479 | 419.7056 | 585.9096 | 580.7210 | 554.5563 (94)  |
| Ext temp.            | 4.3000                    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 1056.9660                 | 1026.8034 | 930.9427 | 768.4716 | 584.7778 | 386.5521 | 256.3621 | 268.4877 | 421.8494 | 652.0627 | 867.2395 | 1046.5184 (97) |
| Month fracti         | 1.0000                    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 348.0481                  | 225.7575  | 138.6578 | 40.8020  | 6.2602   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 49.2180  | 206.2933 | 366.0198 (98)  |
| Space heating        |                           |           |          |          |          |          |          |          |          |          |          |                |
| Space heating per m2 | (98) / (4) = 15.0278 (99) |           |          |          |          |          |          |          |          |          |          |                |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |                 |
|-----------------------------------------------------------------------------------------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)           |
| Fraction of space heat from community system                                            | 1.0000    | (302)           |
| Fraction of heat from community Heat pump                                               | 0.4600    | (303a)          |
| Fraction of heat from community Boilers                                                 | 0.5400    | (303b)          |
| Fraction of total space heat from community Heat pump                                   | 0.4600    | (304a)          |
| Fraction of total space heat from community Boilers                                     | 0.5400    | (304b)          |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)           |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a)          |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)           |
| Space heating:                                                                          |           |                 |
| Annual space heating requirement                                                        | 1381.0568 | (98)            |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 667.0504  | (307a)          |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 783.0592  | (307b)          |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)           |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)           |
| Water heating                                                                           |           |                 |
| Annual water heating requirement                                                        | 1916.0199 | (64)            |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 925.4376  | (310a)          |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1086.3833 | (310b)          |
| Electricity used for heat distribution                                                  | 34.6193   | (313)           |
| Annual totals kWh/year                                                                  |           |                 |
| Electricity for pumps and fans:                                                         |           |                 |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |           |                 |
| mechanical ventilation fans (SFP = 0.6625)                                              | 185.6954  | (330a)          |
| Total electricity for the above, kWh/year                                               | 185.6954  | (331)           |
| Electricity for lighting (calculated in Appendix L)                                     | 391.0125  | (332)           |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |           |                 |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415 | -372.6415 (333) |
| Total delivered energy for all uses                                                     |           | 3665.9969 (338) |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 430.4022           | 0.5190                        | 223.3787 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 1990.8866          | 0.2160                        | 430.0315 (368)           |
| Electrical energy for heat distribution                                                    | 34.6193            | 0.5190                        | 17.9674 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 671.3776 (373)           |
| Space and water heating                                                                    |                    |                               | 671.3776 (376)           |
| Pumps and fans                                                                             | 185.6954           | 0.5190                        | 96.3759 (378)            |
| Energy for lighting                                                                        | 391.0125           | 0.5190                        | 202.9355 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 777.2881 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 8.4600 (384)             |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |  |         |     |
|---------------------------------------------------------------------------------|--|---------|-----|
| DER                                                                             |  | 8.4600  | ZC1 |
| Total Floor Area                                                                |  | 91.9000 |     |
| Assumed number of occupants                                                     |  | 2.6508  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             |  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |  | 15.6385 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |  | 1.9872  | ZC3 |
| Total CO2 emissions                                                             |  | 26.0857 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |  | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |  | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |  | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |  | 26.0857 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 91.9000 (1b)              | x 2.5000 (2b)                   | = 229.7500 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 91.9000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 229.7500 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other                       | total           | m <sup>3</sup> per hour |
|---------------------------------------------------------------------------|-----------------|----------------------|-----------------------------|-----------------|-------------------------|
| Number of chimneys                                                        | 0               | 0                    | 0                           | 0 * 40 =        | 0.0000 (6a)             |
| Number of open flues                                                      | 0               | 0                    | 0                           | 0 * 20 =        | 0.0000 (6b)             |
| Number of intermittent fans                                               |                 |                      |                             | 3 * 10 =        | 30.0000 (7a)            |
| Number of passive vents                                                   |                 |                      |                             | 0 * 10 =        | 0.0000 (7b)             |
| Number of flueless gas fires                                              |                 |                      |                             | 0 * 40 =        | 0.0000 (7c)             |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |                             | 30.0000 / (5) = | 0.1306 (8)              |
| Pressure test                                                             |                 |                      |                             |                 | Yes                     |
| Measured/design AP50                                                      |                 |                      |                             |                 | 5.0000                  |
| Infiltration rate                                                         |                 |                      |                             |                 | 0.3806 (18)             |
| Number of sides sheltered                                                 |                 |                      |                             |                 | 2 (19)                  |
| Shelter factor                                                            |                 |                      | (20) = 1 - [0.075 x (19)] = |                 | 0.8500 (20)             |
| Infiltration rate adjusted to include shelter factor                      |                 |                      | (21) = (18) x (20) =        |                 | 0.3235 (21)             |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4125 | 0.4044 | 0.3963 | 0.3558 | 0.3478 | 0.3073 | 0.3073 | 0.2992 | 0.3235 | 0.3478 | 0.3639 | 0.3801 (22b) |
| Effective ac    | 0.5851 | 0.5818 | 0.5785 | 0.5633 | 0.5605 | 0.5472 | 0.5472 | 0.5448 | 0.5523 | 0.5605 | 0.5662 | 0.5722 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 16.7600                   | 1.3258                        | 22.2197      |                                | (27)          |
| External Wall 1                                                | 63.4000                 | 16.7600                    | 46.6400                   | 0.1800                        | 8.3952       |                                | (29a)         |
| Corridor wall                                                  | 3.5000                  | 2.1000                     | 1.4000                    | 0.1800                        | 0.2520       |                                | (29a)         |
| roof                                                           | 91.9000                 |                            | 91.9000                   | 0.1300                        | 11.9470      |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 158.8000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 45.3339      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 3.9315 (36)   |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 49.2654 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 44.3576 | 44.1072 | 43.8617 | 42.7088 | 42.4931 | 41.4890 | 41.4890 | 41.3030 | 41.8757 | 42.4931 | 42.9295 | 43.3857 (38) |
| Heat transfer coeff       | 93.6230 | 93.3726 | 93.1271 | 91.9742 | 91.7585 | 90.7544 | 90.7544 | 90.5684 | 91.1411 | 91.7585 | 92.1949 | 92.6511 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 91.9732 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.0187 | 1.0160 | 1.0134 | 1.0008 | 0.9985 | 0.9875 | 0.9875 | 0.9855 | 0.9917 | 0.9985 | 1.0032 | 1.0082 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.0008 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

| Assumed occupancy                                           |          |          |          |          |          |          |         |          |          |          |          | 2.6508 (42)                       |
|-------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|----------|-----------------------------------|
| Average daily hot water use (litres/day)                    |          |          |          |          |          |          |         |          |          |          |          | 97.1575 (43)                      |
|                                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul     | Aug      | Sep      | Oct      | Nov      | Dec                               |
| Daily hot water use                                         | 106.8733 | 102.9870 | 99.1007  | 95.2144  | 91.3281  | 87.4418  | 87.4418 | 91.3281  | 95.2144  | 99.1007  | 102.9870 | 106.8733 (44)                     |
| Energy conte                                                | 158.4900 | 138.6164 | 143.0397 | 124.7055 | 119.6579 | 103.2556 | 95.6815 | 109.7959 | 111.1073 | 129.4848 | 141.3428 | 153.4891 (45)                     |
| Energy content (annual)                                     |          |          |          |          |          |          |         |          |          |          |          | Total = Sum(45)m = 1528.6664 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 23.7735  | 20.7925  | 21.4560  | 18.7058  | 17.9487  | 15.4883  | 14.3522 | 16.4694  | 16.6661  | 19.4227  | 21.2014  | 23.0234 (46)                      |
| Water storage loss:                                         |          |          |          |          |          |          |         |          |          |          |          | 2.0000 (47)                       |
| Store volume                                                |          |          |          |          |          |          |         |          |          |          |          | 0.2388 (48)                       |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |          |          |         |          |          |          |          | 0.5400 (49)                       |
| Temperature factor from Table 2b                            |          |          |          |          |          |          |         |          |          |          |          | 0.1290 (55)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |          |          |          |         |          |          |          |          |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 185.7501 | 163.2384 | 170.2998 | 151.0862 | 146.9180 | 129.6364 | 122.9417 | 137.0561 | 137.4880 | 156.7449 | 167.7236 | 180.7492 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 185.7501 | 163.2384 | 170.2998 | 151.0862 | 146.9180 | 129.6364 | 122.9417 | 137.0561 | 137.4880 | 156.7449 | 167.7236 | 180.7492 (64) |
| Heat gains from water heating, kWh/month                        | 74.5060  | 65.7876  | 69.3688  | 62.5692  | 61.5944  | 55.4371  | 53.6222  | 58.3153  | 58.0478  | 64.8618  | 68.1011  | 72.8432 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |           |           |           |           |           |           |           |           |           |           |           |           |       |
|-------------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-------|
| Metabolic gains (Table 5), Watts                                                    | Jan       | Feb       | Mar       | Apr       | May       | Jun       | Jul       | Aug       | Sep       | Oct       | Nov       | Dec       | (66)m |
| (66)m                                                                               | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | 132.5422  | (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 22.0382   | 19.5741   | 15.9187   | 12.0515   | 9.0086    | 7.6055    | 8.2180    | 10.6821   | 14.3374   | 18.2047   | 21.2475   | 22.6507   | (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 242.5301  | 245.0468  | 238.7048  | 225.2034  | 208.1603  | 192.1422  | 181.4412  | 178.9245  | 185.2665  | 198.7679  | 215.8110  | 231.8290  | (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | 36.2542   | (69)  |
| Pumps, fans                                                                         | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | 3.0000    | (70)  |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | -106.0337 | (71)  |
| Water heating gains (Table 5)                                                       | 100.1425  | 97.8982   | 93.2376   | 86.9017   | 82.7881   | 76.9960   | 72.0729   | 78.3807   | 80.6219   | 87.1799   | 94.5849   | 97.9076   | (72)  |
| Total internal gains                                                                | 430.4735  | 428.2818  | 413.6239  | 389.9192  | 365.7197  | 342.5064  | 327.4947  | 333.7499  | 345.9885  | 369.9150  | 397.4060  | 418.1500  | (73)  |

#### 6. Solar gains

| [Jan]       |            |          |          |          |                                |          |                                   |          |                                    |          |                              |          |               |  |
|-------------|------------|----------|----------|----------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|---------------|--|
|             | Area<br>m2 |          |          |          | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W    |  |
| Southeast   | 16.7600    |          |          |          | 36.7938                        |          | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 188.4607 (77) |  |
| Solar gains | 188.4607   | 321.0183 | 439.2313 | 544.2289 | 609.5817                       | 605.1735 | 583.4519                          | 534.6957 | 475.5946                           | 354.7937 | 225.7325                     | 161.2831 | (83)          |  |
| Total gains | 618.9342   | 749.3002 | 852.8551 | 934.1481 | 975.3014                       | 947.6799 | 910.9465                          | 868.4456 | 821.5831                           | 724.7087 | 623.1385                     | 579.4331 | (84)          |  |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 68.1664 | 68.3492 | 68.5294 | 69.3884 | 69.5515 | 70.3211 | 70.3211 | 70.4655 | 70.0227 | 69.5515 | 69.2223 | 68.8815 |              |
| alpha                                                                       | 5.5444  | 5.5566  | 5.5686  | 5.6259  | 5.6368  | 5.6881  | 5.6881  | 5.6977  | 5.6682  | 5.6368  | 5.6148  | 5.5921  |              |
| util living area                                                            | 0.9964  | 0.9894  | 0.9700  | 0.9126  | 0.7873  | 0.5977  | 0.4361  | 0.4759  | 0.7180  | 0.9392  | 0.9910  | 0.9975  | (86)         |
| MIT                                                                         | 20.0088 | 20.2019 | 20.4518 | 20.7265 | 20.9102 | 20.9848 | 20.9978 | 20.9965 | 20.9590 | 20.7124 | 20.3028 | 19.9735 | (87)         |
| Th 2                                                                        | 20.0677 | 20.0700 | 20.0722 | 20.0827 | 20.0846 | 20.0937 | 20.0937 | 20.0954 | 20.0902 | 20.0846 | 20.0807 | 20.0765 | (88)         |
| util rest of house                                                          | 0.9953  | 0.9861  | 0.9607  | 0.8868  | 0.7337  | 0.5196  | 0.3475  | 0.3844  | 0.6410  | 0.9152  | 0.9876  | 0.9967  | (89)         |
| MIT 2                                                                       | 18.7487 | 19.0305 | 19.3897 | 19.7747 | 20.0018 | 20.0842 | 20.0929 | 20.0940 | 20.0604 | 19.7660 | 19.1866 | 18.7037 | (90)         |
| Living area fraction                                                        | 19.1340 | 19.3886 | 19.7145 | 20.0657 | 20.2795 | 20.3595 | 20.3696 | 20.3700 | 20.3352 | 20.0554 | 19.5279 | 19.0920 | (92)         |
| Temperature adjustment                                                      | 19.1340 | 19.3886 | 19.7145 | 20.0657 | 20.2795 | 20.3595 | 20.3696 | 20.3700 | 20.3352 | 20.0554 | 19.5279 | 19.0920 | (93)         |
| adjusted MIT                                                                | 19.1340 | 19.3886 | 19.7145 | 20.0657 | 20.2795 | 20.3595 | 20.3696 | 20.3700 | 20.3352 | 20.0554 | 19.5279 | 19.0920 | (93)         |

#### 8. Space heating requirement

|                                  |           |           |           |           |          |          |          |          |          |          |           |           |       |
|----------------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-------|
| Utilisation                      | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov       | Dec       |       |
| Useful gains                     | 615.0299  | 736.4929  | 815.5216  | 827.8535  | 727.4292 | 514.6072 | 341.2955 | 358.1656 | 544.5672 | 662.6235 | 613.6705  | 576.7980  | (95)  |
| Ext temp.                        | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000    | 4.2000    | (96)  |
| Heat loss rate W                 | 1388.8008 | 1352.8412 | 1230.6254 | 1026.9594 | 787.2451 | 522.7042 | 342.1102 | 359.5547 | 568.2814 | 867.6103 | 1145.7866 | 1379.7583 | (97)  |
| Month fracti                     | 1.0000    | 1.0000    | 1.0000    | 1.0000    | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000    | 1.0000    | (97a) |
| Space heating kWh                | 575.6856  | 414.1861  | 308.8372  | 143.3562  | 44.5030  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 152.5102 | 383.1236  | 597.4024  | (98)  |
| Space heating                    |           |           |           |           |          |          |          |          |          |          |           | 2619.6043 | (98)  |
| Space heating per m <sup>2</sup> |           |           |           |           |          |          |          |          |          |          |           | 28.5049   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2801.7159 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 575.6856 | 414.1861 | 308.8372 | 143.3562 | 44.5030  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 152.5102 | 383.1236 | 597.4024  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 615.7065 | 442.9798 | 330.3071 | 153.3222 | 47.5968  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 163.1125 | 409.7579 | 638.9331  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 185.7501 | 163.2384 | 170.2998 | 151.0862 | 146.9180 | 129.6364 | 122.9417 | 137.0561 | 137.4880 | 156.7449 | 167.7236 | 180.7492  | (64)            |
| Efficiency of water heater (217)m                                     | 87.6335  | 87.1948  | 86.3832  | 84.6742  | 82.0555  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.7409  | 86.9501  | 87.7665   | (216)           |
| Fuel for water heating, kWh/month                                     | 211.9624 | 187.2112 | 197.1447 | 178.4325 | 179.0471 | 162.4516 | 154.0622 | 171.7495 | 172.2908 | 184.9695 | 192.8963 | 205.9434  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 2198.1613 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2801.7159 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 389.2012  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 5464.0783 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2801.7159          | 0.2160                        | 605.1706 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 2198.1613          | 0.2160                        | 474.8028 (264)           |
| Space and water heating                                                                           |                    |                               | 1079.9735 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 389.2012           | 0.5190                        | 201.9954 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1320.8939 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 11.7516 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.1980 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.4236 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (11.7516 * 1.00) + 2.1980 + 0.4236, rounded to 2 d.p. |                    |                               | 14.3700 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | A-4-04                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP-1-2                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 86 B                                                                    | DER           | 11.46   | TER            | 19.24      |
| Environmental                      | 92 A                                                                    | % DER<TER     | 40.44   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.50                                                                    | DFEE          | 47.59   | TFEE           | 53.54      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 11.12   |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Top-floor flat, total floor area 57 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 19.24 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 11.46 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 53.5 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 47.6 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.15 (max. 0.30) | 0.15 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.11 (max. 0.20) | 0.11 (max. 0.35) | OK |
| Openings      | 1.38 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage  
Permitted by DBSCG 0.32  
Primary pipework insulated: Nominal cylinder loss: 0.09 kWh/day  
OK  
No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls:

No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing South: 7.61 m<sup>2</sup>, No overhang  
Windows facing South West: 8.40 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Roof U-value 0.11 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.49 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 57.0000 (1b)              | x 2.5000 (2b)                   | = 142.5000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 142.5000 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 1                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.9250 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1388 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1769                       | 0.1734 | 0.1700    | 0.1526 | 0.1492 | 0.1318 | 0.1318                      | 0.1283      | 0.1388 | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2774                       | 0.2739 | 0.2705    | 0.2531 | 0.2497 | 0.2323 | 0.2323                      | 0.2288      | 0.2393 | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                    | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K                     | A x U<br>W/K | K-value<br>kJ/m2K | A x K<br>kJ/K   |
|------------------------------------------------------------|-------------|----------------|---------------|--------------------------------------|--------------|-------------------|-----------------|
| W03 (Uw = 1.40)                                            |             |                | 8.4000        | 1.3258                               | 11.1364      |                   | (27)            |
| W02 (Uw = 1.40)                                            |             |                | 7.6100        | 1.3258                               | 10.0890      |                   | (27)            |
| door                                                       |             |                | 2.1000        | 1.2500                               | 2.6250       |                   | (26a)           |
| External Wall 1                                            | 49.0000     | 16.0100        | 32.9900       | 0.1500                               | 4.9485       | 140.0000          | 4618.6000 (29a) |
| Corridor wall                                              | 3.5000      | 2.1000         | 1.4000        | 0.1409                               | 0.1973       | 110.0000          | 154.0000 (29a)  |
| roof                                                       | 57.0000     |                | 57.0000       | 0.1100                               | 6.2700       | 9.0000            | 513.0000 (30)   |
| Total net area of external elements Aum(A, m2)             |             |                | 109.5000      |                                      |              |                   | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                        |             |                |               | (26)...(30) + (32) =                 | 35.2662      |                   | (33)            |
| Party Wall 1                                               |             |                | 22.2000       | 0.0000                               | 0.0000       | 140.0000          | 3108.0000 (32)  |
| Party Floor                                                |             |                | 57.0000       |                                      |              | 80.0000           | 4560.0000 (32d) |
| Internal Wall                                              |             |                | 84.5000       |                                      |              | 9.0000            | 760.5000 (32c)  |
| Heat capacity Cm = Sum(A x k)                              |             |                |               | (28)...(30) + (32) + (32a)...(32e) = |              |                   | 13714.1000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K          |             |                |               |                                      |              |                   | 240.5982 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) |             |                |               |                                      |              |                   | 15.3980 (36)    |
| Total fabric heat loss                                     |             |                |               |                                      |              | (33) + (36) =     | 50.6642 (37)    |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                  |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.8957 (42)      |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 83.3918 (43)     |
| Daily hot water use                      | Jan 91.7310 | Feb 88.3953 | Mar 85.0596 | Apr 81.7240 | May 78.3883 | Jun 75.0526 | Jul 75.0526 | Aug 78.3883 | Sep 81.7240 | Oct 85.0596 | Nov 88.3953 | Dec 91.7310 (44) |



|                                                                 |                      |          |          |          |          |          |          |                                          |          |                    |          |                |
|-----------------------------------------------------------------|----------------------|----------|----------|----------|----------|----------|----------|------------------------------------------|----------|--------------------|----------|----------------|
| Energy content                                                  | 136.0344             | 118.9765 | 122.7731 | 107.0366 | 102.7042 | 88.6259  | 82.1249  | 94.2395                                  | 95.3650  | 111.1388           | 121.3167 | 131.7420 (45)  |
| Energy content (annual)                                         |                      |          |          |          |          |          |          |                                          |          | Total = Sum(45)m = |          | 1312.0776 (45) |
| Distribution loss                                               | (46)m = 0.15 x (45)m |          |          |          |          |          |          |                                          |          |                    |          |                |
|                                                                 | 20.4052              | 17.8465  | 18.4160  | 16.0555  | 15.4056  | 13.2939  | 12.3187  | 14.1359                                  | 14.3048  | 16.6708            | 18.1975  | 19.7613 (46)   |
| Water storage loss:                                             |                      |          |          |          |          |          |          |                                          |          |                    |          |                |
| Store volume                                                    |                      |          |          |          |          |          |          |                                          |          |                    |          | 2.0000 (47)    |
| b) If manufacturer declared loss factor is not known :          |                      |          |          |          |          |          |          |                                          |          |                    |          |                |
| Hot water storage loss factor from Table 2 (kWh/litre/day)      |                      |          |          |          |          |          |          |                                          |          |                    |          | 0.0115 (51)    |
| Volume factor from Table 2a                                     |                      |          |          |          |          |          |          |                                          |          |                    |          | 3.9149 (52)    |
| Temperature factor from Table 2b                                |                      |          |          |          |          |          |          |                                          |          |                    |          | 1.0000 (53)    |
| Enter (49) or (54) in (55)                                      |                      |          |          |          |          |          |          |                                          |          |                    |          | 0.0904 (55)    |
| Total storage loss                                              |                      |          |          |          |          |          |          |                                          |          |                    |          |                |
|                                                                 | 2.8029               | 2.5316   | 2.8029   | 2.7124   | 2.8029   | 2.7124   | 2.8029   | 2.8029                                   | 2.7124   | 2.8029             | 2.7124   | 2.8029 (56)    |
| If cylinder contains dedicated solar storage                    |                      |          |          |          |          |          |          |                                          |          |                    |          |                |
|                                                                 | 2.8029               | 2.5316   | 2.8029   | 2.7124   | 2.8029   | 2.7124   | 2.8029   | 2.8029                                   | 2.7124   | 2.8029             | 2.7124   | 2.8029 (57)    |
| Primary loss                                                    | 23.2624              | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624                                  | 22.5120  | 23.2624            | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month |                      |          |          |          |          |          |          |                                          |          |                    |          |                |
|                                                                 | 162.0996             | 142.5193 | 148.8384 | 132.2610 | 128.7694 | 113.8503 | 108.1902 | 120.3048                                 | 120.5895 | 137.2040           | 146.5411 | 157.8073 (62)  |
| Solar input                                                     | 0.0000               | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                   | 0.0000   | 0.0000             | 0.0000   | 0.0000 (63)    |
|                                                                 |                      |          |          |          |          |          |          | Solar input (sum of months) = Sum(63)m = |          |                    |          | 0.0000 (63)    |
| Output from w/h                                                 |                      |          |          |          |          |          |          |                                          |          |                    |          |                |
|                                                                 | 162.0996             | 142.5193 | 148.8384 | 132.2610 | 128.7694 | 113.8503 | 108.1902 | 120.3048                                 | 120.5895 | 137.2040           | 146.5411 | 157.8073 (64)  |
|                                                                 |                      |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =   |          |                    |          | 1618.9750 (64) |
| Heat gains from water heating, kWh/month                        |                      |          |          |          |          |          |          |                                          |          |                    |          |                |
|                                                                 | 66.0836              | 58.3939  | 61.6743  | 55.7692  | 55.0013  | 49.6477  | 48.1587  | 52.1868                                  | 51.8884  | 57.8058            | 60.5173  | 64.6564 (65)   |

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.7386  | 13.0907  | 10.6461  | 8.0598   | 6.0248   | 5.0864   | 5.4960   | 7.1439   | 9.5885   | 12.1749  | 14.2099  | 15.1483 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 165.3227 | 167.0382 | 162.7151 | 153.5118 | 141.8942 | 130.9753 | 123.6809 | 121.9653 | 126.2884 | 135.4918 | 147.1093 | 158.0282 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 (71) |
| Water heating gains (Table 5)                                                       | 88.8221  | 86.8958  | 82.8955  | 77.4572  | 73.9265  | 68.9551  | 64.7295  | 70.1436  | 72.0673  | 77.6960  | 84.0519  | 86.9038 (72)  |
| Total internal gains                                                                | 320.3185 | 318.4598 | 307.6918 | 290.4639 | 273.2806 | 256.4519 | 245.3414 | 250.6879 | 259.3793 | 276.7977 | 296.8061 | 311.5153 (73) |

| [Jan        |          |          |          | Area     | Solar flux | g             | FF            |          | Access   | Gains        |          |               |
|-------------|----------|----------|----------|----------|------------|---------------|---------------|----------|----------|--------------|----------|---------------|
|             |          |          |          | m2       | Table 6a   | Specific data | Specific data |          | factor   | W            |          |               |
|             |          |          |          |          | W/m2       | or Table 6b   | or Table 6c   |          | Table 6d |              |          |               |
| Southwest   |          |          |          | 8.4000   | 36.7938    | 0.3700        | 0.8900        |          | 0.7700   | 70.5309 (79) |          |               |
| South       |          |          |          | 7.6100   | 46.7521    | 0.5600        | 0.6800        |          | 0.7700   | 93.8892 (78) |          |               |
| Solar gains | 164.4201 | 273.9065 | 360.2520 | 425.0528 | 458.8224   | 448.4905      | 435.2686      | 410.7613 | 382.6003 | 298.6319     | 195.7705 | 141.4886 (83) |
| Total gains | 484.7385 | 592.3662 | 667.9438 | 715.5167 | 732.1030   | 704.9424      | 680.6100      | 661.4493 | 641.9796 | 575.4296     | 492.5766 | 453.0040 (84) |

| Temperature during heating periods in the living area from Table 9, Th1 (C)   |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
|-------------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Utilisation factor for gains for living area, n <sub>l,m</sub> (see Table 9a) |         |         |         |         |         |         |         |         |         |         |         |              |
|                                                                               | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                           | 59.7947 | 59.9482 | 60.1025 | 60.8859 | 61.0451 | 61.8535 | 61.8535 | 62.0177 | 61.5276 | 61.0451 | 60.7276 | 60.4134      |
| alpha                                                                         | 4.9863  | 4.9965  | 5.0068  | 5.0591  | 5.0697  | 5.1236  | 5.1236  | 5.1345  | 5.1018  | 5.0697  | 5.0485  | 5.0276       |
| util living area                                                              | 0.9891  | 0.9715  | 0.9352  | 0.8576  | 0.7258  | 0.5462  | 0.3960  | 0.4241  | 0.6351  | 0.8811  | 0.9749  | 0.9920 (86)  |
| MIT                                                                           | 20.0014 | 20.2348 | 20.4965 | 20.7540 | 20.9159 | 20.9843 | 20.9975 | 20.9964 | 20.9665 | 20.7564 | 20.3285 | 19.9556 (87) |
| Th 2                                                                          | 19.9864 | 19.9887 | 19.9911 | 20.0027 | 20.0051 | 20.0168 | 20.0168 | 20.0191 | 20.0121 | 20.0051 | 20.0004 | 19.9957 (88) |
| util rest of house                                                            | 0.9859  | 0.9635  | 0.9178  | 0.8224  | 0.6670  | 0.4678  | 0.3087  | 0.3353  | 0.5558  | 0.8434  | 0.9664  | 0.9895 (89)  |
| MIT 2                                                                         | 18.6815 | 19.0171 | 19.3847 | 19.7359 | 19.9298 | 20.0071 | 20.0159 | 20.0178 | 19.9888 | 19.7497 | 19.1639 | 18.6221 (90) |
| Living area fraction                                                          |         |         |         |         |         |         |         |         |         |         |         | 0.5053 (91)  |
| MIT                                                                           | 19.3484 | 19.6324 | 19.9464 | 20.2503 | 20.4280 | 20.5009 | 20.5119 | 20.5123 | 20.4828 | 20.2584 | 19.7523 | 19.2958 (92) |
| Temperature adjustment                                                        |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                  | 19.3484 | 19.6324 | 19.9464 | 20.2503 | 20.4280 | 20.5009 | 20.5119 | 20.5123 | 20.4828 | 20.2584 | 19.7523 | 19.2958 (93) |

|                   | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|-------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Utilisation       | 0.9832   | 0.9601   | 0.9169   | 0.8318   | 0.6930   | 0.5070   | 0.3529   | 0.3802   | 0.5946   | 0.8540   | 0.9639   | 0.9873 (94)   |
| Useful gains      | 476.6084 | 568.7483 | 612.4687 | 595.1692 | 507.3281 | 357.4146 | 240.1636 | 251.4801 | 381.7093 | 491.4021 | 474.7701 | 447.2606 (95) |
| Ext temp.         | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)   |
| Heat loss rate W  | 958.7200 | 936.1845 | 852.2754 | 710.1574 | 544.6657 | 363.4265 | 240.9259 | 252.5972 | 395.1886 | 602.7222 | 793.6857 | 951.8938 (97) |
| Month fracti      | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)  |
| Space heating kWh | 358.6910 | 246.9171 | 178.4162 | 82.7915  | 27.7791  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 82.8222  | 229.6192 | 375.4471 (98) |

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### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating 1582.4834 (98)  
Space heating per m2 (98) / (4) = 27.7629 (99)

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                 |
|-----------------------------------------------------------------------------------------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)    |
| Fraction of space heat from community system                                            | 1.0000 (302)    |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)   |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)   |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)   |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)   |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)    |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)   |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)    |
| Space heating:                                                                          |                 |
| Annual space heating requirement                                                        | 1582.4834 (98)  |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 764.3395 (307a) |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 897.2681 (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)    |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)    |
| Water heating                                                                           |                 |
| Annual water heating requirement                                                        | 1618.9750 (64)  |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 781.9649 (310a) |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 917.9588 (310b) |
| Electricity used for heat distribution                                                  | 33.6153 (313)   |
| Annual totals kWh/year                                                                  |                 |
| Electricity for pumps and fans:                                                         |                 |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                 |
| mechanical ventilation fans (SFP = 0.6625)                                              | 115.1756 (330a) |
| Total electricity for the above, kWh/year                                               | 115.1756 (331)  |
| Electricity for lighting (calculated in Appendix L)                                     | 260.2889 (332)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |                 |
| PV Unit 0 (0.80 * 0.49 * 951 * 1.00) =                                                  | -372.6415       |
| Total delivered energy for all uses                                                     | 3364.3544 (338) |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 417.9201           | 0.5190                        | 216.9005 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 1933.1490          | 0.2160                        | 417.5602 (368)           |
| Electrical energy for heat distribution                                                    | 33.6153            | 0.5190                        | 17.4463 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 651.9071 (373)           |
| Space and water heating                                                                    |                    |                               | 651.9071 (376)           |
| Pumps and fans                                                                             | 115.1756           | 0.5190                        | 59.7761 (378)            |
| Energy for lighting                                                                        | 260.2889           | 0.5190                        | 135.0899 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -372.6415          | 0.5190                        | -193.4009 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 653.3722 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 11.4600 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 11.4600 ZC1 |
| Total Floor Area                                                                | TFA | 57.0000     |
| Assumed number of occupants                                                     | N   | 1.8957      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.1871 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 2.8859 ZC3  |
| Total CO2 emissions                                                             |     | 31.5330 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 31.5330 ZC8 |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 57.0000 (1b)              | x 2.5000 (2b)                   | = 142.5000 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 57.0000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 142.5000 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1404 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.3904 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 1 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3611 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4604 | 0.4513 | 0.4423 | 0.3972 | 0.3882 | 0.3430 | 0.3430 | 0.3340 | 0.3611 | 0.3882 | 0.4062 | 0.4243 (22b) |
| Effective ac    | 0.6060 | 0.6019 | 0.5978 | 0.5789 | 0.5753 | 0.5588 | 0.5588 | 0.5558 | 0.5652 | 0.5753 | 0.5825 | 0.5900 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K              |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|----------------------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)                      |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 12.1500                   | 1.3258                        | 16.1080      |                                | (27)                       |
| External Wall 1                                                | 49.0000                 | 12.1500                    | 36.8500                   | 0.1800                        | 6.6330       |                                | (29a)                      |
| Corridor wall                                                  | 3.5000                  | 2.1000                     | 1.4000                    | 0.1800                        | 0.2520       |                                | (29a)                      |
| roof                                                           | 57.0000                 |                            | 57.0000                   | 0.1300                        | 7.4100       |                                | (30)                       |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 109.5000                  |                               |              |                                | (31)                       |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 32.9230      |                                | (33)                       |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35)              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 13.7230 (36)               |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 46.6460 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 28.4958 | 28.3022 | 28.1126 | 27.2217 | 27.0550 | 26.2791 | 26.2791 | 26.1354 | 26.5779 | 27.0550 | 27.3922 | 27.7447 (38) |
| Heat transfer coeff       | 75.1417 | 74.9482 | 74.7585 | 73.8676 | 73.7010 | 72.9250 | 72.9250 | 72.7813 | 73.2239 | 73.7010 | 74.0382 | 74.3907 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 73.8668 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.3183 | 1.3149 | 1.3116 | 1.2959 | 1.2930 | 1.2794 | 1.2794 | 1.2769 | 1.2846 | 1.2930 | 1.2989 | 1.3051 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.2959 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

| Assumed occupancy                                           |          |          |          |          |         |         |         |         |         |          |          | 1.8957 (42)                       |
|-------------------------------------------------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|----------|----------|-----------------------------------|
| Average daily hot water use (litres/day)                    |          |          |          |          |         |         |         |         |         |          |          | 79.2222 (43)                      |
|                                                             | Jan      | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct      | Nov      | Dec                               |
| Daily hot water use                                         | 87.1444  | 83.9755  | 80.8066  | 77.6378  | 74.4689 | 71.3000 | 71.3000 | 74.4689 | 77.6378 | 80.8066  | 83.9755  | 87.1444 (44)                      |
| Energy conte                                                | 129.2327 | 113.0277 | 116.6345 | 101.6848 | 97.5689 | 84.1946 | 78.0187 | 89.5275 | 90.5968 | 105.5818 | 115.2508 | 125.1549 (45)                     |
| Energy content (annual)                                     |          |          |          |          |         |         |         |         |         |          |          | Total = Sum(45)m = 1246.4737 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 19.3849  | 16.9542  | 17.4952  | 15.2527  | 14.6353 | 12.6292 | 11.7028 | 13.4291 | 13.5895 | 15.8373  | 17.2876  | 18.7732 (46)                      |
| Water storage loss:                                         |          |          |          |          |         |         |         |         |         |          |          |                                   |
| Store volume                                                |          |          |          |          |         |         |         |         |         |          |          | 2.0000 (47)                       |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |          |         |         |         |         |         |          |          | 0.2388 (48)                       |
| Temperature factor from Table 2b                            |          |          |          |          |         |         |         |         |         |          |          | 0.5400 (49)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |          |         |         |         |         |         |          |          | 0.1290 (55)                       |

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### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 156.4928 | 137.6498 | 143.8946 | 128.0655 | 124.8291 | 110.5754 | 105.2788 | 116.7877 | 116.9776 | 132.8420 | 141.6316 | 152.4151 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 156.4928 | 137.6498 | 143.8946 | 128.0655 | 124.8291 | 110.5754 | 105.2788 | 116.7877 | 116.9776 | 132.8420 | 141.6316 | 152.4151 (64) |
| Heat gains from water heating, kWh/month                        | 64.7780  | 57.2794  | 60.5891  | 54.9148  | 54.2498  | 49.0993  | 47.7493  | 51.5760  | 51.2281  | 56.9141  | 59.4255  | 63.4221 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836  | 94.7836 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 14.7649  | 13.1140  | 10.6650  | 8.0741   | 6.0355   | 5.0954   | 5.5058   | 7.1566   | 9.6056   | 12.1965  | 14.2352  | 15.1752 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 165.3227 | 167.0382 | 162.7151 | 153.5118 | 141.8942 | 130.9753 | 123.6809 | 121.9653 | 126.2884 | 135.4918 | 147.1093 | 158.0282 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784  | 32.4784 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 | -75.8269 (71) |
| Water heating gains (Table 5)                                                       | 87.0672  | 85.2371  | 81.4369  | 76.2706  | 72.9164  | 68.1935  | 64.1792  | 69.3226  | 71.1501  | 76.4974  | 82.5355  | 85.2448 (72)  |
| Total internal gains                                                                | 321.5898 | 319.8244 | 309.2522 | 292.2915 | 275.2812 | 258.6994 | 247.8009 | 252.8797 | 261.4792 | 278.6208 | 298.3150 | 312.8833 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| South       |          |          |          |          | 5.7800     | 46.7521                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 82.5849 (78) |               |
| Southwest   |          |          |          |          | 6.3700     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 71.6286 (79) |               |
| <hr/>       |          |          |          |          |            |                                |                                   |                                    |                              |          |              |               |
| Solar gains | 154.2134 | 257.2627 | 339.2273 | 401.5688 | 434.5979   | 425.2856                       | 412.5504                          | 388.5129                           | 360.7351                     | 280.7297 | 183.6857     | 132.6601 (83) |
| Total gains | 475.8032 | 577.0871 | 648.4795 | 693.8603 | 709.8791   | 683.9850                       | 660.3513                          | 641.3925                           | 622.2143                     | 559.3505 | 482.0007     | 445.5433 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 52.6782 | 52.8143 | 52.9483 | 53.5868 | 53.7080 | 54.2795 | 54.2795 | 54.3867 | 54.0579                   | 53.7080 | 53.4634 | 53.2101      |
| alpha                                                                       | 4.5119  | 4.5210  | 4.5299  | 4.5725  | 4.5805  | 4.6186  | 4.6186  | 4.6258  | 4.6039                    | 4.5805  | 4.5642  | 4.5473       |
| util living area                                                            | 0.9922  | 0.9811  | 0.9584  | 0.9070  | 0.8061  | 0.6404  | 0.4768  | 0.5093  | 0.7270                    | 0.9229  | 0.9831  | 0.9941 (86)  |
| MIT                                                                         | 19.7486 | 19.9755 | 20.2597 | 20.5756 | 20.8183 | 20.9538 | 20.9904 | 20.9869 | 20.9150                   | 20.5981 | 20.1092 | 19.7071 (87) |
| Th 2                                                                        | 19.8265 | 19.8292 | 19.8318 | 19.8440 | 19.8463 | 19.8570 | 19.8570 | 19.8590 | 19.8529                   | 19.8463 | 19.8417 | 19.8368 (88) |
| util rest of house                                                          | 0.9896  | 0.9751  | 0.9450  | 0.8771  | 0.7460  | 0.5428  | 0.3576  | 0.3893  | 0.6361                    | 0.8914  | 0.9766  | 0.9921 (89)  |
| MIT 2                                                                       | 18.1972 | 18.5261 | 18.9320 | 19.3743 | 19.6798 | 19.8285 | 19.8538 | 19.8542 | 19.7930                   | 19.4162 | 18.7312 | 18.1442 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.5053 (91)  |
| MIT                                                                         | 18.9811 | 19.2584 | 19.6029 | 19.9812 | 20.2550 | 20.3971 | 20.4281 | 20.4265 | 20.3599                   | 20.0134 | 19.4275 | 18.9339 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.9811 | 19.2584 | 19.6029 | 19.9812 | 20.2550 | 20.3971 | 20.4281 | 20.4265 | 20.3599                   | 20.0134 | 19.4275 | 18.9339 (93) |

#### 8. Space heating requirement

|                      |           |           |          |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 469.6550  | 560.5607  | 610.7945 | 611.3713 | 545.8978 | 403.9982 | 276.1165 | 288.7548 | 422.3082 | 501.5682     | 469.2967 | 441.1021 (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 1103.1613 | 1076.1363 | 979.5502 | 818.5454 | 630.5148 | 422.7505 | 279.1622 | 293.0560 | 458.3719 | 693.7755     | 912.7043 | 1096.0637 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 471.3286  | 346.4668  | 274.3542 | 149.1654 | 62.9550  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 143.0022     | 319.2534 | 487.2914 (98)  |
| Space heating        |           |           |          |          |          |          |          |          |          |              |          | 2253.8172 (98) |
| Space heating per m2 |           |           |          |          |          |          |          |          |          | (98) / (4) = |          | 39.5407 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2410.4997 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 471.3286 | 346.4668 | 274.3542 | 149.1654 | 62.9550  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 143.0022 | 319.2534 | 487.2914  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 504.0948 | 370.5528 | 293.4270 | 159.5352 | 67.3316  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 152.9435 | 341.4475 | 521.1673  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 156.4928 | 137.6498 | 143.8946 | 128.0655 | 124.8291 | 110.5754 | 105.2788 | 116.7877 | 116.9776 | 132.8420 | 141.6316 | 152.4151  | (64)            |
| Efficiency of water heater (217)m                                     | 87.5731  | 87.1764  | 86.5093  | 85.2214  | 83.0936  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.0106  | 86.9185  | 79.8000   | (216)           |
| Fuel for water heating, kWh/month                                     | 178.6996 | 157.8979 | 166.3343 | 150.2740 | 150.2270 | 138.5656 | 131.9283 | 146.3505 | 146.5884 | 156.2652 | 162.9475 | 173.7948  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1859.8733 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2410.4997 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 260.7522  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4606.1251 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2410.4997          | 0.2160                        | 520.6679 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1859.8733          | 0.2160                        | 401.7326 (264)           |
| Space and water heating                                                                           |                    |                               | 922.4006 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 260.7522           | 0.5190                        | 135.3304 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1096.6559 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 16.1825 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.3742 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.6829 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (16.1825 * 1.00) + 2.3742 + 0.6829, rounded to 2 d.p. |                    |                               | 19.2400 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | D-0-01                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP-1-2                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 85 B                                                                    | DER           | 14.15   | TER            | 25.52      |
| Environmental                      | 92 A                                                                    | % DER<TER     | 44.55   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.45                                                                    | DFEE          | 61.72   | TFEE           | 63.73      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 3.16    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Ground-floor flat, total floor area 43 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 25.52 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.15 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 63.7 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 61.7 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.18 (max. 0.30) | 0.18 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | 0.11 (max. 0.25) | 0.11 (max. 0.70) | OK |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK

Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing West: 6.66 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Floor U-value 0.11 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.50 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 43.4000 (1b)              | x 2.8000 (2b)                   | = 121.5200 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 43.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 121.5200 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
|                                                                                              |                              |        |           |        |        |        | Air changes per hour        |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes         |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000      |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 (18) |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 2 (19)      |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1275 (21) |        |        |        |               |
|                                                                                              | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind speed                                                                                   | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Wind factor                                                                                  | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
| Adj infilt rate                                                                              | 0.1626                       | 0.1594 | 0.1562    | 0.1403 | 0.1371 | 0.1211 | 0.1211                      | 0.1179      | 0.1275 | 0.1371 | 0.1434 | 0.1498 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2631                       | 0.2599 | 0.2567    | 0.2408 | 0.2376 | 0.2216 | 0.2216                      | 0.2184      | 0.2280 | 0.2376 | 0.2439 | 0.2503 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2  | U-value<br>W/m2K     | A x U<br>W/K  | K-value<br>kJ/m2K                    | A x K<br>kJ/K |               |               |               |               |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------|----------------------|---------------|--------------------------------------|---------------|---------------|---------------|---------------|---------------|----------------|------|
| W01 (Uw = 1.40)                                                     |                |                | 6.6600         | 1.3258               | 8.8295        |                                      |               | (27)          |               |               |               |                |      |
| door                                                                |                |                | 2.1000         | 1.4000               | 2.9400        |                                      |               | (26a)         |               |               |               |                |      |
| Heat Loss Floor 1                                                   |                |                | 43.4000        | 0.1100               | 4.7740        | 110.0000                             | 4774.0000     | (28a)         |               |               |               |                |      |
| External Wall 1                                                     | 37.5000        | 8.7600         | 28.7400        | 0.1800               | 5.1732        | 140.0000                             | 4023.6000     | (29a)         |               |               |               |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 80.9000        |                      |               |                                      |               | (31)          |               |               |               |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                | (26)...(30) + (32) = | 21.7167       |                                      |               | (33)          |               |               |               |                |      |
| Party Wall 1                                                        |                |                | 37.5000        | 0.0000               | 0.0000        | 140.0000                             | 5250.0000     | (32)          |               |               |               |                |      |
| Party Ceilings                                                      |                |                | 43.4000        |                      |               | 80.0000                              | 3472.0000     | (32b)         |               |               |               |                |      |
| Internal Wall                                                       |                |                | 58.2000        |                      |               | 9.0000                               | 523.8000      | (32c)         |               |               |               |                |      |
| Heat capacity Cm = Sum(A x k)                                       |                |                |                |                      |               | (28)...(30) + (32) + (32a)...(32e) = | 18043.4000    | (34)          |               |               |               |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                      |               |                                      | 415.7465      | (35)          |               |               |               |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                |                      |               |                                      | 12.2778       | (36)          |               |               |               |                |      |
| Total fabric heat loss                                              |                |                |                |                      |               | (33) + (36) =                        | 33.9945       | (37)          |               |               |               |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                      |               |                                      |               |               |               |               |               |                |      |
| (38)m                                                               | Jan<br>10.5492 | Feb<br>10.4214 | Mar<br>10.2936 | Apr<br>9.6545        | May<br>9.5266 | Jun<br>8.8875                        | Jul<br>8.8875 | Aug<br>8.7597 | Sep<br>9.1432 | Oct<br>9.5266 | Nov<br>9.7823 | Dec<br>10.0379 | (38) |
| Heat transfer coeff                                                 | 44.5438        | 44.4159        | 44.2881        | 43.6490              | 43.5212       | 42.8821                              | 42.8821       | 42.7542       | 43.1377       | 43.5212       | 43.7768       | 44.0325        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                |                      |               |                                      |               |               |               |               |               | 43.6170        | (39) |
| HLP                                                                 | Jan<br>1.0264  | Feb<br>1.0234  | Mar<br>1.0205  | Apr<br>1.0057        | May<br>1.0028 | Jun<br>0.9881                        | Jul<br>0.9881 | Aug<br>0.9851 | Sep<br>0.9940 | Oct<br>1.0028 | Nov<br>1.0087 | Dec<br>1.0146  | (40) |
| HLP (average)                                                       |                |                |                |                      |               |                                      |               |               |               |               |               | 1.0050         | (40) |
| Days in month                                                       | 31             | 28             | 31             | 30                   | 31            | 30                                   | 31            | 31            | 30            | 31            | 30            | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |                    |             |                  |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------------|-------------|------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |                    |             | 1.4993 (42)      |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |                    |             | 73.4837 (43)     |
| Daily hot water use                      | Jan 80.8321 | Feb 77.8927 | Mar 74.9534 | Apr 72.0140 | May 69.0747 | Jun 66.1353 | Jul 66.1353 | Aug 69.0747 | Sep 72.0140 | Oct 74.9534        | Nov 77.8927 | Dec 80.8321 (44) |
| Energy conte                             | 119.8716    | 104.8405    | 108.1860    | 94.3192     | 90.5015     | 78.0959     | 72.3673     | 83.0426     | 84.0344     | 97.9339            | 106.9026    | 116.0893 (45)    |
| Energy content (annual)                  |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = |             | 1156.1846 (45)   |

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### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                                                                  |          |          |          |          |          |          |          |          |          |          |          |                |
|------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Distribution loss (46)m = 0.15 x (45)m                                                                           | 17.9807  | 15.7261  | 16.2279  | 14.1479  | 13.5752  | 11.7144  | 10.8551  | 12.4564  | 12.6052  | 14.6901  | 16.0354  | 17.4134 (46)   |
| Water storage loss:                                                                                              |          |          |          |          |          |          |          |          |          |          |          |                |
| Store volume                                                                                                     |          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):                                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                                                                 |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                                                                       |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)    |
| Total storage loss                                                                                               |          |          |          |          |          |          |          |          |          |          |          |                |
| 22.9400 20.7200 22.9400 22.2000 22.9400 22.2000 22.9400 22.9400 22.2000 22.9400 22.2000 22.9400 (56)             |          |          |          |          |          |          |          |          |          |          |          |                |
| If cylinder contains dedicated solar storage                                                                     |          |          |          |          |          |          |          |          |          |          |          |                |
| 22.9400 20.7200 22.9400 22.2000 22.9400 22.2000 22.9400 22.9400 22.2000 22.9400 22.2000 22.9400 (57)             |          |          |          |          |          |          |          |          |          |          |          |                |
| Primary loss                                                                                                     | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month                                                  |          |          |          |          |          |          |          |          |          |          |          |                |
| 166.0740 146.5717 154.3884 139.0312 136.7039 122.8079 118.5697 129.2450 128.7464 144.1363 151.6146 162.2917 (62) |          |          |          |          |          |          |          |          |          |          |          |                |
| Solar input                                                                                                      | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum(63)m =                                                                         |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)    |
| Output from w/h                                                                                                  | 166.0740 | 146.5717 | 154.3884 | 139.0312 | 136.7039 | 122.8079 | 118.5697 | 129.2450 | 128.7464 | 144.1363 | 151.6146 | 162.2917 (64)  |
| Total per year (kWh/year) = Sum(64)m =                                                                           |          |          |          |          |          |          |          |          |          |          |          | 1700.1806 (64) |
| Heat gains from water heating, kWh/month                                                                         |          |          |          |          |          |          |          |          |          |          |          |                |
| 76.8192 68.2444 72.9338 67.1307 67.0537 61.7365 61.0241 64.5736 63.7110 69.5250 71.3147 75.5616 (65)             |          |          |          |          |          |          |          |          |          |          |          |                |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 12.4438  | 11.0525  | 8.9885   | 6.8049   | 5.0867   | 4.2944   | 4.6403   | 6.0316   | 8.0956   | 10.2792  | 11.9974  | 12.7897 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 130.1693 | 131.5200 | 128.1162 | 120.8698 | 111.7225 | 103.1254 | 97.3820  | 96.0312  | 99.4351  | 106.6815 | 115.8287 | 124.4259 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 (71) |
| Water heating gains (Table 5)                                                       | 103.2517 | 101.5542 | 98.0292  | 93.2371  | 90.1259  | 85.7451  | 82.0216  | 86.7924  | 88.4875  | 93.4475  | 99.0482  | 101.5613 (72) |
| Total internal gains                                                                | 291.3550 | 289.6169 | 280.6241 | 266.4020 | 252.4254 | 238.6552 | 229.5341 | 234.3455 | 241.5085 | 255.8985 | 272.3645 | 284.2671 (73) |

#### 6. Solar gains

| [Jan]       |  |  | Area     | Solar flux | g             | FF            | Access   | Gains        |          |          |          |          |          |               |
|-------------|--|--|----------|------------|---------------|---------------|----------|--------------|----------|----------|----------|----------|----------|---------------|
|             |  |  | m2       | Table 6a   | Specific data | Specific data | factor   | W            |          |          |          |          |          |               |
|             |  |  |          | W/m2       | or Table 6b   | or Table 6c   | Table 6d |              |          |          |          |          |          |               |
| West        |  |  | 6.6600   | 19.6403    | 0.3700        | 0.6400        | 0.7700   | 21.4653 (80) |          |          |          |          |          |               |
| Solar gains |  |  | 21.4653  | 41.9906    | 69.1526       | 100.8549      | 123.6015 | 126.5281     | 120.4599 | 103.4733 | 80.4273  | 49.8254  | 26.7647  | 17.6520 (83)  |
| Total gains |  |  | 312.8203 | 331.6076   | 349.7767      | 367.2569      | 376.0269 | 365.1833     | 349.9940 | 337.8188 | 321.9358 | 305.7239 | 299.1292 | 301.9191 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |          |          |          |          |          |          |          |          |                           |          |          |              |
|-----------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|----------|----------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |          |          |          |          |          |          |          |          |                           |          |          | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep                       | Oct      | Nov      | Dec          |
| tau                                                                         | 112.5198 | 112.8436 | 113.1693 | 114.8263 | 115.1636 | 116.8800 | 116.8800 | 117.2294 | 116.1873                  | 115.1636 | 114.4911 | 113.8263     |
| alpha                                                                       | 8.5013   | 8.5229   | 8.5446   | 8.6551   | 8.6776   | 8.7920   | 8.7920   | 8.8153   | 8.7458                    | 8.6776   | 8.6327   | 8.5884       |
| util living area                                                            | 0.9996   | 0.9992   | 0.9975   | 0.9865   | 0.9265   | 0.7354   | 0.5380   | 0.5801   | 0.8588                    | 0.9890   | 0.9989   | 0.9997 (86)  |
| MIT                                                                         | 20.3786  | 20.4468  | 20.5770  | 20.7604  | 20.9185  | 20.9915  | 20.9994  | 20.9990  | 20.9694                   | 20.7828  | 20.5527  | 20.3680 (87) |
| Th 2                                                                        | 20.0614  | 20.0639  | 20.0663  | 20.0786  | 20.0810  | 20.0933  | 20.0933  | 20.0958  | 20.0884                   | 20.0810  | 20.0761  | 20.0712 (88) |
| util rest of house                                                          | 0.9994   | 0.9988   | 0.9959   | 0.9774   | 0.8825   | 0.6401   | 0.4279   | 0.4674   | 0.7762                    | 0.9797   | 0.9981   | 0.9996 (89)  |
| MIT 2                                                                       | 19.2394  | 19.3411  | 19.5330  | 19.8056  | 20.0113  | 20.0895  | 20.0932  | 20.0955  | 20.0705                   | 19.8416  | 19.5061  | 19.2319 (90) |
| Living area fraction                                                        |          |          |          |          |          |          |          |          | fLA = Living area / (4) = |          |          | 0.8249 (91)  |
| MIT                                                                         | 20.1791  | 20.2532  | 20.3942  | 20.5932  | 20.7597  | 20.8335  | 20.8407  | 20.8408  | 20.8120                   | 20.6180  | 20.3694  | 20.1691 (92) |
| Temperature adjustment                                                      |          |          |          |          |          |          |          |          |                           |          |          | 0.0000       |
| adjusted MIT                                                                | 20.1791  | 20.2532  | 20.3942  | 20.5932  | 20.7597  | 20.8335  | 20.8407  | 20.8408  | 20.8120                   | 20.6180  | 20.3694  | 20.1691 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |              |          |                |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|                      | 0.9995   | 0.9989   | 0.9965   | 0.9830   | 0.9166   | 0.7187   | 0.5188   | 0.5605   | 0.8438   | 0.9858       | 0.9984   | 0.9996 (94)    |
| Useful gains         | 312.6505 | 331.2418 | 348.5617 | 361.0314 | 344.6698 | 262.4665 | 181.5752 | 189.3427 | 271.6537 | 301.3862     | 298.6571 | 301.7980 (95)  |
| Ext temp.            | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 707.3168 | 681.9252 | 615.3484 | 510.3958 | 394.2875 | 267.3060 | 181.8520 | 189.8620 | 289.5394 | 435.9952     | 580.8943 | 703.1580 (97)  |
| Month fracti         | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 293.6317 | 235.6592 | 198.4893 | 107.5424 | 36.9155  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 100.1491     | 203.2108 | 298.6119 (98)  |
| Space heating        |          |          |          |          |          |          |          |          |          |              |          | 1474.2098 (98) |
| Space heating per m2 |          |          |          |          |          |          |          |          |          | (98) / (4) = |          | 33.9680 (99)   |

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8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                 |
|-----------------------------------------------------------------------------------------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)    |
| Fraction of space heat from community system                                            | 1.0000 (302)    |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)   |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)   |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)   |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)   |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)    |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)   |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)    |
| Space heating:                                                                          |                 |
| Annual space heating requirement                                                        | 1474.2098 (98)  |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 712.0434 (307a) |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 835.8770 (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)    |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)    |
| Water heating                                                                           |                 |
| Annual water heating requirement                                                        | 1700.1806 (64)  |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 821.1872 (310a) |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 964.0024 (310b) |
| Electricity used for heat distribution                                                  | 33.3311 (313)   |
| Annual totals kWh/year                                                                  |                 |
| Electricity for pumps and fans:                                                         |                 |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                 |
| mechanical ventilation fans (SFP = 0.6625)                                              | 98.2185 (330a)  |
| Total electricity for the above, kWh/year                                               | 98.2185 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 219.7622 (332)  |
| Energy saving/generation technologies (Appendices M, N and Q)                           |                 |
| PV Unit 0 (0.80 * 0.50 * 951 * 1.00) =                                                  | -380.2464       |
| Total delivered energy for all uses                                                     | -380.2464 (333) |
|                                                                                         | 3270.8443 (338) |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 414.3866           | 0.5190                        | 215.0667 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 1916.8044          | 0.2160                        | 414.0298 (368)           |
| Electrical energy for heat distribution                                                    | 33.3311            | 0.5190                        | 17.2988 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 646.3953 (373)           |
| Space and water heating                                                                    |                    |                               | 646.3953 (376)           |
| Pumps and fans                                                                             | 98.2185            | 0.5190                        | 50.9754 (378)            |
| Energy for lighting                                                                        | 219.7622           | 0.5190                        | 114.0566 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -380.2464          | 0.5190                        | -197.3479 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 614.0794 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 14.1500 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 14.1500 ZC1 |
| Total Floor Area                                                                |     | 43.4000     |
| Assumed number of occupants                                                     | TFA | 1.4993      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | N   | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   | EF  | 17.7732 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 3.5711 ZC3  |
| Total CO2 emissions                                                             |     | 35.4942 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 35.4942 ZC8 |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 43.4000 (1b)              | x 2.8000 (2b)                   | = 121.5200 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 43.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 121.5200 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour       |
| Pressure test                                                             |                 |                      |       |                             | 20.0000 / (5) = 0.1646 (8) |
| Measured/design AP50                                                      |                 |                      |       |                             | Yes                        |
| Infiltration rate                                                         |                 |                      |       |                             | 5.0000                     |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0.4146 (18)                |
|                                                                           |                 |                      |       |                             | 2 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.8500 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3524 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
|                 | 0.4493 | 0.4405 | 0.4317 | 0.3876 | 0.3788 | 0.3348 | 0.3348 | 0.3260 | 0.3524 | 0.3788 | 0.3964 | 0.4141 (22b) |
| Effective ac    | 0.6009 | 0.5970 | 0.5932 | 0.5751 | 0.5718 | 0.5560 | 0.5560 | 0.5531 | 0.5621 | 0.5718 | 0.5786 | 0.5857 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2  | U-value<br>W/m2K     | A x U<br>W/K   | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------|----------------------|----------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|------|
| TER Semi-glazed door                                                |                |                | 2.1000         | 1.2000               | 2.5200         |                   |                | (26a)          |                |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                | 6.6600         | 1.3258               | 8.8295         |                   |                | (27)           |                |                |                |                |      |
| Heat Loss Floor 1                                                   |                |                | 43.4000        | 0.1300               | 5.6420         |                   |                | (28a)          |                |                |                |                |      |
| External Wall 1                                                     | 37.5000        | 8.7600         | 28.7400        | 0.1800               | 5.1732         |                   |                | (29a)          |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 80.9000        |                      |                |                   |                | (31)           |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                | (26)...(30) + (32) = | 22.1647        |                   |                | (33)           |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                      |                |                   | 250.0000       | (35)           |                |                |                |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                |                      |                |                   | 10.1950        | (36)           |                |                |                |                |      |
| Total fabric heat loss                                              |                |                |                |                      |                | (33) + (36) =     | 32.3597        | (37)           |                |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                      |                |                   |                |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>24.0985 | Feb<br>23.9413 | Mar<br>23.7873 | Apr<br>23.0636       | May<br>22.9282 | Jun<br>22.2980    | Jul<br>22.2980 | Aug<br>22.1813 | Sep<br>22.5407 | Oct<br>22.9282 | Nov<br>23.2021 | Dec<br>23.4885 | (38) |
| Heat transfer coeff                                                 | 56.4583        | 56.3011        | 56.1470        | 55.4234              | 55.2880        | 54.6577           | 54.6577        | 54.5410        | 54.9005        | 55.2880        | 55.5619        | 55.8482        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                |                      |                |                   |                |                |                |                |                | 55.4227        | (39) |
| HLP                                                                 | Jan<br>1.3009  | Feb<br>1.2973  | Mar<br>1.2937  | Apr<br>1.2770        | May<br>1.2739  | Jun<br>1.2594     | Jul<br>1.2594  | Aug<br>1.2567  | Sep<br>1.2650  | Oct<br>1.2739  | Nov<br>1.2802  | Dec<br>1.2868  | (40) |
| HLP (average)                                                       |                |                |                |                      |                |                   |                |                |                |                |                | 1.2770         | (40) |
| Days in month                                                       | 31             | 28             | 31             | 30                   | 31             | 30                | 31             | 31             | 30             | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |             |             |             |             |             |             |             |             |             |                    |             |                  |
|-------------------------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------------|-------------|------------------|
| Assumed occupancy                                           |             |             |             |             |             |             |             |             |             |                    |             | 1.4993 (42)      |
| Average daily hot water use (litres/day)                    |             |             |             |             |             |             |             |             |             |                    |             | 69.8095 (43)     |
| Daily hot water use                                         | Jan 76.7905 | Feb 73.9981 | Mar 71.2057 | Apr 68.4133 | May 65.6209 | Jun 62.8286 | Jul 62.8286 | Aug 65.6209 | Sep 68.4133 | Oct 71.2057        | Nov 73.9981 | Dec 76.7905 (44) |
| Energy conte                                                | 113.8780    | 99.5985     | 102.7767    | 89.6032     | 85.9764     | 74.1911     | 68.7490     | 78.8904     | 79.8326     | 93.0372            | 101.5574    | 110.2848 (45)    |
| Energy content (annual)                                     |             |             |             |             |             |             |             |             |             | Total = Sum(45)m = |             | 1098.3754 (45)   |
| Distribution loss (46)m = 0.15 x (45)m                      | 17.0817     | 14.9398     | 15.4165     | 13.4405     | 12.8965     | 11.1287     | 10.3123     | 11.8336     | 11.9749     | 13.9556            | 15.2336     | 16.5427 (46)     |
| Water storage loss:                                         |             |             |             |             |             |             |             |             |             |                    |             |                  |
| Store volume                                                |             |             |             |             |             |             |             |             |             |                    |             | 2.0000 (47)      |
| a) If manufacturer declared loss factor is known (kWh/day): |             |             |             |             |             |             |             |             |             |                    |             | 0.2388 (48)      |
| Temperature factor from Table 2b                            |             |             |             |             |             |             |             |             |             |                    |             | 0.5400 (49)      |
| Enter (49) or (54) in (55)                                  |             |             |             |             |             |             |             |             |             |                    |             | 0.1290 (55)      |
| Total storage loss                                          |             |             |             |             |             |             |             |             |             |                    |             |                  |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |         |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|---------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977  | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977  | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 141.1382 | 124.2205 | 130.0368 | 115.9840 | 113.2365 | 100.5719 | 96.0091 | 106.1506 | 106.2134 | 120.2974 | 127.9382 | 137.5449 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 141.1382 | 124.2205 | 130.0368 | 115.9840 | 113.2365 | 100.5719 | 96.0091 | 106.1506 | 106.2134 | 120.2974 | 127.9382 | 137.5449 (64) |
|                                                                 | 59.6726  | 52.8141  | 55.9814  | 50.8977  | 50.3953  | 45.7732  | 44.6671 | 48.0392  | 47.6490  | 52.7430  | 54.8725  | 58.4778 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | 74.9674  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 12.2094  | 10.8442  | 8.8191   | 6.6767   | 4.9909   | 4.2135   | 4.5528   | 5.9180   | 7.9431   | 10.0856  | 11.7713  | 12.5487  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 130.1693 | 131.5200 | 128.1162 | 120.8698 | 111.7225 | 103.1254 | 97.3820  | 96.0312  | 99.4351  | 106.6815 | 115.8287 | 124.4259 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | 30.4967  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | -59.9739 | (71) |
| Water heating gains (Table 5)                                                       | 80.2051  | 78.5925  | 75.2438  | 70.6912  | 67.7356  | 63.5738  | 60.0365  | 64.5688  | 66.1791  | 70.8911  | 76.2118  | 78.5992  | (72) |
| Total internal gains                                                                | 271.0739 | 269.4470 | 260.6693 | 246.7279 | 232.9392 | 219.4030 | 210.4615 | 215.0082 | 222.0475 | 236.1484 | 252.3020 | 264.0640 | (73) |

#### 6. Solar gains

| [Jan]       |  |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d |          |          | Gains<br>W   |
|-------------|--|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|----------|----------|--------------|
| -----       |  |          |          |          |            |                                |                                   |                                    |          |          |                              |          |          |              |
| West        |  |          |          |          | 6.6600     | 19.6403                        | 0.6300                            | 0.7000                             |          |          | 0.7700                       |          |          | 39.9755 (80) |
| -----       |  |          |          |          |            |                                |                                   |                                    |          |          |                              |          |          |              |
| Solar gains |  | 39.9755  | 78.2005  | 128.7850 | 187.8253   | 230.1869                       | 235.6373                          | 224.3363                           | 192.7016 | 149.7823 | 92.7914                      | 49.8447  | 32.8739  | (83)         |
| Total gains |  | 311.0494 | 347.6474 | 389.4543 | 434.5532   | 463.1261                       | 455.0402                          | 434.7978                           | 407.7098 | 371.8298 | 328.9398                     | 302.1467 | 296.9378 | (84)         |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 53.3826 | 53.5316 | 53.6785 | 54.3794 | 54.5125 | 55.1411 | 55.1411 | 55.2591 | 54.8973 | 54.5125 | 54.2438 | 53.9657 |              |
| alpha                                                                       | 4.5588  | 4.5688  | 4.5786  | 4.6253  | 4.6342  | 4.6761  | 4.6761  | 4.6839  | 4.6598  | 4.6342  | 4.6163  | 4.5977  |              |
| util living area                                                            | 0.9957  | 0.9922  | 0.9819  | 0.9482  | 0.8626  | 0.7017  | 0.5371  | 0.5894  | 0.8309  | 0.9664  | 0.9920  | 0.9965  | (86)         |
| MIT                                                                         | 19.6666 | 19.8167 | 20.0896 | 20.4531 | 20.7573 | 20.9353 | 20.9852 | 20.9775 | 20.8519 | 20.4559 | 20.0010 | 19.6438 | (87)         |
| Th 2                                                                        | 20.3496 | 20.3514 | 20.3531 | 20.3615 | 20.3630 | 20.3703 | 20.3703 | 20.3716 | 20.3675 | 20.3630 | 20.3599 | 20.3566 | (88)         |
| util rest of house                                                          | 0.9950  | 0.9909  | 0.9785  | 0.9381  | 0.8361  | 0.6493  | 0.4663  | 0.5181  | 0.7900  | 0.9581  | 0.9903  | 0.9959  | (89)         |
| MIT 2                                                                       | 19.0930 | 19.2440 | 19.5165 | 19.8802 | 20.1688 | 20.3280 | 20.3632 | 20.3602 | 20.2608 | 19.8877 | 19.4350 | 19.0759 | (90)         |
| Living area fraction                                                        | 19.5661 | 19.7164 | 19.9892 | 20.3527 | 20.6543 | 20.8289 | 20.8763 | 20.8694 | 20.7484 | 20.3564 | 19.9019 | 19.5444 | (91)         |
| MIT                                                                         | 20.1661 | 20.3164 | 20.5892 | 20.9527 | 21.2543 | 21.4289 | 21.4763 | 21.4694 | 21.3484 | 20.9564 | 20.5019 | 20.1444 | (92)         |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.6000  |              |
| adjusted MIT                                                                |         |         |         |         |         |         |         |         |         |         |         |         | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 0.9947   | 0.9908   | 0.9798   | 0.9475   | 0.8720   | 0.7338   | 0.5873   | 0.6384   | 0.8501   | 0.9659   | 0.9907   | 0.9957    | (94)  |
| Ext temp.            | 309.4102 | 344.4402 | 381.5951 | 411.7367 | 403.8454 | 333.9136 | 255.3712 | 260.2768 | 316.0745 | 317.7187 | 299.3373 | 295.6657  | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Month fracti         | 895.7736 | 867.9593 | 791.0680 | 668.0040 | 528.2371 | 373.2542 | 266.5255 | 276.4903 | 397.9407 | 572.5845 | 744.6353 | 890.4638  | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating        | 436.2544 | 351.8048 | 304.6478 | 184.5125 | 92.5474  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 189.6202 | 320.6146 | 442.5298  | (98)  |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 2322.5314 | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 53.5145   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          | 88.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          | 2624.3293 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                             | 436.2544 | 351.8048 | 304.6478 | 184.5125 | 92.5474  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 189.6202 | 320.6146 | 442.5298 (98)   |
| Space heating efficiency (main heating system 1)                      | 88.5000  | 88.5000  | 88.5000  | 88.5000  | 88.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 88.5000  | 88.5000  | 88.5000 (210)   |
| Space heating fuel (main heating system)                              | 492.9428 | 397.5196 | 344.2348 | 208.4887 | 104.5734 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 214.2601 | 362.2764 | 500.0336 (211)  |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (215)    |
| Water heating                                                         |          |          |          |          |          |          |          |          |          |          |          |                 |
| Water heating requirement                                             | 141.1382 | 124.2205 | 130.0368 | 115.9840 | 113.2365 | 100.5719 | 96.0091  | 106.1506 | 106.2134 | 120.2974 | 127.9382 | 137.5449 (64)   |
| Efficiency of water heater                                            | 82.6113  | 82.4232  | 81.9913  | 81.0263  | 79.2610  | 74.8000  | 74.8000  | 74.8000  | 74.8000  | 81.0023  | 82.1483  | 74.8000 (216)   |
| (217)m                                                                | 82.6113  | 82.4232  | 81.9913  | 81.0263  | 79.2610  | 74.8000  | 74.8000  | 74.8000  | 74.8000  | 81.0023  | 82.1483  | 82.6951 (217)   |
| Fuel for water heating, kWh/month                                     | 170.8460 | 150.7106 | 158.5983 | 143.1436 | 142.8654 | 134.4544 | 128.3544 | 141.9125 | 141.9966 | 148.5111 | 155.7406 | 166.3279 (219)  |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1783.4613 (219) |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2624.3293 (211) |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 39.0000 (230c)  |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 84.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 215.6211 (232)  |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4707.4117 (238) |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2624.3293          | 0.2160                        | 566.8551 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1783.4613          | 0.2160                        | 385.2276 (264)           |
| Space and water heating                                                                           |                    |                               | 952.0828 (265)           |
| Pumps and fans                                                                                    | 84.0000            | 0.5190                        | 43.5960 (267)            |
| Energy for lighting                                                                               | 215.6211           | 0.5190                        | 111.9073 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1107.5861 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 21.9374 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.5785 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 1.0045 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (21.9374 * 1.00) + 2.5785 + 1.0045, rounded to 2 d.p. |                    |                               | 25.5200 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | D-1/2-01                                                                |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP-1-2                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 86 B                                                                    | DER           | 12.20   | TER            | 19.24      |
| Environmental                      | 93 A                                                                    | % DER<TER     | 36.59   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.46                                                                    | DFEE          | 50.37   | TFEE           | 50.38      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 0.02    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 50 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating:Mains gas (c), Electricity (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 19.24 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 12.20 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 50.4 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 50.4 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.18 (max. 0.30) | 0.18 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                           |                          |   |
|---------------------------|--------------------------|---|
| Main heating system:      | Community heating scheme | - |
| Secondary heating system: | None                     |   |

#### 5 Cylinder insulation

|                             |                                      |
|-----------------------------|--------------------------------------|
| Hot water storage           | Measured cylinder loss: 0.74 kWh/day |
| Permitted by DBSCG 0.32     | Fail                                 |
| Primary pipework insulated: | No primary pipework                  |

#### 6 Controls

|                         |                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room statsOK |
| Hot water controls:     | No cylinderstat                                                                              |

#### 7 Low energy lights

|                                                          |        |
|----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings:100% |        |
| Minimum                                                  | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.53   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 94%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |                                                                         |      |
|-----------------------------------|-------------------------------------------------------------------------|------|
| Overheating risk (Thames Valley): | High                                                                    | Fail |
| Based on:                         |                                                                         |      |
| Overshading:                      | Average                                                                 |      |
| Windows facing East:              | 7.32 m <sup>2</sup> , Overhang width less than twice window, ratio 1.00 |      |
| Windows facing West:              | 6.66 m <sup>2</sup> , No overhang                                       |      |
| Air change rate:                  | 0.50 ach                                                                |      |
| Blinds/curtains:                  | None                                                                    |      |

#### 10 Key features

|                    |                                      |
|--------------------|--------------------------------------|
| Party wall U-value | 0.00 W/m <sup>2</sup> K              |
| Air permeability   | 3.0 m <sup>3</sup> /m <sup>2</sup> h |
| Photovoltaic array | 0.50 kW                              |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 49.5000 (1b)              | x 2.5500 (2b)                   | = 126.2250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 49.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 126.2250 (5)              |

#### 2. Ventilation rate

|                                                                                              |        |        |        |        | main    | secondary |         | other  |        | total  | m3 per hour                 |               |             |
|----------------------------------------------------------------------------------------------|--------|--------|--------|--------|---------|-----------|---------|--------|--------|--------|-----------------------------|---------------|-------------|
|                                                                                              |        |        |        |        | heating | +         | heating | +      |        | =      |                             |               |             |
| Number of chimneys                                                                           |        |        |        |        | 0       | +         | 0       | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a)   |             |
| Number of open flues                                                                         |        |        |        |        | 0       | +         | 0       | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b)   |             |
| Number of intermittent fans                                                                  |        |        |        |        |         |           |         |        |        |        | 0 * 10 =                    | 0.0000 (7a)   |             |
| Number of passive vents                                                                      |        |        |        |        |         |           |         |        |        |        | 0 * 10 =                    | 0.0000 (7b)   |             |
| Number of flueless gas fires                                                                 |        |        |        |        |         |           |         |        |        |        | 0 * 40 =                    | 0.0000 (7c)   |             |
|                                                                                              |        |        |        |        |         |           |         |        |        |        | Air changes per hour        |               |             |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =                    |        |        |        |        |         |           |         |        |        |        | 0.0000 / (5) =              |               | 0.0000 (8)  |
| Pressure test                                                                                |        |        |        |        |         |           |         |        |        |        | Yes                         |               |             |
| Measured/design AP50                                                                         |        |        |        |        |         |           |         |        |        |        |                             |               | 3.0000      |
| Infiltration rate                                                                            |        |        |        |        |         |           |         |        |        |        |                             |               | 0.1500 (18) |
| Number of sides sheltered                                                                    |        |        |        |        |         |           |         |        |        |        |                             |               | 1 (19)      |
| Shelter factor                                                                               |        |        |        |        |         |           |         |        |        |        | (20) = 1 - [0.075 x (19)] = |               | 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                                         |        |        |        |        |         |           |         |        |        |        | (21) = (18) x (20) =        |               | 0.1388 (21) |
|                                                                                              | Jan    | Feb    | Mar    | Apr    | May     | Jun       | Jul     | Aug    | Sep    | Oct    | Nov                         | Dec           |             |
| Wind speed                                                                                   | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000  | 3.8000    | 3.8000  | 3.7000 | 4.0000 | 4.3000 | 4.5000                      | 4.7000 (22)   |             |
| Wind factor                                                                                  | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750  | 0.9500    | 0.9500  | 0.9250 | 1.0000 | 1.0750 | 1.1250                      | 1.1750 (22a)  |             |
| Adj infilt rate                                                                              | 0.1769 | 0.1734 | 0.1700 | 0.1526 | 0.1492  | 0.1318    | 0.1318  | 0.1283 | 0.1388 | 0.1492 | 0.1561                      | 0.1630 (22b)  |             |
| Balanced mechanical ventilation with heat recovery                                           |        |        |        |        |         |           |         |        |        |        |                             |               |             |
| If mechanical ventilation:                                                                   |        |        |        |        |         |           |         |        |        |        |                             | 0.5000 (23a)  |             |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |        |        |        |        |         |           |         |        |        |        |                             | 79.9000 (23c) |             |
| Effective ac                                                                                 | 0.2774 | 0.2739 | 0.2705 | 0.2531 | 0.2497  | 0.2323    | 0.2323  | 0.2288 | 0.2393 | 0.2497 | 0.2566                      | 0.2635 (25)   |             |

#### 3. Heat losses and heat loss parameter

| Element                                                    | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2          | U-value<br>W/m2K | A x U<br>W/K                             | K-value<br>kJ/m2K | A x K<br>kJ/K   |
|------------------------------------------------------------|-------------|----------------|------------------------|------------------|------------------------------------------|-------------------|-----------------|
| W29 (Uw = 1.40)                                            |             |                | 7.3200                 | 1.3258           | 9.7045                                   |                   | (27)            |
| W02 (Uw = 1.40)                                            |             |                | 6.6600                 | 1.3258           | 8.8295                                   |                   | (27)            |
| door                                                       |             |                | 2.1000                 | 1.4000           | 2.9400                                   |                   | (26a)           |
| External Wall 1                                            | 55.6000     | 13.9800        | 41.6200                | 0.1800           | 7.4916                                   | 140.0000          | 5826.8000 (29a) |
| stair wall                                                 | 22.2000     | 2.1000         | 20.1000                | 0.1800           | 3.6180                                   | 140.0000          | 2814.0000 (29a) |
| Total net area of external elements Aum(A, m2)             |             |                | 77.8000                |                  |                                          |                   | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                        |             |                | (26) ... (30) + (32) = |                  | 32.5837                                  |                   | (33)            |
| Party Wall 1                                               |             |                | 5.1000                 | 0.0000           | 0.0000                                   | 140.0000          | 714.0000 (32)   |
| Party Floor 1                                              |             |                | 49.5000                |                  |                                          | 80.0000           | 3960.0000 (32d) |
| Party Ceilings                                             |             |                | 49.5000                |                  |                                          | 80.0000           | 3960.0000 (32b) |
| Internal Wall                                              |             |                | 64.4000                |                  |                                          | 9.0000            | 579.6000 (32c)  |
| Heat capacity Cm = Sum(A x k)                              |             |                |                        |                  | (28) ... (30) + (32) + (32a) ... (32e) = |                   | 17854.4000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K          |             |                |                        |                  |                                          |                   | 360.6949 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) |             |                |                        |                  |                                          |                   | 7.5945 (36)     |
| Total fabric heat loss                                     |             |                |                        |                  |                                          | (33) + (36) =     | 40.1782 (37)    |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                  |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.6754 (42)      |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 77.8847 (43)     |
| Daily hot water use                      | Jan 85.6732 | Feb 82.5578 | Mar 79.4424 | Apr 76.3270 | May 73.2117 | Jun 70.0963 | Jul 70.0963 | Aug 73.2117 | Sep 76.3270 | Oct 79.4424 | Nov 82.5578 | Dec 85.6732 (44) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy content (annual)                                         | 127.0509 | 111.1195 | 114.6654 | 99.9681  | 95.9218  | 82.7732  | 76.7015  | 88.0161  | 89.0673  | 103.7994            | 113.3051 | 123.0420 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1225.4303 (45) |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
| If cylinder contains dedicated solar storage                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| Primary loss                                                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 173.2533 | 152.8507 | 160.8678 | 144.6801 | 142.1242 | 127.4852 | 122.9039 | 134.2185 | 133.7793 | 150.0018            | 158.0171 | 169.2444 (62)  |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 79.2063  | 70.3322  | 75.0882  | 69.0090  | 68.8559  | 63.2917  | 62.4652  | 66.2273  | 65.3845  | 71.4752             | 73.4436  | 77.8734 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.0102  | 11.5556  | 9.3976   | 7.1146   | 5.3183   | 4.4899   | 4.8515   | 6.3062   | 8.4641   | 10.7471  | 12.5435  | 13.3718 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 145.9354 | 147.4497 | 143.6336 | 135.5095 | 125.2544 | 115.6159 | 109.1769 | 107.6625 | 111.4787 | 119.6027 | 129.8579 | 139.4963 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 (71) |
| Water heating gains (Table 5)                                                       | 106.4601 | 104.6610 | 100.9250 | 95.8458  | 92.5483  | 87.9051  | 83.9586  | 89.0152  | 90.8118  | 96.0688  | 102.0049 | 104.6685 (72) |
| Total internal gains                                                                | 313.5366 | 311.7972 | 302.0870 | 286.6008 | 271.2517 | 256.1418 | 246.1178 | 251.1147 | 258.8854 | 274.5495 | 292.5372 | 305.6675 (73) |

#### 6. Solar gains

| [Jan]       |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W   |      |
|-------------|----------|----------|------------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|--------------|------|
| East        |          |          | 7.3200     | 19.6403                        |          | 0.3700                            |          | 0.8900                             |          | 0.7700                       |          | 32.8083 (76) |      |
| West        |          |          | 6.6600     | 19.6403                        |          | 0.5600                            |          | 0.6800                             |          | 0.7700                       |          | 34.5185 (80) |      |
| -----       |          |          |            |                                |          |                                   |          |                                    |          |                              |          |              |      |
| Solar gains | 67.3268  | 131.7054 | 216.9001   | 316.3358                       | 387.6814 | 396.8609                          | 377.8278 | 324.5485                           | 252.2638 | 156.2796                     | 83.9486  | 55.3662      | (83) |
| Total gains | 380.8634 | 443.5026 | 518.9871   | 602.9366                       | 658.9331 | 653.0027                          | 623.9456 | 575.6632                           | 511.1491 | 430.8291                     | 376.4857 | 361.0338     | (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 95.8677 | 96.1362 | 96.4062 | 97.7793 | 98.0587 | 99.4796 | 99.4796 | 99.7688 | 98.9063 | 98.0587 | 97.5016 | 96.9508      |
| alpha                                                                       | 7.3912  | 7.4091  | 7.4271  | 7.5186  | 7.5372  | 7.6320  | 7.6320  | 7.6513  | 7.5938  | 7.5372  | 7.5001  | 7.4634       |
| util living area                                                            | 0.9987  | 0.9955  | 0.9784  | 0.8903  | 0.6968  | 0.4876  | 0.3515  | 0.3970  | 0.6652  | 0.9509  | 0.9958  | 0.9991 (86)  |
| MIT                                                                         | 20.3106 | 20.4451 | 20.6602 | 20.8900 | 20.9839 | 20.9990 | 20.9999 | 20.9998 | 20.9914 | 20.8336 | 20.5254 | 20.2879 (87) |
| Th 2                                                                        | 20.0459 | 20.0483 | 20.0507 | 20.0628 | 20.0652 | 20.0774 | 20.0774 | 20.0798 | 20.0725 | 20.0652 | 20.0604 | 20.0556 (88) |
| util rest of house                                                          | 0.9981  | 0.9934  | 0.9689  | 0.8531  | 0.6337  | 0.4179  | 0.2778  | 0.3177  | 0.5817  | 0.9238  | 0.9935  | 0.9987 (89)  |
| MIT 2                                                                       | 19.1388 | 19.3363 | 19.6448 | 19.9542 | 20.0537 | 20.0769 | 20.0773 | 20.0798 | 20.0680 | 19.8962 | 19.4635 | 19.1134 (90) |
| Living area fraction                                                        | 19.6951 | 19.8627 | 20.1268 | 20.3985 | 20.4953 | 20.5147 | 20.5153 | 20.5166 | 20.5064 | 20.3412 | 19.9676 | 19.6710 (91) |
| MIT                                                                         | 19.6951 | 19.8627 | 20.1268 | 20.3985 | 20.4953 | 20.5147 | 20.5153 | 20.5166 | 20.5064 | 20.3412 | 19.9676 | 19.6710 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.6951 | 19.8627 | 20.1268 | 20.3985 | 20.4953 | 20.5147 | 20.5153 | 20.5166 | 20.5064 | 20.3412 | 19.9676 | 19.6710 (93) |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |                           |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec                       |
| Useful gains         | 0.9978   | 0.9929   | 0.9698   | 0.8674   | 0.6633   | 0.4510   | 0.3128   | 0.3554   | 0.6215   | 0.9330   | 0.9932   | 0.9984 (94)               |
| Ext temp.            | 380.0100 | 440.3640 | 503.2946 | 523.0011 | 437.0954 | 294.5016 | 195.1804 | 204.5879 | 317.6676 | 401.9722 | 373.9359 | 360.4720 (95)             |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)               |
| Month fracti         | 796.4400 | 771.9092 | 701.0245 | 583.2252 | 444.8455 | 294.8766 | 195.1993 | 204.6361 | 321.2415 | 492.6859 | 654.5303 | 791.4247 (97)             |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)              |
| Space heating        | 309.8246 | 222.7984 | 147.1111 | 43.3613  | 5.7661   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 67.4910  | 202.0280 | 320.6288 (98)             |
| Space heating per m2 |          |          |          |          |          |          |          |          |          |          |          | 1319.0091 (98)            |
|                      |          |          |          |          |          |          |          |          |          |          |          | (98) / (4) = 26.6466 (99) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |           |                 |
|-----------------------------------------------------------------------------------------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000    | (301)           |
| Fraction of space heat from community system                                            | 1.0000    | (302)           |
| Fraction of heat from community Heat pump                                               | 0.4600    | (303a)          |
| Fraction of heat from community Boilers                                                 | 0.5400    | (303b)          |
| Fraction of total space heat from community Heat pump                                   | 0.4600    | (304a)          |
| Fraction of total space heat from community Boilers                                     | 0.5400    | (304b)          |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000    | (305)           |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000    | (305a)          |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500    | (306)           |
| Space heating:                                                                          |           |                 |
| Annual space heating requirement                                                        | 1319.0091 | (98)            |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 637.0814  | (307a)          |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 747.8782  | (307b)          |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000    | (308)           |
| Space heating fuel for secondary/supplementary system                                   | 0.0000    | (309)           |
| Water heating                                                                           |           |                 |
| Annual water heating requirement                                                        | 1769.4263 | (64)            |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 854.6329  | (310a)          |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1003.2647 | (310b)          |
| Electricity used for heat distribution                                                  | 32.4286   | (313)           |
| Annual totals kWh/year                                                                  |           |                 |
| Electricity for pumps and fans:                                                         |           |                 |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |           |                 |
| mechanical ventilation fans (SFP = 0.6625)                                              | 102.0214  | (330a)          |
| Total electricity for the above, kWh/year                                               | 102.0214  | (331)           |
| Electricity for lighting (calculated in Appendix L)                                     | 229.7650  | (332)           |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |           |                 |
| PV Unit 0 (0.80 * 0.50 * 951 * 1.00) =                                                  | -380.2464 | -380.2464 (333) |
| Total delivered energy for all uses                                                     |           | 3194.3971 (338) |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 403.1660           | 0.5190                        | 209.2432 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 1864.9019          | 0.2160                        | 402.8188 (368)           |
| Electrical energy for heat distribution                                                    | 32.4286            | 0.5190                        | 16.8304 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 628.8924 (373)           |
| Space and water heating                                                                    |                    |                               | 628.8924 (376)           |
| Pumps and fans                                                                             | 102.0214           | 0.5190                        | 52.9491 (378)            |
| Energy for lighting                                                                        | 229.7650           | 0.5190                        | 119.2480 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -380.2464          | 0.5190                        | -197.3479 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 603.7416 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 12.2000 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |  |     |         |     |
|---------------------------------------------------------------------------------|--|-----|---------|-----|
| DER                                                                             |  |     | 12.2000 | ZC1 |
| Total Floor Area                                                                |  | TFA | 49.5000 |     |
| Assumed number of occupants                                                     |  | N   | 1.6754  |     |
| CO2 emission factor in Table 12 for electricity displaced from grid             |  | EF  | 0.5190  |     |
| CO2 emissions from appliances, equation (L14)                                   |  |     | 17.4704 | ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |  |     | 3.2164  | ZC3 |
| Total CO2 emissions                                                             |  |     | 32.8867 | ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |  |     | 0.0000  | ZC5 |
| Additional allowable electricity generation, kWh/m²/year                        |  |     | 0.0000  | ZC6 |
| Resulting CO2 emissions offset from additional allowable electricity generation |  |     | 0.0000  | ZC7 |
| Net CO2 emissions                                                               |  |     | 32.8867 | ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 49.5000 (1b)              | x 2.5500 (2b)                   | = 126.2250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 49.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 126.2250 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1584 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.4084 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 1 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3778 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4817 | 0.4723 | 0.4628 | 0.4156 | 0.4061 | 0.3589 | 0.3589 | 0.3495 | 0.3778 | 0.4061 | 0.4250 | 0.4439 (22b) |
| Effective ac    | 0.6160 | 0.6115 | 0.6071 | 0.5864 | 0.5825 | 0.5644 | 0.5644 | 0.5611 | 0.5714 | 0.5825 | 0.5903 | 0.5985 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2  | U-value<br>W/m2K | A x U<br>W/K                 | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------|------------------|------------------------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|------|
| TER Semi-glazed door                                                |                |                | 2.1000         | 1.2000           | 2.5200                       |                   |                | (26a)          |                |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                | 10.2700        | 1.3258           | 13.6155                      |                   |                | (27)           |                |                |                |                |      |
| External Wall 1                                                     | 55.6000        | 10.2700        | 45.3300        | 0.1800           | 8.1594                       |                   |                | (29a)          |                |                |                |                |      |
| stair wall                                                          | 22.2000        | 2.1000         | 20.1000        | 0.1800           | 3.6180                       |                   |                | (29a)          |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 77.8000        |                  |                              |                   |                | (31)           |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                |                  | (26)...(30) + (32) = 27.9129 |                   |                | (33)           |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                  |                              |                   |                |                | 250.0000 (35)  |                |                |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                |                  |                              |                   |                |                | 4.3455 (36)    |                |                |                |      |
| Total fabric heat loss                                              |                |                |                |                  |                              | (33) + (36) =     | 32.2584        | (37)           |                |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                  |                              |                   |                |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>25.6600 | Feb<br>25.4723 | Mar<br>25.2884 | Apr<br>24.4244   | May<br>24.2627               | Jun<br>23.5102    | Jul<br>23.5102 | Aug<br>23.3708 | Sep<br>23.8001 | Oct<br>24.2627 | Nov<br>24.5897 | Dec<br>24.9316 | (38) |
| Heat transfer coeff                                                 | 57.9184        | 57.7308        | 57.5468        | 56.6828          | 56.5211                      | 55.7686           | 55.7686        | 55.6293        | 56.0585        | 56.5211        | 56.8482        | 57.1901        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                |                  |                              |                   |                |                |                |                |                | 56.6820        | (39) |
| HLP                                                                 | Jan<br>1.1701  | Feb<br>1.1663  | Mar<br>1.1626  | Apr<br>1.1451    | May<br>1.1418                | Jun<br>1.1266     | Jul<br>1.1266  | Aug<br>1.1238  | Sep<br>1.1325  | Oct<br>1.1418  | Nov<br>1.1484  | Dec<br>1.1554  | (40) |
| HLP (average)                                                       |                |                |                |                  |                              |                   |                |                |                |                |                | 1.1451         | (40) |
| Days in month                                                       | 31             | 28             | 31             | 30               | 31                           | 30                | 31             | 31             | 30             | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |         |         |         |         |         |         |         |          |                                   |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|---------|----------|-----------------------------------|
| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |         |          |                                   |
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |         |          | 1.6754 (42)                       |
|                                                             |          |          |          |         |         |         |         |         |         |         |          | 73.9905 (43)                      |
| Jan                                                         | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec      |                                   |
| Daily hot water use                                         | 81.3896  | 78.4299  | 75.4703  | 72.5107 | 69.5511 | 66.5915 | 66.5915 | 69.5511 | 72.5107 | 75.4703 | 78.4299  | 81.3896 (44)                      |
| Energy conte                                                | 120.6984 | 105.5636 | 108.9321 | 94.9697 | 91.1257 | 78.6345 | 72.8664 | 83.6153 | 84.6139 | 98.6094 | 107.6399 | 116.8899 (45)                     |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         |         |          | Total = Sum(45)m = 1164.1588 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |         |         |         |         |         |         |         |          |                                   |
|                                                             | 18.1048  | 15.8345  | 16.3398  | 14.2455 | 13.6688 | 11.7952 | 10.9300 | 12.5423 | 12.6921 | 14.7914 | 16.1460  | 17.5335 (46)                      |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |         |          |                                   |
| Store volume                                                |          |          |          |         |         |         |         |         |         |         |          | 2.0000 (47)                       |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |         |          | 0.2388 (48)                       |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |         |          | 0.5400 (49)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |         |          | 0.1290 (55)                       |
| Total storage loss                                          |          |          |          |         |         |         |         |         |         |         |          |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501 (64) |
|                                                                 | 61.9403  | 54.7975  | 58.0280  | 52.6820  | 52.1074  | 47.2506  | 46.0362  | 49.6102  | 49.2388  | 54.5957  | 56.8949  | 60.6740 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.0577  | 11.5978  | 9.4319   | 7.1406   | 5.3377   | 4.5063   | 4.8692   | 6.3292   | 8.4950   | 10.7863  | 12.5893  | 13.4206  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 145.9354 | 147.4497 | 143.6336 | 135.5095 | 125.2544 | 115.6159 | 109.1769 | 107.6625 | 111.4787 | 119.6027 | 129.8579 | 139.4963 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | (71) |
| Water heating gains (Table 5)                                                       | 83.2531  | 81.5440  | 77.9947  | 73.1695  | 70.0368  | 65.6258  | 61.8766  | 66.6804  | 68.3872  | 73.3814  | 79.0207  | 81.5511  | (72) |
| Total internal gains                                                                | 293.3771 | 291.7223 | 282.1911 | 266.9505 | 251.7597 | 236.8789 | 227.0536 | 231.8029 | 239.4917 | 254.9013 | 272.5987 | 285.5989 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|--------------|---------------|
| East        |          |          |          |          | 5.3800     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 32.2925      |               |
| West        |          |          |          |          | 4.8900     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 29.3513 (80) |               |
| <hr/>       |          |          |          |          |            |                                |                                   |                                    |                              |          |              |               |
| Solar gains | 61.6438  | 120.5884 | 198.5919 | 289.6345 | 354.9579   | 363.3626                       | 345.9360                          | 297.1539                           | 230.9706                     | 143.0883 | 76.8626      | 50.6929 (83)  |
| Total gains | 355.0209 | 412.3107 | 480.7830 | 556.5849 | 606.7176   | 600.2415                       | 572.9896                          | 528.9568                           | 470.4623                     | 397.9896 | 349.4613     | 336.2918 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 59.3507 | 59.5436 | 59.7340 | 60.6445 | 60.8179 | 61.6386 | 61.6386 | 61.7930 | 61.3199 | 60.8179 | 60.4681 | 60.1066 |              |
| alpha                                                                       | 4.9567  | 4.9696  | 4.9823  | 5.0430  | 5.0545  | 5.1092  | 5.1092  | 5.1195  | 5.0880  | 5.0545  | 5.0312  | 5.0071  |              |
| util living area                                                            | 0.9956  | 0.9901  | 0.9718  | 0.9083  | 0.7698  | 0.5770  | 0.4250  | 0.4776  | 0.7447  | 0.9503  | 0.9907  | 0.9966  | (86)         |
| MIT                                                                         | 19.8397 | 20.0140 | 20.3049 | 20.6576 | 20.8886 | 20.9798 | 20.9965 | 20.9938 | 20.9306 | 20.6017 | 20.1574 | 19.8141 | (87)         |
| Th 2                                                                        | 19.9440 | 19.9471 | 19.9501 | 19.9642 | 19.9668 | 19.9791 | 19.9791 | 19.9814 | 19.9744 | 19.9668 | 19.9615 | 19.9559 | (88)         |
| util rest of house                                                          | 0.9941  | 0.9869  | 0.9625  | 0.8801  | 0.7106  | 0.4924  | 0.3281  | 0.3751  | 0.6614  | 0.9286  | 0.9871  | 0.9955  | (89)         |
| MIT 2                                                                       | 18.4125 | 18.6677 | 19.0871 | 19.5822 | 19.8663 | 19.9669 | 19.9779 | 19.9791 | 19.9238 | 19.5220 | 18.8880 | 18.3837 | (90)         |
| Living area fraction                                                        | 19.0901 | 19.3068 | 19.6652 | 20.0928 | 20.3517 | 20.4477 | 20.4615 | 20.4608 | 20.4017 | 20.0346 | 19.4907 | 19.0628 | (92)         |
| Temperature adjustment                                                      | 19.0901 | 19.3068 | 19.6652 | 20.0928 | 20.3517 | 20.4477 | 20.4615 | 20.4608 | 20.4017 | 20.0346 | 19.4907 | 19.0628 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 0.9925   | 0.9843   | 0.9594   | 0.8840   | 0.7339   | 0.5321   | 0.3743   | 0.4239   | 0.6981   | 0.9303   | 0.9850   | 0.9942    | (94)  |
| Ext temp.            | 352.3662 | 405.8536 | 461.2712 | 492.0255 | 445.2601 | 319.3615 | 214.4415 | 224.2304 | 328.4427 | 370.2658 | 344.2066 | 334.3271  | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Month fracti         | 856.6178 | 831.7178 | 757.6175 | 634.4370 | 489.0012 | 326.1207 | 215.3495 | 225.9004 | 353.2663 | 533.2545 | 704.3860 | 850.0047  | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating per m2 | 375.1631 | 286.1807 | 220.4816 | 102.5363 | 32.5434  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 121.2635 | 259.3292 | 383.6641  | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 1781.1621 | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 35.9831   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |                 |          |          |          |          |          |          |          |          |          |          |                 |
|-----------------------------------------------------------------------|-----------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) | 0.0000 (201)    |          |          |          |          |          |          |          |          |          |          |                 |
| Fraction of space heat from main system(s)                            | 1.0000 (202)    |          |          |          |          |          |          |          |          |          |          |                 |
| Efficiency of main space heating system 1 (in %)                      | 93.5000 (206)   |          |          |          |          |          |          |          |          |          |          |                 |
| Efficiency of secondary/supplementary heating system, %               | 0.0000 (208)    |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating requirement                                             | 1904.9862 (211) |          |          |          |          |          |          |          |          |          |          |                 |
|                                                                       | Jan             | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                             | 375.1631        | 286.1807 | 220.4816 | 102.5363 | 32.5434  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 121.2635 | 259.3292 | 383.6641 (98)   |
| Space heating efficiency (main heating system 1)                      | 93.5000         | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000 (210)   |
| Space heating fuel (main heating system)                              | 401.2440        | 306.0757 | 235.8092 | 109.6645 | 34.8058  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 129.6936 | 277.3574 | 410.3359 (211)  |
| Water heating requirement                                             | 0.0000          | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (215)    |
| Water heating requirement                                             | 147.9585        | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501 (64)   |
| Efficiency of water heater (217)m                                     | 87.1933         | 86.8585  | 86.0922  | 84.3684  | 81.8876  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 84.7147  | 86.5461  | 79.8000 (216)   |
| Fuel for water heating, kWh/month                                     | 169.6903        | 149.8824 | 158.1936 | 143.8340 | 144.5711 | 131.5981 | 125.4719 | 138.9417 | 139.0911 | 148.5806 | 154.8546 | 165.1147 (219)  |
| Water heating fuel used                                               |                 |          |          |          |          |          |          |          |          |          |          | 1769.8242 (219) |
| Annual totals kWh/year                                                |                 |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system                                      |                 |          |          |          |          |          |          |          |          |          |          | 1904.9862 (211) |
| Space heating fuel - secondary                                        |                 |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Electricity for pumps and fans:                                       |                 |          |          |          |          |          |          |          |          |          |          |                 |
| central heating pump                                                  |                 |          |          |          |          |          |          |          |          |          |          | 30.0000 (230c)  |
| main heating flue fan                                                 |                 |          |          |          |          |          |          |          |          |          |          | 45.0000 (230e)  |
| Total electricity for the above, kWh/year                             |                 |          |          |          |          |          |          |          |          |          |          | 75.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)                   |                 |          |          |          |          |          |          |          |          |          |          | 230.6035 (232)  |
| Total delivered energy for all uses                                   |                 |          |          |          |          |          |          |          |          |          |          | 3980.4138 (238) |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1904.9862          | 0.2160                        | 411.4770 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1769.8242          | 0.2160                        | 382.2820 (264)           |
| Space and water heating                                                                           |                    |                               | 793.7590 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 230.6035           | 0.5190                        | 119.6832 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 952.3672 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 16.0355 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.4178 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7864 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (16.0355 * 1.00) + 2.4178 + 0.7864, rounded to 2 d.p. |                    |                               | 19.2400 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | D-1/2-02                                                                |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP-1-2                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 86 B                                                                    | DER           | 10.54   | TER            | 17.51      |
| Environmental                      | 93 A                                                                    | % DER<TER     | 39.80   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.42                                                                    | DFEE          | 40.68   | TFEE           | 42.07      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 3.29    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Top-floor flat, total floor area 51 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 17.51 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 10.54 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 42.1 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 40.7 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.18 (max. 0.30) | 0.18 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | (no roof)        |                  |    |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK

Hot water controls:

No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing East: 3.33 m<sup>2</sup>, No overhang  
Windows facing South: 12.19 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.50 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 51.4000 (1b)              | x 2.5500 (2b)                   | = 131.0700 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 131.0700 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |              |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|--------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |              |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    |        | 0.0000      | (6a)   |        |              |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    |        | 0.0000      | (6b)   |        |              |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    |        | 0.0000      | (7a)   |        |              |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    |        | 0.0000      | (7b)   |        |              |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    |        | 0.0000      | (7c)   |        |              |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |              |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              |        | 0.0000      | (8)    |        |              |
| Pressure test                                                                                |                              |        |           |        |        |        |                             |        | Yes         |        |        |              |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             |        | 3.0000      |        |        |              |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             |        | 0.1500      | (18)   |        |              |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             |        | 1           | (19)   |        |              |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = |        | 0.9250      | (20)   |        |              |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        |        | 0.1388      | (21)   |        |              |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec          |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)  |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a) |
|                                                                                              | 0.1769                       | 0.1734 | 0.1700    | 0.1526 | 0.1492 | 0.1318 | 0.1318                      | 0.1283 | 0.1388      | 0.1492 | 0.1561 | 0.1630 (22b) |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |              |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        |              |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        |              |
| Effective ac                                                                                 | 0.2774                       | 0.2739 | 0.2705    | 0.2531 | 0.2497 | 0.2323 | 0.2323                      | 0.2288 | 0.2393      | 0.2497 | 0.2566 | 0.2635 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.3900                    | 1.3258                        | 11.1231      |                                | (27)                                                 |
| W02 (Uw = 1.40)                                                |                         |                            | 7.1300                    | 1.3258                        | 9.4527       |                                | (27)                                                 |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                | (26a)                                                |
| External Wall 1                                                | 57.1000                 | 15.5200                    | 41.5800                   | 0.1800                        | 7.4844       | 140.0000                       | 5821.2000 (29a)                                      |
| stair wall                                                     | 13.5000                 | 2.1000                     | 11.4000                   | 0.1800                        | 2.0520       | 140.0000                       | 1596.0000 (29a)                                      |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 70.6000                   |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            | (26)...(30) + (32) =      |                               | 33.0522      |                                | (33)                                                 |
| Party Wall 1                                                   |                         |                            | 8.4000                    | 0.0000                        | 0.0000       | 140.0000                       | 1176.0000 (32)                                       |
| Party Floor 1                                                  |                         |                            | 51.4000                   |                               |              | 80.0000                        | 4112.0000 (32d)                                      |
| Party Ceilings 1                                               |                         |                            | 51.4000                   |                               |              | 80.0000                        | 4112.0000 (32b)                                      |
| Internal Wall                                                  |                         |                            | 95.0000                   |                               |              | 9.0000                         | 855.0000 (32c)                                       |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 17672.2000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 343.8171 (35)                                        |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 7.1785 (36)                                          |
| Total fabric heat loss                                         |                         |                            |                           |                               |              |                                | (33) + (36) = 40.2307 (37)                           |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 11.9987 | 11.8486 | 11.6986 | 10.9484 | 10.7984 | 10.0482 | 10.0482 | 9.8982  | 10.3483 | 10.7984 | 11.0985 | 11.3985 (38) |
| Heat transfer coeff       | 52.2293 | 52.0793 | 51.9293 | 51.1791 | 51.0291 | 50.2789 | 50.2789 | 50.1289 | 50.5790 | 51.0291 | 51.3291 | 51.6292 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 51.1416 (39) |
| HLP                       | 1.0161  | 1.0132  | 1.0103  | 0.9957  | 0.9928  | 0.9782  | 0.9782  | 0.9753  | 0.9840  | 0.9928  | 0.9986  | 1.0045 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 0.9950 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                  |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.7314 (42)      |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 79.2842 (43)     |
| Daily hot water use                      | Jan 87.2127 | Feb 84.0413 | Mar 80.8699 | Apr 77.6986 | May 74.5272 | Jun 71.3558 | Jul 71.3558 | Aug 74.5272 | Sep 77.6986 | Oct 80.8699 | Nov 84.0413 | Dec 87.2127 (44) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Energy content (annual)                                         | 129.3339 | 113.1162 | 116.7258 | 101.7644 | 97.6454  | 84.2605  | 78.0798  | 89.5977  | 90.6677  | 105.6645 | 115.3411 | 125.2529 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          | 19.4001  | 16.9674  | 17.5089  | 15.2647  | 14.6468  | 12.6391  | 11.7120  | 13.4396  | 13.6002  | 15.8497  | 17.3012  | 1247.4498 (45) |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)    |
| Total storage loss                                              | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month | 175.5363 | 154.8474 | 162.9282 | 146.4764 | 143.8478 | 128.9725 | 124.2822 | 135.8001 | 135.3797 | 151.8669 | 160.0531 | 171.4553 (62)  |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)    |
| Output from w/h                                                 | 175.5363 | 154.8474 | 162.9282 | 146.4764 | 143.8478 | 128.9725 | 124.2822 | 135.8001 | 135.3797 | 151.8669 | 160.0531 | 171.4553 (64)  |
| Heat gains from water heating, kWh/month                        | 79.9654  | 70.9961  | 75.7733  | 69.6063  | 69.4290  | 63.7862  | 62.9234  | 66.7531  | 65.9166  | 72.0954  | 74.1205  | 78.6085 (65)   |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |          |          |          |          |          |          |          | 1791.4458 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.4501  | 11.9463  | 9.7153   | 7.3551   | 5.4981   | 4.6417   | 5.0155   | 6.5193   | 8.7503   | 11.1105  | 12.9675  | 13.8239 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 150.8691 | 152.4347 | 148.4896 | 140.0908 | 129.4890 | 119.5247 | 112.8679 | 111.3024 | 115.2475 | 123.6462 | 134.2481 | 144.2124 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 (71) |
| Water heating gains (Table 5)                                                       | 107.4804 | 105.6490 | 101.8458 | 96.6754  | 93.3185  | 88.5920  | 84.5745  | 89.7220  | 91.5509  | 96.9024  | 102.9451 | 105.6566 (72) |
| Total internal gains                                                                | 320.7702 | 319.0005 | 309.0212 | 293.0919 | 277.2761 | 261.7289 | 251.4285 | 256.5142 | 264.5192 | 280.6296 | 299.1314 | 312.6635 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W   |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|----------|------------------------------------|------------------------------|----------|--------------|---------------|
| South       |          |          |          | 8.3900     | 46.7521                        | 0.3700                            |          | 0.8900                             | 0.7700                       |          | 89.5133 (78) |               |
| East        |          |          |          | 3.3300     | 19.6403                        | 0.5600                            |          | 0.6800                             | 0.7700                       |          | 17.2592 (76) |               |
| South       |          |          |          | 3.8000     | 46.7521                        | 0.5600                            |          | 0.6800                             | 0.7700                       |          | 46.8829 (78) |               |
| Solar gains | 153.6555 | 257.1446 | 340.1513 | 402.6949   | 434.5115                       | 424.2517                          | 411.9743 | 389.2214                           | 361.9129                     | 281.0007 | 183.1963     | 132.0521 (83) |
| Total gains | 474.4257 | 576.1451 | 649.1726 | 695.7867   | 711.7876                       | 685.9806                          | 663.4028 | 645.7356                           | 626.4320                     | 561.6303 | 482.3277     | 444.7155 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 93.9883 | 94.2590 | 94.5314 | 95.9170 | 96.1990 | 97.6343 | 97.6343 | 97.9265 | 97.0551 | 96.1990 | 95.6366 | 95.0808      |
| alpha                                                                       | 7.2659  | 7.2839  | 7.3021  | 7.3945  | 7.4133  | 7.5090  | 7.5090  | 7.5284  | 7.4703  | 7.4133  | 7.3758  | 7.3387       |
| util living area                                                            | 0.9945  | 0.9787  | 0.9341  | 0.8237  | 0.6553  | 0.4682  | 0.3334  | 0.3570  | 0.5540  | 0.8547  | 0.9812  | 0.9964 (86)  |
| MIT                                                                         | 20.4250 | 20.6055 | 20.7893 | 20.9336 | 20.9883 | 20.9992 | 20.9999 | 20.9999 | 20.9972 | 20.9270 | 20.6542 | 20.3897 (87) |
| Th 2                                                                        | 20.0699 | 20.0723 | 20.0748 | 20.0869 | 20.0894 | 20.1015 | 20.1015 | 20.1040 | 20.0967 | 20.0894 | 20.0845 | 20.0796 (88) |
| util rest of house                                                          | 0.9922  | 0.9707  | 0.9125  | 0.7801  | 0.5958  | 0.4030  | 0.2654  | 0.2875  | 0.4831  | 0.8067  | 0.9727  | 0.9948 (89)  |
| MIT 2                                                                       | 19.3276 | 19.5865 | 19.8379 | 20.0241 | 20.0809 | 20.1012 | 20.1015 | 20.1040 | 20.0952 | 20.0235 | 19.6684 | 19.2844 (90) |
| Living area fraction                                                        | 19.8037 | 20.0286 | 20.2506 | 20.4187 | 20.4746 | 20.4908 | 20.4913 | 20.4927 | 20.4865 | 20.4155 | 20.0961 | 19.7639 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 19.8037 | 20.0286 | 20.2506 | 20.4187 | 20.4746 | 20.4908 | 20.4913 | 20.4927 | 20.4865 | 20.4155 | 20.0961 | 19.7639 (93) |

#### 8. Space heating requirement

|                | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
|----------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Utilisation    | 0.9914   | 0.9703   | 0.9171   | 0.7967   | 0.6214   | 0.4313   | 0.2949   | 0.3177   | 0.5139   | 0.8251   | 0.9729   | 0.9941 (94)   |
| Useful gains   | 470.3374 | 559.0242 | 595.3440 | 554.3276 | 442.3035 | 295.8738 | 195.6365 | 205.1361 | 321.9084 | 463.3746 | 469.2449 | 442.1121 (95) |
| Ext temp.      | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)   |
| Heat loss rate | W        |          |          |          |          |          |          |          |          |          |          |               |
|                | 809.7466 | 787.8858 | 714.0609 | 589.5149 | 447.7598 | 296.1811 | 195.6509 | 205.1611 | 323.0233 | 500.8760 | 667.0788 | 803.5525 (97) |
| Month fracti   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)  |
| Space heating  | kWh      |          |          |          |          |          |          |          |          |          |          |               |
|                | 252.5205 | 153.7950 | 88.3254  | 25.3349  | 4.0595   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 27.9010  | 142.4404 | 268.9117 (98) |
| Space heating  |          |          |          |          |          |          |          |          |          |          |          | 963.2883 (98) |

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### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 18.7410 (99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 963.2883 (98)    |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 465.2682 (307a)  |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 546.1845 (307b)  |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1791.4458 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 865.2683 (310a)  |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1015.7498 (310b) |
| Electricity used for heat distribution                                                  | 28.9247 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 105.9373 (330a)  |
| Total electricity for the above, kWh/year                                               | 105.9373 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 237.5329 (332)   |
| Energy saving/generation technologies (Appendices M, N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.50 * 951 * 1.00) =                                                  | -380.2464        |
| Total delivered energy for all uses                                                     | 2855.6946 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 359.6045           | 0.5190                        | 186.6347 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 1663.4017          | 0.2160                        | 359.2948 (368)           |
| Electrical energy for heat distribution                                                    | 28.9247            | 0.5190                        | 15.0119 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 560.9414 (373)           |
| Space and water heating                                                                    |                    |                               | 560.9414 (376)           |
| Pumps and fans                                                                             | 105.9373           | 0.5190                        | 54.9815 (378)            |
| Energy for lighting                                                                        | 237.5329           | 0.5190                        | 123.2796 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -380.2464          | 0.5190                        | -197.3479 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 541.8546 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 10.5400 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |             |
|---------------------------------------------------------------------------------|-------------|
| DER                                                                             | 10.5400 ZC1 |
| Total Floor Area                                                                | 51.4000     |
| Assumed number of occupants                                                     | TFA         |
| CO2 emission factor in Table 12 for electricity displaced from grid             | N 1.7314    |
| CO2 emissions from appliances, equation (L14)                                   | EF 0.5190   |
| CO2 emissions from cooking, equation (L16)                                      | 17.3934 ZC2 |
| Total CO2 emissions                                                             | 3.1236 ZC3  |
| Residual CO2 emissions offset from biofuel CHP                                  | 31.0570 ZC4 |
| Additional allowable electricity generation, kWh/m²/year                        | 0.0000 ZC5  |
| Resulting CO2 emissions offset from additional allowable electricity generation | 0.0000 ZC6  |
| Net CO2 emissions                                                               | 0.0000 ZC7  |
|                                                                                 | 31.0570 ZC8 |

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### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 51.4000 (1b)              | x 2.5500 (2b)                   | = 131.0700 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 131.0700 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1526 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.4026 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 1 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3724 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4748 | 0.4655 | 0.4562 | 0.4096 | 0.4003 | 0.3538 | 0.3538 | 0.3445 | 0.3724 | 0.4003 | 0.4189 | 0.4376 (22b) |
| Effective ac    | 0.6127 | 0.6083 | 0.6041 | 0.5839 | 0.5801 | 0.5626 | 0.5626 | 0.5593 | 0.5693 | 0.5801 | 0.5878 | 0.5957 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                             | Gross<br>m2    | Openings<br>m2 | NetArea<br>m2  | U-value<br>W/m2K | A x U<br>W/K                 | K-value<br>kJ/m2K | A x K<br>kJ/K  |                |                |                |                |                |      |
|---------------------------------------------------------------------|----------------|----------------|----------------|------------------|------------------------------|-------------------|----------------|----------------|----------------|----------------|----------------|----------------|------|
| TER Semi-glazed door                                                |                |                | 2.1000         | 1.2000           | 2.5200                       |                   |                | (26a)          |                |                |                |                |      |
| TER Opening Type (Uw = 1.40)                                        |                |                | 10.7500        | 1.3258           | 14.2519                      |                   |                | (27)           |                |                |                |                |      |
| External Wall 1                                                     | 57.1000        | 10.7500        | 46.3500        | 0.1800           | 8.3430                       |                   |                | (29a)          |                |                |                |                |      |
| stair wall                                                          | 13.5000        | 2.1000         | 11.4000        | 0.1800           | 2.0520                       |                   |                | (29a)          |                |                |                |                |      |
| Total net area of external elements Aum(A, m2)                      |                |                | 70.6000        |                  |                              |                   |                | (31)           |                |                |                |                |      |
| Fabric heat loss, W/K = Sum (A x U)                                 |                |                |                |                  | (26)...(30) + (32) = 27.1669 |                   |                | (33)           |                |                |                |                |      |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                   |                |                |                |                  |                              |                   |                | 250.0000 (35)  |                |                |                |                |      |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)          |                |                |                |                  |                              |                   |                | 5.2610 (36)    |                |                |                |                |      |
| Total fabric heat loss                                              |                |                |                |                  |                              | (33) + (36) =     | 32.4279        | (37)           |                |                |                |                |      |
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                  |                              |                   |                |                |                |                |                |                |      |
| (38)m                                                               | Jan<br>26.5020 | Feb<br>26.3127 | Mar<br>26.1271 | Apr<br>25.2555   | May<br>25.0924               | Jun<br>24.3333    | Jul<br>24.3333 | Aug<br>24.1927 | Sep<br>24.6257 | Oct<br>25.0924 | Nov<br>25.4223 | Dec<br>25.7672 | (38) |
| Heat transfer coeff                                                 | 58.9299        | 58.7406        | 58.5550        | 57.6834          | 57.5203                      | 56.7612           | 56.7612        | 56.6206        | 57.0536        | 57.5203        | 57.8502        | 58.1951        | (39) |
| Average = Sum(39)m / 12 =                                           |                |                |                |                  |                              |                   |                |                |                |                |                | 57.6826        | (39) |
| HLP                                                                 | Jan<br>1.1465  | Feb<br>1.1428  | Mar<br>1.1392  | Apr<br>1.1222    | May<br>1.1191                | Jun<br>1.1043     | Jul<br>1.1043  | Aug<br>1.1016  | Sep<br>1.1100  | Oct<br>1.1191  | Nov<br>1.1255  | Dec<br>1.1322  | (40) |
| HLP (average)                                                       |                |                |                |                  |                              |                   |                |                |                |                |                | 1.1222         | (40) |
| Days in month                                                       | 31             | 28             | 31             | 30               | 31                           | 30                | 31             | 31             | 30             | 31             | 30             | 31             | (41) |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |         |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |                    |          | 1.7314 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |                    |          | 75.3200 (43)   |
| Jan                                                         | Feb      | Mar      | Apr      | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov                | Dec      |                |
| Daily hot water use                                         | 82.8520  | 79.8392  | 76.8264  | 73.8136 | 70.8008 | 67.7880 | 67.7880 | 70.8008 | 73.8136 | 76.8264            | 79.8392  | 82.8520 (44)   |
| Energy conte                                                | 122.8672 | 107.4604 | 110.8895 | 96.6762 | 92.7631 | 80.0475 | 74.1758 | 85.1178 | 86.1344 | 100.3813           | 109.5740 | 118.9903 (45)  |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1185.0773 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      |          |          |          |         |         |         |         |         |         |                    |          |                |
|                                                             | 18.4301  | 16.1191  | 16.6334  | 14.5014 | 13.9145 | 12.0071 | 11.1264 | 12.7677 | 12.9202 | 15.0572            | 16.4361  | 17.8485 (46)   |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |         |         |         |         |         |         |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |                    |          | 0.1290 (55)    |
| Total storage loss                                          |          |          |          |         |         |         |         |         |         |                    |          |                |

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|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| Primary loss                                                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Solar input                                                     | 150.1273 | 132.0825 | 138.1497 | 123.0570 | 120.0232 | 106.4283 | 101.4359 | 112.3779 | 112.5151 | 127.6414 | 135.9548 | 146.2504 (62) |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Heat gains from water heating, kWh/month                        | 150.1273 | 132.0825 | 138.1497 | 123.0570 | 120.0232 | 106.4283 | 101.4359 | 112.3779 | 112.5151 | 127.6414 | 135.9548 | 146.2504 (64) |
|                                                                 | 62.6614  | 55.4282  | 58.6789  | 53.2495  | 52.6518  | 47.7204  | 46.4716  | 50.1098  | 49.7443  | 55.1849  | 57.5380  | 61.3724 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
| (66)m                                                                               | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.4909  | 11.9825  | 9.7448   | 7.3775   | 5.5147   | 4.6558   | 5.0307   | 6.5391   | 8.7768   | 11.1442  | 13.0069  | 13.8659  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 150.8691 | 152.4347 | 148.4896 | 140.0908 | 129.4890 | 119.5247 | 112.8679 | 111.3024 | 115.2475 | 123.6462 | 134.2481 | 144.2124 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | (69) |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | (70) |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | (71) |
| Water heating gains (Table 5)                                                       | 84.2224  | 82.4825  | 78.8695  | 73.9576  | 70.7686  | 66.2784  | 62.4618  | 67.3518  | 69.0893  | 74.1732  | 79.9139  | 82.4898  | (72) |
| Total internal gains                                                                | 300.5530 | 298.8703 | 289.0744 | 273.3964 | 257.7429 | 242.4294 | 232.3310 | 237.1639 | 245.0842 | 260.9342 | 279.1395 | 292.5386 | (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W    |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|---------------|---------------|
| East        |          |          |          |          | 2.3100     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 13.8654       |               |
| South       |          |          |          |          | 8.4400     | 46.7521                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 120.5910 (76) |               |
| <hr/>       |          |          |          |          |            |                                |                                   |                                    |                              |          |               |               |
| Solar gains | 134.4564 | 224.6206 | 296.2449 | 349.4824 | 376.1350   | 366.8741                       | 356.4134                          | 337.4001                           | 314.7526                     | 245.2035 | 160.2300      | 115.6040 (83) |
| Total gains | 435.0094 | 523.4909 | 585.3193 | 622.8788 | 633.8779   | 609.3035                       | 588.7444                          | 574.5640                           | 559.8368                     | 506.1378 | 439.3695      | 408.1426 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec     |              |
| tau                                                                         | 60.5710 | 60.7662 | 60.9588 | 61.8799 | 62.0554 | 62.8853 | 62.8853 | 63.0415 | 62.5630 | 62.0554 | 61.7015 | 61.3358 |              |
| alpha                                                                       | 5.0381  | 5.0511  | 5.0639  | 5.1253  | 5.1370  | 5.1924  | 5.1924  | 5.2028  | 5.1709  | 5.1370  | 5.1134  | 5.0891  |              |
| util living area                                                            | 0.9908  | 0.9768  | 0.9472  | 0.8804  | 0.7588  | 0.5791  | 0.4213  | 0.4492  | 0.6651  | 0.8983  | 0.9788  | 0.9931  | (86)         |
| MIT                                                                         | 19.9887 | 20.2053 | 20.4606 | 20.7253 | 20.9008 | 20.9808 | 20.9969 | 20.9957 | 20.9607 | 20.7362 | 20.3135 | 19.9508 | (87)         |
| Th 2                                                                        | 19.9630 | 19.9660 | 19.9689 | 19.9827 | 19.9853 | 19.9973 | 19.9973 | 19.9996 | 19.9927 | 19.9853 | 19.9801 | 19.9746 | (88)         |
| util rest of house                                                          | 0.9879  | 0.9699  | 0.9319  | 0.8474  | 0.6997  | 0.4957  | 0.3269  | 0.3537  | 0.5826  | 0.8628  | 0.9713  | 0.9910  | (89)         |
| MIT 2                                                                       | 18.6422 | 18.9552 | 19.3167 | 19.6829 | 19.8963 | 19.9856 | 19.9963 | 19.9979 | 19.9656 | 19.7077 | 19.1243 | 18.5958 | (90)         |
| Living area fraction                                                        | 19.2264 | 19.4976 | 19.8130 | 20.1352 | 20.3321 | 20.4174 | 20.4304 | 20.4308 | 20.3973 | 20.1539 | 19.6402 | 19.1837 | (92)         |
| Temperature adjustment                                                      | 19.2264 | 19.4976 | 19.8130 | 20.1352 | 20.3321 | 20.4174 | 20.4304 | 20.4308 | 20.3973 | 20.1539 | 19.6402 | 19.1837 | (93)         |

#### 8. Space heating requirement

|                      |          |          |          |          |          |          |          |          |          |          |          |           |       |
|----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------|
| Utilisation          | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |       |
| Useful gains         | 0.9852   | 0.9661   | 0.9292   | 0.8529   | 0.7210   | 0.5314   | 0.3680   | 0.3952   | 0.6170   | 0.8695   | 0.9682   | 0.9887    | (94)  |
| Ext temp.            | 428.5853 | 505.7321 | 543.8524 | 531.2384 | 457.0122 | 323.7709 | 216.6380 | 227.0951 | 345.3966 | 440.0616 | 425.3786 | 403.5386  | (95)  |
| Heat loss rate W     | 4.3000   | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000    | (96)  |
| Month fracti         | 879.6094 | 857.4694 | 779.5446 | 648.0835 | 496.5225 | 330.1998 | 217.4172 | 228.2269 | 359.2853 | 549.5448 | 725.4556 | 871.9781  | (97)  |
| Space heating kWh    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000   | 1.0000    | (97a) |
| Space heating per m2 | 335.5619 | 236.3675 | 175.3550 | 84.1285  | 29.3956  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 81.4555  | 216.0554 | 348.5190  | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 1506.8384 | (98)  |
|                      |          |          |          |          |          |          |          |          |          |          |          | 29.3159   | (99)  |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 1611.5919 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 335.5619 | 236.3675 | 175.3550 | 84.1285  | 29.3956  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 81.4555  | 216.0554 | 348.5190  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 358.8897 | 252.7994 | 187.5455 | 89.9770  | 31.4392  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 87.1182  | 231.0753 | 372.7476  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 150.1273 | 132.0825 | 138.1497 | 123.0570 | 120.0232 | 106.4283 | 101.4359 | 112.3779 | 112.5151 | 127.6414 | 135.9548 | 146.2504  | (64)            |
| Efficiency of water heater (217)m                                     | 86.8984  | 86.3494  | 85.4510  | 83.8243  | 81.7004  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 83.6529  | 86.0440  | 87.0498   | (216)           |
| Fuel for water heating, kWh/month                                     | 172.7619 | 152.9628 | 161.6712 | 146.8035 | 146.9066 | 133.3688 | 127.1127 | 140.8245 | 140.9964 | 152.5846 | 158.0061 | 168.0078  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1802.0065 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 1611.5919 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 238.2541  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 3726.8525 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 1611.5919          | 0.2160                        | 348.1038 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1802.0065          | 0.2160                        | 389.2334 (264)           |
| Space and water heating                                                                           |                    |                               | 737.3373 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 238.2541           | 0.5190                        | 123.6539 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 899.9161 (272)           |
| Emissions per m2 for space and water heating                                                      |                    |                               | 14.3451 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.4057 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7573 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (14.3451 * 1.00) + 2.4057 + 0.7573, rounded to 2 d.p. |                    |                               | 17.5100 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                      |                |               |         |                |            |
|----------------------|----------------|---------------|---------|----------------|------------|
| Property Reference   | D-3-01         |               |         | Issued on Date | 08/01/2020 |
| Assessment Reference | ASHP - Be lean | Prop Type Ref | 2bed 3F |                |            |
| Property             |                |               |         |                |            |

|                                    |      |             |       |      |       |
|------------------------------------|------|-------------|-------|------|-------|
| SAP Rating                         | 79 C | DER         | 24.79 | TER  | 23.68 |
| Environmental                      | 84 B | % DER<TER   | -4.69 |      |       |
| CO <sub>2</sub> Emissions (t/year) | 1.03 | DFEE        | 69.97 | TFEE | 73.17 |
| General Requirements Compliance    | Fail | % DFEE<TFEE | 4.38  |      |       |

|                  |                                                                         |             |           |
|------------------|-------------------------------------------------------------------------|-------------|-----------|
| Assessor Details | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com | Assessor ID | R479-0001 |
| Client           |                                                                         |             |           |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 50 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuel for main heating: Mains gas (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 23.68 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 24.79 kgCO<sub>2</sub>/m<sup>2</sup> Fail  
Excess emissions = 1.11 kgCO<sub>2</sub>/m<sup>2</sup> (4.7%)

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 73.2 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 70.0 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element          | Average          | Highest          |    |
|------------------|------------------|------------------|----|
| External wall    | 0.18 (max. 0.30) | 0.18 (max. 0.70) | OK |
| Party wall       | 0.00 (max. 0.20) | -                | OK |
| Floor (no floor) |                  |                  |    |
| Roof             | 0.13 (max. 0.20) | 0.13 (max. 0.35) | OK |
| Openings         | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

|                                 |                     |    |
|---------------------------------|---------------------|----|
| Air permeability at 50 pascals: | 3.00 (design value) |    |
| Maximum                         | 10.0                | OK |

#### 4 Heating efficiency

|                      |                          |   |
|----------------------|--------------------------|---|
| Main heating system: | Community heating scheme | - |
|----------------------|--------------------------|---|

Secondary heating system:

None

#### 5 Cylinder insulation

|                             |                                      |
|-----------------------------|--------------------------------------|
| Hot water storage           | Measured cylinder loss: 0.74 kWh/day |
| Permitted by DBSCG 0.32     | Fail                                 |
| Primary pipework insulated: | No primary pipework                  |

#### 6 Controls

|                         |                                                                                            |    |
|-------------------------|--------------------------------------------------------------------------------------------|----|
| Space heating controls: | Charging system linked to use of community heating, programmer and at least two room stats | OK |
|-------------------------|--------------------------------------------------------------------------------------------|----|

Hot water controls:

No cylinder stat

#### 7 Low energy lights

|                                                           |        |
|-----------------------------------------------------------|--------|
| Percentage of fixed lights with low-energy fittings: 100% |        |
| Minimum                                                   | 75% OK |

#### 8 Mechanical ventilation

|                                      |        |
|--------------------------------------|--------|
| Continuous supply and extract system |        |
| Specific fan power:                  | 0.53   |
| Maximum                              | 1.5 OK |
| MVHR efficiency:                     | 94%    |
| Minimum:                             | 70% OK |

#### 9 Summertime temperature

|                                   |      |      |
|-----------------------------------|------|------|
| Overheating risk (Thames Valley): | High | Fail |
|-----------------------------------|------|------|

Based on:

|                      |                                                                         |
|----------------------|-------------------------------------------------------------------------|
| Overshading:         | Average                                                                 |
| Windows facing East: | 7.32 m <sup>2</sup> , Overhang width less than twice window, ratio 1.00 |
| Windows facing West: | 6.66 m <sup>2</sup> , No overhang                                       |
| Air change rate:     | 0.50 ach                                                                |
| Blinds/curtains:     | None                                                                    |

#### 10 Key features

|                    |                                      |
|--------------------|--------------------------------------|
| Party wall U-value | 0.00 W/m <sup>2</sup> K              |
| Air permeability   | 3.0 m <sup>3</sup> /m <sup>2</sup> h |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 49.5000 (1b)              | x 2.5500 (2b)                   | = 126.2250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 49.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 126.2250 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes    |             |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000 |             |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 | (18)        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 1      | (19)        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.9250 | (20)        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1388 | (21)        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1769                       | 0.1734 | 0.1700    | 0.1526 | 0.1492 | 0.1318 | 0.1318                      | 0.1283 | 0.1388      | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2774                       | 0.2739 | 0.2705    | 0.2531 | 0.2497 | 0.2323 | 0.2323                      | 0.2288 | 0.2393      | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                    | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K     | A x U<br>W/K | K-value<br>kJ/m2K                    | A x K<br>kJ/K   |
|------------------------------------------------------------|-------------|----------------|---------------|----------------------|--------------|--------------------------------------|-----------------|
| W29 (Uw = 1.40)                                            |             |                | 7.3200        | 1.3258               | 9.7045       |                                      | (27)            |
| W02 (Uw = 1.40)                                            |             |                | 6.6600        | 1.3258               | 8.8295       |                                      | (27)            |
| door                                                       |             |                | 2.1000        | 1.4000               | 2.9400       |                                      | (26a)           |
| External Wall 1                                            | 55.6000     | 13.9800        | 41.6200       | 0.1800               | 7.4916       | 140.0000                             | 5826.8000 (29a) |
| stair wall                                                 | 22.2000     | 2.1000         | 20.1000       | 0.1800               | 3.6180       | 140.0000                             | 2814.0000 (29a) |
| External Roof 1                                            | 49.5000     |                | 49.5000       | 0.1300               | 6.4350       | 9.0000                               | 445.5000 (30)   |
| Total net area of external elements Aum(A, m2)             |             |                | 127.3000      |                      |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                        |             |                |               | (26)...(30) + (32) = | 39.0187      |                                      | (33)            |
| Party Wall 1                                               |             |                | 5.1000        | 0.0000               | 0.0000       | 140.0000                             | 714.0000 (32)   |
| Party Floor 1                                              |             |                | 49.5000       |                      |              | 80.0000                              | 3960.0000 (32d) |
| Internal Wall                                              |             |                | 64.4000       |                      |              | 9.0000                               | 579.6000 (32c)  |
| Heat capacity Cm = Sum(A x k)                              |             |                |               |                      |              | (28)...(30) + (32) + (32a)...(32e) = | 14339.9000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K          |             |                |               |                      |              |                                      | 289.6949 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) |             |                |               |                      |              |                                      | 18.7175 (36)    |
| Total fabric heat loss                                     |             |                |               |                      |              | (33) + (36) =                        | 57.7362 (37)    |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                  |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.6754 (42)      |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 77.8847 (43)     |
| Daily hot water use                      | Jan 85.6732 | Feb 82.5578 | Mar 79.4424 | Apr 76.3270 | May 73.2117 | Jun 70.0963 | Jul 70.0963 | Aug 73.2117 | Sep 76.3270 | Oct 79.4424 | Nov 82.5578 | Dec 85.6732 (44) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy content (annual)                                         | 127.0509 | 111.1195 | 114.6654 | 99.9681  | 95.9218  | 82.7732  | 76.7015  | 88.0161  | 89.0673  | 103.7994            | 113.3051 | 123.0420 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1225.4303 (45) |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
| If cylinder contains dedicated solar storage                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| Primary loss                                                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 173.2533 | 152.8507 | 160.8678 | 144.6801 | 142.1242 | 127.4852 | 122.9039 | 134.2185 | 133.7793 | 150.0018            | 158.0171 | 169.2444 (62)  |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 79.2063  | 70.3322  | 75.0882  | 69.0090  | 68.8559  | 63.2917  | 62.4652  | 66.2273  | 65.3845  | 71.4752             | 73.4436  | 77.8734 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.0102  | 11.5556  | 9.3976   | 7.1146   | 5.3183   | 4.4899   | 4.8515   | 6.3062   | 8.4641   | 10.7471  | 12.5435  | 13.3718 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 145.9354 | 147.4497 | 143.6336 | 135.5095 | 125.2544 | 115.6159 | 109.1769 | 107.6625 | 111.4787 | 119.6027 | 129.8579 | 139.4963 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 (71) |
| Water heating gains (Table 5)                                                       | 106.4601 | 104.6610 | 100.9250 | 95.8458  | 92.5483  | 87.9051  | 83.9586  | 89.0152  | 90.8118  | 96.0688  | 102.0049 | 104.6685 (72) |
| Total internal gains                                                                | 313.5366 | 311.7972 | 302.0870 | 286.6008 | 271.2517 | 256.1418 | 246.1178 | 251.1147 | 258.8854 | 274.5495 | 292.5372 | 305.6675 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          |          | Access<br>factor<br>Table 6d | Gains<br>W    |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|----------|------------------------------|---------------|
| East        |          |          |          |          | 7.3200     | 19.6403                        | 0.3700                            | 0.8900                             |          |          | 0.7700                       | 32.8083 (76)  |
| West        |          |          |          |          | 6.6600     | 19.6403                        | 0.5600                            | 0.6800                             |          |          | 0.7700                       | 34.5185 (80)  |
| Solar gains | 67.3268  | 131.7054 | 216.9001 | 316.3358 | 387.6814   | 396.8609                       | 377.8278                          | 324.5485                           | 252.2638 | 156.2796 | 83.9486                      | 55.3662 (83)  |
| Total gains | 380.8634 | 443.5026 | 518.9871 | 602.9366 | 658.9331   | 653.0027                       | 623.9456                          | 575.6632                           | 511.1491 | 430.8291 | 376.4857                     | 361.0338 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 57.4863 | 57.6065 | 57.7271 | 58.3379 | 58.4616 | 59.0881 | 59.0881 | 59.2150 | 58.8359 | 58.4616 | 58.2147 | 57.9699      |
| alpha                                                                       | 4.8324  | 4.8404  | 4.8485  | 4.8892  | 4.8974  | 4.9392  | 4.9392  | 4.9477  | 4.9224  | 4.8974  | 4.8810  | 4.8647       |
| util living area                                                            | 0.9969  | 0.9930  | 0.9796  | 0.9313  | 0.8138  | 0.6291  | 0.4690  | 0.5257  | 0.7917  | 0.9638  | 0.9934  | 0.9976 (86)  |
| MIT                                                                         | 19.7403 | 19.9093 | 20.2019 | 20.5698 | 20.8416 | 20.9663 | 20.9935 | 20.9889 | 20.8983 | 20.5229 | 20.0624 | 19.7109 (87) |
| Th 2                                                                        | 19.7635 | 19.7657 | 19.7679 | 19.7792 | 19.7814 | 19.7927 | 19.7927 | 19.7949 | 19.7882 | 19.7814 | 19.7769 | 19.7724 (88) |
| util rest of house                                                          | 0.9956  | 0.9902  | 0.9713  | 0.9040  | 0.7484  | 0.5243  | 0.3438  | 0.3942  | 0.6967  | 0.9436  | 0.9903  | 0.9966 (89)  |
| MIT 2                                                                       | 18.1207 | 18.3679 | 18.7908 | 19.3084 | 19.6445 | 19.7744 | 19.7909 | 19.7915 | 19.7191 | 19.2598 | 18.6001 | 18.0840 (90) |
| Living area fraction                                                        | 18.8896 | 19.0997 | 19.4607 | 19.9073 | 20.2128 | 20.3403 | 20.3618 | 20.3600 | 20.2789 | 19.8595 | 19.2943 | 18.8564 (91) |
| MIT                                                                         | 18.8896 | 19.0997 | 19.4607 | 19.9073 | 20.2128 | 20.3403 | 20.3618 | 20.3600 | 20.2789 | 19.8595 | 19.2943 | 18.8564 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 18.8896 | 19.0997 | 19.4607 | 19.9073 | 20.2128 | 20.3403 | 20.3618 | 20.3600 | 20.2789 | 19.8595 | 19.2943 | 18.8564 (93) |

#### 8. Space heating requirement

|                      |           |          |          |          |          |          |          |          |          |          |          |                |
|----------------------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation          | Jan       | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Useful gains         | 0.9944    | 0.9882   | 0.9687   | 0.9074   | 0.7735   | 0.5735   | 0.4036   | 0.4572   | 0.7386   | 0.9453   | 0.9886   | 0.9956 (94)    |
| Ext temp.            | 378.7343  | 438.2615 | 502.7463 | 547.0783 | 509.6774 | 374.5182 | 251.8246 | 263.1880 | 377.5536 | 407.2436 | 372.1979 | 359.4543 (95)  |
| Heat loss rate W     | 4.3000    | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Month fracti         | 1010.9322 | 981.8646 | 894.3196 | 751.5743 | 580.0223 | 386.9684 | 253.5965 | 266.3821 | 418.3223 | 630.8968 | 834.3898 | 1007.0878 (97) |
| Space heating kWh    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating per m2 | 470.3552  | 365.3013 | 291.3306 | 147.2371 | 52.3366  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 166.3979 | 332.7782 | 481.8393 (98)  |
|                      |           |          |          |          |          |          |          |          |          |          |          | 2307.5762 (98) |
|                      |           |          |          |          |          |          |          |          |          |          |          | 46.6177 (99)   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

-----  
8c. Space cooling requirement  
-----

Not applicable

-----  
9b. Energy requirements  
-----

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Boilers                                                 | 1.0000 (303a)    |
| Fraction of total space heat from community Boilers                                     | 1.0000 (304a)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 2307.5762 (98)   |
| Space heat from Boilers = (98) x 1.00 x 1.00 x 1.10                                     | 2538.3338 (307a) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1769.4263 (64)   |
| Water heat from Boilers = (64) x 1.00 x 1.00 x 1.10                                     | 1946.3689 (310a) |
| Electricity used for heat distribution                                                  | 44.8470 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 102.0214 (330a)  |
| Total electricity for the above, kWh/year                                               | 102.0214 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 229.7650 (332)   |
| Total delivered energy for all uses                                                     | 4816.4891 (338)  |

-----  
12b. Carbon dioxide emissions - Community heating scheme  
-----

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367a)           |
| Space heating from Boilers                                                                 | 4776.0412          | 0.2160                        | 1031.6249 (367)          |
| Electrical energy for heat distribution                                                    | 44.8470            | 0.5190                        | 23.2756 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 1054.9005 (373)          |
| Space and water heating                                                                    |                    |                               | 1054.9005 (376)          |
| Pumps and fans                                                                             | 102.0214           | 0.5190                        | 52.9491 (378)            |
| Energy for lighting                                                                        | 229.7650           | 0.5190                        | 119.2480 (379)           |
| Total CO2, kg/year                                                                         |                    |                               | 1227.0976 (383)          |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 24.7900 (384)            |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 24.7900 ZC1 |
| Total Floor Area                                                                | TFA | 49.5000     |
| Assumed number of occupants                                                     | N   | 1.6754      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.4704 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 3.2164 ZC3  |
| Total CO2 emissions                                                             |     | 45.4767 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 45.4767 ZC8 |

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 49.5000 (1b)              | x 2.5500 (2b)                   | = 126.2250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 49.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 126.2250 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1584 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.4084 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 1 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3778 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4817 | 0.4723 | 0.4628 | 0.4156 | 0.4061 | 0.3589 | 0.3589 | 0.3495 | 0.3778 | 0.4061 | 0.4250 | 0.4439 (22b) |
| Effective ac    | 0.6160 | 0.6115 | 0.6071 | 0.5864 | 0.5825 | 0.5644 | 0.5644 | 0.5611 | 0.5714 | 0.5825 | 0.5903 | 0.5985 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K                 | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K              |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|------------------------------|--------------------------------|----------------------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200                       |                                | (26a)                      |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 10.2700                   | 1.3258                        | 13.6155                      |                                | (27)                       |
| External Wall 1                                                | 55.6000                 | 10.2700                    | 45.3300                   | 0.1800                        | 8.1594                       |                                | (29a)                      |
| stair wall                                                     | 22.2000                 | 2.1000                     | 20.1000                   | 0.1800                        | 3.6180                       |                                | (29a)                      |
| External Roof 1                                                | 49.5000                 |                            | 49.5000                   | 0.1300                        | 6.4350                       |                                | (30)                       |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 127.3000                  |                               |                              |                                | (31)                       |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           |                               | (26)...(30) + (32) = 34.3479 |                                | (33)                       |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |                              |                                | 250.0000 (35)              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |                              |                                | 15.4685 (36)               |
| Total fabric heat loss                                         |                         |                            |                           |                               |                              |                                | (33) + (36) = 49.8164 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 25.6600 | 25.4723 | 25.2884 | 24.4244 | 24.2627 | 23.5102 | 23.5102 | 23.3708 | 23.8001 | 24.2627 | 24.5897 | 24.9316 (38) |
| Heat transfer coeff       | 75.4764 | 75.2888 | 75.1048 | 74.2408 | 74.0791 | 73.3266 | 73.3266 | 73.1873 | 73.6165 | 74.0791 | 74.4062 | 74.7481 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 74.2400 (39) |
| HLP                       | 1.5248  | 1.5210  | 1.5173  | 1.4998  | 1.4965  | 1.4813  | 1.4813  | 1.4785  | 1.4872  | 1.4965  | 1.5032  | 1.5101 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.4998 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |         |          | 1.6754 (42)                       |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|---------|----------|-----------------------------------|
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |         |          | 73.9905 (43)                      |
|                                                             | Jan      | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov      | Dec                               |
| Daily hot water use                                         | 81.3896  | 78.4299  | 75.4703  | 72.5107 | 69.5511 | 66.5915 | 66.5915 | 69.5511 | 72.5107 | 75.4703 | 78.4299  | 81.3896 (44)                      |
| Energy conte                                                | 120.6984 | 105.5636 | 108.9321 | 94.9697 | 91.1257 | 78.6345 | 72.8664 | 83.6153 | 84.6139 | 98.6094 | 107.6399 | 116.8899 (45)                     |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         |         |          | Total = Sum(45)m = 1164.1588 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 18.1048  | 15.8345  | 16.3398  | 14.2455 | 13.6688 | 11.7952 | 10.9300 | 12.5423 | 12.6921 | 14.7914 | 16.1460  | 17.5335 (46)                      |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |         |          | 2.0000 (47)                       |
| Store volume                                                |          |          |          |         |         |         |         |         |         |         |          | 0.2388 (48)                       |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |         |          | 0.5400 (49)                       |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |         |          | 0.1290 (55)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |         |          |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501 (64) |
| Heat gains from water heating, kWh/month                        | 61.9403  | 54.7975  | 58.0280  | 52.6820  | 52.1074  | 47.2506  | 46.0362  | 49.6102  | 49.2388  | 54.5957  | 56.8949  | 60.6740 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.0577  | 11.5978  | 9.4319   | 7.1406   | 5.3377   | 4.5063   | 4.8692   | 6.3292   | 8.4950   | 10.7863  | 12.5893  | 13.4206 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 145.9354 | 147.4497 | 143.6336 | 135.5095 | 125.2544 | 115.6159 | 109.1769 | 107.6625 | 111.4787 | 119.6027 | 129.8579 | 139.4963 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 (71) |
| Water heating gains (Table 5)                                                       | 83.2531  | 81.5440  | 77.9947  | 73.1695  | 70.0368  | 65.6258  | 61.8766  | 66.6804  | 68.3872  | 73.3814  | 79.0207  | 81.5511 (72)  |
| Total internal gains                                                                | 293.3771 | 291.7223 | 282.1911 | 266.9505 | 251.7597 | 236.8789 | 227.0536 | 231.8029 | 239.4917 | 254.9013 | 272.5987 | 285.5989 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W    |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|---------------|
| East        |          |          |          | 5.3800     | 19.6403                        | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 32.2925 (76)  |
| West        |          |          |          | 4.8900     | 19.6403                        | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 29.3513 (80)  |
| -----       |          |          |          |            |                                |                                   |          |                                    |          |                              |          |               |
| Solar gains | 61.6438  | 120.5884 | 198.5919 | 289.6345   | 354.9579                       | 363.3626                          | 345.9360 | 297.1539                           | 230.9706 | 143.0883                     | 76.8626  | 50.6929 (83)  |
| Total gains | 355.0209 | 412.3107 | 480.7830 | 556.5849   | 606.7176                       | 600.2415                          | 572.9896 | 528.9568                           | 470.4623 | 397.9896                     | 349.4613 | 336.2918 (84) |
| -----       |          |          |          |            |                                |                                   |          |                                    |          |                              |          |               |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 45.5440 | 45.6575 | 45.7694 | 46.3020 | 46.4031 | 46.8793 | 46.8793 | 46.9686 | 46.6947                   | 46.4031 | 46.1991 | 45.9878      |
| alpha                                                                       | 4.0363  | 4.0438  | 4.0513  | 4.0868  | 4.0935  | 4.1253  | 4.1253  | 4.1312  | 4.1130                    | 4.0935  | 4.0799  | 4.0659       |
| util living area                                                            | 0.9957  | 0.9915  | 0.9793  | 0.9411  | 0.8511  | 0.6956  | 0.5388  | 0.5968  | 0.8340                    | 0.9665  | 0.9921  | 0.9965 (86)  |
| MIT                                                                         | 19.3892 | 19.5723 | 19.9007 | 20.3320 | 20.6921 | 20.9074 | 20.9751 | 20.9624 | 20.7934                   | 20.3115 | 19.7743 | 19.3608 (87) |
| Th 2                                                                        | 19.6690 | 19.6718 | 19.6746 | 19.6876 | 19.6901 | 19.7015 | 19.7015 | 19.7036 | 19.6971                   | 19.6901 | 19.6851 | 19.6800 (88) |
| util rest of house                                                          | 0.9942  | 0.9885  | 0.9716  | 0.9182  | 0.7936  | 0.5866  | 0.3916  | 0.4471  | 0.7478                    | 0.9490  | 0.9887  | 0.9953 (89)  |
| MIT 2                                                                       | 17.5696 | 17.8378 | 18.3141 | 18.9305 | 19.4015 | 19.6439 | 19.6935 | 19.6898 | 19.5394                   | 18.9172 | 18.1423 | 17.5353 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4747 (91)  |
| MIT                                                                         | 18.4334 | 18.6613 | 19.0673 | 19.5958 | 20.0142 | 20.2437 | 20.3019 | 20.2940 | 20.1347                   | 19.5791 | 18.9171 | 18.4020 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.4334 | 18.6613 | 19.0673 | 19.5958 | 20.0142 | 20.2437 | 20.3019 | 20.2940 | 20.1347                   | 19.5791 | 18.9171 | 18.4020 (93) |

#### 8. Space heating requirement

|                      |           |           |          |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|                      | 0.9921    | 0.9854    | 0.9670   | 0.9163   | 0.8097   | 0.6352   | 0.4621   | 0.5186   | 0.7807   | 0.9471       | 0.9859   | 0.9936 (94)    |
| Useful gains         | 352.2176  | 406.2735  | 464.9174 | 509.9808 | 491.2399 | 381.2791 | 264.7523 | 274.3318 | 367.2934 | 376.9226     | 344.5353 | 334.1402 (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 1066.7409 | 1036.0695 | 943.8668 | 794.0681 | 615.9100 | 413.8365 | 271.4504 | 284.9905 | 444.2548 | 665.1670     | 879.2667 | 1061.5690 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 531.6053  | 423.2230  | 356.3383 | 204.5428 | 92.7546  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 214.4538     | 385.0066 | 541.2070 (98)  |
| Space heating        |           |           |          |          |          |          |          |          |          |              |          | 2749.1315 (98) |
| Space heating per m2 |           |           |          |          |          |          |          |          |          | (98) / (4) = |          | 55.5380 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2940.2476 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 531.6053 | 423.2230 | 356.3383 | 204.5428 | 92.7546  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 214.4538 | 385.0066 | 541.2070  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 568.5619 | 452.6449 | 381.1105 | 218.7624 | 99.2028  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 229.3623 | 411.7718 | 578.8311  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501  | (64)            |
| Efficiency of water heater (217)m                                     | 87.9329  | 87.7327  | 87.2645  | 86.1964  | 84.1719  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 86.2240  | 87.4715  | 88.0177   | (217)           |
| Fuel for water heating, kWh/month                                     | 168.2630 | 148.3890 | 156.0683 | 140.7837 | 140.6477 | 131.5981 | 125.4719 | 138.9417 | 139.0911 | 145.9797 | 153.2164 | 163.7739  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1752.2245 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2940.2476 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 230.6035  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4998.0756 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2940.2476          | 0.2160                        | 635.0935 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1752.2245          | 0.2160                        | 378.4805 (264)           |
| Space and water heating                                                                           |                    |                               | 1013.5740 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 230.6035           | 0.5190                        | 119.6832 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1172.1822 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 20.4762 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.4178 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7864 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (20.4762 * 1.00) + 2.4178 + 0.7864, rounded to 2 d.p. |                    |                               | 23.6800 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | D-3-01                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP 46%                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 83 B                                                                    | DER           | 16.26   | TER            | 23.68      |
| Environmental                      | 90 B                                                                    | % DER<TER     | 31.34   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.63                                                                    | DFEE          | 69.97   | TFEE           | 73.17      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 4.38    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 50 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 23.68 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 16.26 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 73.2 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 70.0 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.18 (max. 0.30) | 0.18 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.13 (max. 0.20) | 0.13 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK  
Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing East: 7.32 m<sup>2</sup>, Overhang width less than twice window, ratio 1.00  
Windows facing West: 6.66 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.50 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 49.5000 (1b)              | x 2.5500 (2b)                   | = 126.2250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 49.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 126.2250 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       |        | m3 per hour |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|--------|-------------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |        |             |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 | (6a)        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 | (6b)        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7a)        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 | (7b)        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 | (7c)        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |        |             |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 | (8)         |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes    |             |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000 |             |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500 | (18)        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 1      | (19)        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.9250 | (20)        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1388 | (21)        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug    | Sep         | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000 | 4.0000      | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250 | 1.0000      | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1769                       | 0.1734 | 0.1700    | 0.1526 | 0.1492 | 0.1318 | 0.1318                      | 0.1283 | 0.1388      | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |        |             |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |        |             |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |        |             |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2774                       | 0.2739 | 0.2705    | 0.2531 | 0.2497 | 0.2323 | 0.2323                      | 0.2288 | 0.2393      | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                    | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K     | A x U<br>W/K | K-value<br>kJ/m2K                    | A x K<br>kJ/K   |
|------------------------------------------------------------|-------------|----------------|---------------|----------------------|--------------|--------------------------------------|-----------------|
| W29 (Uw = 1.40)                                            |             |                | 7.3200        | 1.3258               | 9.7045       |                                      | (27)            |
| W02 (Uw = 1.40)                                            |             |                | 6.6600        | 1.3258               | 8.8295       |                                      | (27)            |
| door                                                       |             |                | 2.1000        | 1.4000               | 2.9400       |                                      | (26a)           |
| External Wall 1                                            | 55.6000     | 13.9800        | 41.6200       | 0.1800               | 7.4916       | 140.0000                             | 5826.8000 (29a) |
| stair wall                                                 | 22.2000     | 2.1000         | 20.1000       | 0.1800               | 3.6180       | 140.0000                             | 2814.0000 (29a) |
| External Roof 1                                            | 49.5000     |                | 49.5000       | 0.1300               | 6.4350       | 9.0000                               | 445.5000 (30)   |
| Total net area of external elements Aum(A, m2)             |             |                | 127.3000      |                      |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                        |             |                |               | (26)...(30) + (32) = | 39.0187      |                                      | (33)            |
| Party Wall 1                                               |             |                | 5.1000        | 0.0000               | 0.0000       | 140.0000                             | 714.0000 (32)   |
| Party Floor 1                                              |             |                | 49.5000       |                      |              | 80.0000                              | 3960.0000 (32d) |
| Internal Wall                                              |             |                | 64.4000       |                      |              | 9.0000                               | 579.6000 (32c)  |
| Heat capacity Cm = Sum(A x k)                              |             |                |               |                      |              | (28)...(30) + (32) + (32a)...(32e) = | 14339.9000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K          |             |                |               |                      |              |                                      | 289.6949 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) |             |                |               |                      |              |                                      | 18.7175 (36)    |
| Total fabric heat loss                                     |             |                |               |                      |              | (33) + (36) =                        | 57.7362 (37)    |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                  |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.6754 (42)      |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 77.8847 (43)     |
| Daily hot water use                      | Jan 85.6732 | Feb 82.5578 | Mar 79.4424 | Apr 76.3270 | May 73.2117 | Jun 70.0963 | Jul 70.0963 | Aug 73.2117 | Sep 76.3270 | Oct 79.4424 | Nov 82.5578 | Dec 85.6732 (44) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy content (annual)                                         | 127.0509 | 111.1195 | 114.6654 | 99.9681  | 95.9218  | 82.7732  | 76.7015  | 88.0161  | 89.0673  | 103.7994            | 113.3051 | 123.0420 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1225.4303 (45) |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
| If cylinder contains dedicated solar storage                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| Primary loss                                                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 173.2533 | 152.8507 | 160.8678 | 144.6801 | 142.1242 | 127.4852 | 122.9039 | 134.2185 | 133.7793 | 150.0018            | 158.0171 | 169.2444 (62)  |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 79.2063  | 70.3322  | 75.0882  | 69.0090  | 68.8559  | 63.2917  | 62.4652  | 66.2273  | 65.3845  | 71.4752             | 73.4436  | 77.8734 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.0102  | 11.5556  | 9.3976   | 7.1146   | 5.3183   | 4.4899   | 4.8515   | 6.3062   | 8.4641   | 10.7471  | 12.5435  | 13.3718 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 145.9354 | 147.4497 | 143.6336 | 135.5095 | 125.2544 | 115.6159 | 109.1769 | 107.6625 | 111.4787 | 119.6027 | 129.8579 | 139.4963 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 (71) |
| Water heating gains (Table 5)                                                       | 106.4601 | 104.6610 | 100.9250 | 95.8458  | 92.5483  | 87.9051  | 83.9586  | 89.0152  | 90.8118  | 96.0688  | 102.0049 | 104.6685 (72) |
| Total internal gains                                                                | 313.5366 | 311.7972 | 302.0870 | 286.6008 | 271.2517 | 256.1418 | 246.1178 | 251.1147 | 258.8854 | 274.5495 | 292.5372 | 305.6675 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g        | Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d | Gains<br>W   |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|----------|------------------------------|------------------------------------|------------------------------|--------------|----------|---------------|
| East        |          |          |          | 7.3200     | 19.6403                        |          | 0.3700                       | 0.8900                             | 0.7700                       | 32.8083 (76) |          |               |
| West        |          |          |          | 6.6600     | 19.6403                        |          | 0.5600                       | 0.6800                             | 0.7700                       | 34.5185 (80) |          |               |
| -----       |          |          |          |            |                                |          |                              |                                    |                              |              |          |               |
| Solar gains | 67.3268  | 131.7054 | 216.9001 | 316.3358   | 387.6814                       | 396.8609 | 377.8278                     | 324.5485                           | 252.2638                     | 156.2796     | 83.9486  | 55.3662 (83)  |
| Total gains | 380.8634 | 443.5026 | 518.9871 | 602.9366   | 658.9331                       | 653.0027 | 623.9456                     | 575.6632                           | 511.1491                     | 430.8291     | 376.4857 | 361.0338 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 57.4863 | 57.6065 | 57.7271 | 58.3379 | 58.4616 | 59.0881 | 59.0881 | 59.2150 | 58.8359 | 58.4616 | 58.2147 | 57.9699      |
| alpha                                                                       | 4.8324  | 4.8404  | 4.8485  | 4.8892  | 4.8974  | 4.9392  | 4.9392  | 4.9477  | 4.9224  | 4.8974  | 4.8810  | 4.8647       |
| util living area                                                            | 0.9969  | 0.9930  | 0.9796  | 0.9313  | 0.8138  | 0.6291  | 0.4690  | 0.5257  | 0.7917  | 0.9638  | 0.9934  | 0.9976 (86)  |
| MIT                                                                         | 19.7403 | 19.9093 | 20.2019 | 20.5698 | 20.8416 | 20.9663 | 20.9935 | 20.9889 | 20.8983 | 20.5229 | 20.0624 | 19.7109 (87) |
| Th 2                                                                        | 19.7635 | 19.7657 | 19.7679 | 19.7792 | 19.7814 | 19.7927 | 19.7927 | 19.7949 | 19.7882 | 19.7814 | 19.7769 | 19.7724 (88) |
| util rest of house                                                          | 0.9956  | 0.9902  | 0.9713  | 0.9040  | 0.7484  | 0.5243  | 0.3438  | 0.3942  | 0.6967  | 0.9436  | 0.9903  | 0.9966 (89)  |
| MIT 2                                                                       | 18.1207 | 18.3679 | 18.7908 | 19.3084 | 19.6445 | 19.7744 | 19.7909 | 19.7915 | 19.7191 | 19.2598 | 18.6001 | 18.0840 (90) |
| Living area fraction                                                        | 18.8896 | 19.0997 | 19.4607 | 19.9073 | 20.2128 | 20.3403 | 20.3618 | 20.3600 | 20.2789 | 19.8595 | 19.2943 | 18.8564 (91) |
| MIT                                                                         | 18.8896 | 19.0997 | 19.4607 | 19.9073 | 20.2128 | 20.3403 | 20.3618 | 20.3600 | 20.2789 | 19.8595 | 19.2943 | 18.8564 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 18.8896 | 19.0997 | 19.4607 | 19.9073 | 20.2128 | 20.3403 | 20.3618 | 20.3600 | 20.2789 | 19.8595 | 19.2943 | 18.8564 (93) |

#### 8. Space heating requirement

|                      |           |          |          |          |          |          |          |          |          |          |          |                           |
|----------------------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|
| Utilisation          | Jan       | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec                       |
| Useful gains         | 0.9944    | 0.9882   | 0.9687   | 0.9074   | 0.7735   | 0.5735   | 0.4036   | 0.4572   | 0.7386   | 0.9453   | 0.9886   | 0.9956 (94)               |
| Ext temp.            | 378.7343  | 438.2615 | 502.7463 | 547.0783 | 509.6774 | 374.5182 | 251.8246 | 263.1880 | 377.5536 | 407.2436 | 372.1979 | 359.4543 (95)             |
| Heat loss rate W     | 4.3000    | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)               |
| Month fracti         | 1010.9322 | 981.8646 | 894.3196 | 751.5743 | 580.0223 | 386.9684 | 253.5965 | 266.3821 | 418.3223 | 630.8968 | 834.3898 | 1007.0878 (97)            |
| Space heating kWh    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)              |
| Space heating        | 470.3552  | 365.3013 | 291.3306 | 147.2371 | 52.3366  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 166.3979 | 332.7782 | 481.8393 (98)             |
| Space heating per m2 |           |          |          |          |          |          |          |          |          |          |          | 2307.5762 (98)            |
|                      |           |          |          |          |          |          |          |          |          |          |          | (98) / (4) = 46.6177 (99) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 2307.5762 (98)   |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 1114.5593 (307a) |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 1308.3957 (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1769.4263 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 854.6329 (310a)  |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1003.2647 (310b) |
| Electricity used for heat distribution                                                  | 42.8085 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 102.0214 (330a)  |
| Total electricity for the above, kWh/year                                               | 102.0214 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 229.7650 (332)   |
| Energy saving/generation technologies (Appendices M, N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.50 * 951 * 1.00) =                                                  | -380.2464        |
| Total delivered energy for all uses                                                     | 4232.3925 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |
| Space heating from Heat pump                                                               | 532.2141           | 0.5190                        | 276.2191 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 2461.8322          | 0.2160                        | 531.7557 (368)           |
| Electrical energy for heat distribution                                                    | 42.8085            | 0.5190                        | 22.2176 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 830.1925 (373)           |
| Space and water heating                                                                    |                    |                               | 830.1925 (376)           |
| Pumps and fans                                                                             | 102.0214           | 0.5190                        | 52.9491 (378)            |
| Energy for lighting                                                                        | 229.7650           | 0.5190                        | 119.2480 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -380.2464          | 0.5190                        | -197.3479 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 805.0417 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 16.2600 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |     |             |
|---------------------------------------------------------------------------------|-----|-------------|
| DER                                                                             |     | 16.2600 ZC1 |
| Total Floor Area                                                                | TFA | 49.5000     |
| Assumed number of occupants                                                     | N   | 1.6754      |
| CO2 emission factor in Table 12 for electricity displaced from grid             | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |     | 17.4704 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |     | 3.2164 ZC3  |
| Total CO2 emissions                                                             |     | 36.9467 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |     | 36.9467 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 49.5000 (1b)              | x 2.5500 (2b)                   | = 126.2250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 49.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 126.2250 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total                       | m <sup>3</sup> per hour    |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-----------------------------|----------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =                           | 0 * 40 = 0.0000 (6a)       |
| Number of open flues                                                      | 0               | +                    | 0     | =                           | 0 * 20 = 0.0000 (6b)       |
| Number of intermittent fans                                               |                 |                      |       |                             | 2 * 10 = 20.0000 (7a)      |
| Number of passive vents                                                   |                 |                      |       |                             | 0 * 10 = 0.0000 (7b)       |
| Number of flueless gas fires                                              |                 |                      |       |                             | 0 * 40 = 0.0000 (7c)       |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |                             | Air changes per hour       |
| Pressure test                                                             |                 |                      |       |                             | 20.0000 / (5) = 0.1584 (8) |
| Measured/design AP50                                                      |                 |                      |       |                             | Yes                        |
| Infiltration rate                                                         |                 |                      |       |                             | 5.0000                     |
| Number of sides sheltered                                                 |                 |                      |       |                             | 0.4084 (18)                |
|                                                                           |                 |                      |       |                             | 1 (19)                     |
| Shelter factor                                                            |                 |                      |       | (20) = 1 - [0.075 x (19)] = | 0.9250 (20)                |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       | (21) = (18) x (20) =        | 0.3778 (21)                |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4817 | 0.4723 | 0.4628 | 0.4156 | 0.4061 | 0.3589 | 0.3589 | 0.3495 | 0.3778 | 0.4061 | 0.4250 | 0.4439 (22b) |
|                 | 0.6160 | 0.6115 | 0.6071 | 0.5864 | 0.5825 | 0.5644 | 0.5644 | 0.5611 | 0.5714 | 0.5825 | 0.5903 | 0.5985 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|---------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200       |                                | (26a)         |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 10.2700                   | 1.3258                        | 13.6155      |                                | (27)          |
| External Wall 1                                                | 55.6000                 | 10.2700                    | 45.3300                   | 0.1800                        | 8.1594       |                                | (29a)         |
| stair wall                                                     | 22.2000                 | 2.1000                     | 20.1000                   | 0.1800                        | 3.6180       |                                | (29a)         |
| External Roof 1                                                | 49.5000                 |                            | 49.5000                   | 0.1300                        | 6.4350       |                                | (30)          |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 127.3000                  |                               |              |                                | (31)          |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 34.3479      |                                | (33)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 250.0000 (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                | 15.4685 (36)  |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                  | 49.8164 (37)  |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 25.6600 | 25.4723 | 25.2884 | 24.4244 | 24.2627 | 23.5102 | 23.5102 | 23.3708 | 23.8001 | 24.2627 | 24.5897 | 24.9316 (38) |
| Heat transfer coeff       | 75.4764 | 75.2888 | 75.1048 | 74.2408 | 74.0791 | 73.3266 | 73.3266 | 73.1873 | 73.6165 | 74.0791 | 74.4062 | 74.7481 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 74.2400 (39) |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec         |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|
| HLP           | 1.5248 | 1.5210 | 1.5173 | 1.4998 | 1.4965 | 1.4813 | 1.4813 | 1.4785 | 1.4872 | 1.4965 | 1.5032 | 1.5101 (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.4998 (40) |
| Days in month | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31 (41)     |

#### 4. Water heating energy requirements (kWh/year)

| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |                    |          | 1.6754 (42)    |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |                    |          | 73.9905 (43)   |
|                                                             | Jan      | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct                | Nov      | Dec            |
| Daily hot water use                                         | 81.3896  | 78.4299  | 75.4703  | 72.5107 | 69.5511 | 66.5915 | 66.5915 | 69.5511 | 72.5107 | 75.4703            | 78.4299  | 81.3896 (44)   |
| Energy conte                                                | 120.6984 | 105.5636 | 108.9321 | 94.9697 | 91.1257 | 78.6345 | 72.8664 | 83.6153 | 84.6139 | 98.6094            | 107.6399 | 116.8899 (45)  |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1164.1588 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 18.1048  | 15.8345  | 16.3398  | 14.2455 | 13.6688 | 11.7952 | 10.9300 | 12.5423 | 12.6921 | 14.7914            | 16.1460  | 17.5335 (46)   |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |                    |          |                |
| Store volume                                                |          |          |          |         |         |         |         |         |         |                    |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |                    |          | 0.2388 (48)    |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |                    |          | 0.1290 (55)    |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501 (64) |
| Heat gains from water heating, kWh/month                        | 61.9403  | 54.7975  | 58.0280  | 52.6820  | 52.1074  | 47.2506  | 46.0362  | 49.6102  | 49.2388  | 54.5957  | 56.8949  | 60.6740 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.0577  | 11.5978  | 9.4319   | 7.1406   | 5.3377   | 4.5063   | 4.8692   | 6.3292   | 8.4950   | 10.7863  | 12.5893  | 13.4206 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 145.9354 | 147.4497 | 143.6336 | 135.5095 | 125.2544 | 115.6159 | 109.1769 | 107.6625 | 111.4787 | 119.6027 | 129.8579 | 139.4963 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 (71) |
| Water heating gains (Table 5)                                                       | 83.2531  | 81.5440  | 77.9947  | 73.1695  | 70.0368  | 65.6258  | 61.8766  | 66.6804  | 68.3872  | 73.3814  | 79.0207  | 81.5511 (72)  |
| Total internal gains                                                                | 293.3771 | 291.7223 | 282.1911 | 266.9505 | 251.7597 | 236.8789 | 227.0536 | 231.8029 | 239.4917 | 254.9013 | 272.5987 | 285.5989 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W    |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|---------------|
| East        |          |          |          | 5.3800     | 19.6403                        | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 32.2925 (76)  |
| West        |          |          |          | 4.8900     | 19.6403                        | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 29.3513 (80)  |
| -----       |          |          |          |            |                                |                                   |          |                                    |          |                              |          |               |
| Solar gains | 61.6438  | 120.5884 | 198.5919 | 289.6345   | 354.9579                       | 363.3626                          | 345.9360 | 297.1539                           | 230.9706 | 143.0883                     | 76.8626  | 50.6929 (83)  |
| Total gains | 355.0209 | 412.3107 | 480.7830 | 556.5849   | 606.7176                       | 600.2415                          | 572.9896 | 528.9568                           | 470.4623 | 397.9896                     | 349.4613 | 336.2918 (84) |
| -----       |          |          |          |            |                                |                                   |          |                                    |          |                              |          |               |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 45.5440 | 45.6575 | 45.7694 | 46.3020 | 46.4031 | 46.8793 | 46.8793 | 46.9686 | 46.6947                   | 46.4031 | 46.1991 | 45.9878      |
| alpha                                                                       | 4.0363  | 4.0438  | 4.0513  | 4.0868  | 4.0935  | 4.1253  | 4.1253  | 4.1312  | 4.1130                    | 4.0935  | 4.0799  | 4.0659       |
| util living area                                                            | 0.9957  | 0.9915  | 0.9793  | 0.9411  | 0.8511  | 0.6956  | 0.5388  | 0.5968  | 0.8340                    | 0.9665  | 0.9921  | 0.9965 (86)  |
| MIT                                                                         | 19.3892 | 19.5723 | 19.9007 | 20.3320 | 20.6921 | 20.9074 | 20.9751 | 20.9624 | 20.7934                   | 20.3115 | 19.7743 | 19.3608 (87) |
| Th 2                                                                        | 19.6690 | 19.6718 | 19.6746 | 19.6876 | 19.6901 | 19.7015 | 19.7015 | 19.7036 | 19.6971                   | 19.6901 | 19.6851 | 19.6800 (88) |
| util rest of house                                                          | 0.9942  | 0.9885  | 0.9716  | 0.9182  | 0.7936  | 0.5866  | 0.3916  | 0.4471  | 0.7478                    | 0.9490  | 0.9887  | 0.9953 (89)  |
| MIT 2                                                                       | 17.5696 | 17.8378 | 18.3141 | 18.9305 | 19.4015 | 19.6439 | 19.6935 | 19.6898 | 19.5394                   | 18.9172 | 18.1423 | 17.5353 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4747 (91)  |
| MIT                                                                         | 18.4334 | 18.6613 | 19.0673 | 19.5958 | 20.0142 | 20.2437 | 20.3019 | 20.2940 | 20.1347                   | 19.5791 | 18.9171 | 18.4020 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.4334 | 18.6613 | 19.0673 | 19.5958 | 20.0142 | 20.2437 | 20.3019 | 20.2940 | 20.1347                   | 19.5791 | 18.9171 | 18.4020 (93) |

#### 8. Space heating requirement

|                      |           |           |          |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|                      | 0.9921    | 0.9854    | 0.9670   | 0.9163   | 0.8097   | 0.6352   | 0.4621   | 0.5186   | 0.7807   | 0.9471       | 0.9859   | 0.9936 (94)    |
| Useful gains         | 352.2176  | 406.2735  | 464.9174 | 509.9808 | 491.2399 | 381.2791 | 264.7523 | 274.3318 | 367.2934 | 376.9226     | 344.5353 | 334.1402 (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 1066.7409 | 1036.0695 | 943.8668 | 794.0681 | 615.9100 | 413.8365 | 271.4504 | 284.9905 | 444.2548 | 665.1670     | 879.2667 | 1061.5690 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 531.6053  | 423.2230  | 356.3383 | 204.5428 | 92.7546  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 214.4538     | 385.0066 | 541.2070 (98)  |
| Space heating        |           |           |          |          |          |          |          |          |          |              |          | 2749.1315 (98) |
| Space heating per m2 |           |           |          |          |          |          |          |          |          | (98) / (4) = |          | 55.5380 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2940.2476 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 531.6053 | 423.2230 | 356.3383 | 204.5428 | 92.7546  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 214.4538 | 385.0066 | 541.2070  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 568.5619 | 452.6449 | 381.1105 | 218.7624 | 99.2028  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 229.3623 | 411.7718 | 578.8311  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501  | (64)            |
| Efficiency of water heater (217)m                                     | 87.9329  | 87.7327  | 87.2645  | 86.1964  | 84.1719  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 86.2240  | 87.4715  | 88.0177   | (217)           |
| Fuel for water heating, kWh/month                                     | 168.2630 | 148.3890 | 156.0683 | 140.7837 | 140.6477 | 131.5981 | 125.4719 | 138.9417 | 139.0911 | 145.9797 | 153.2164 | 163.7739  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1752.2245 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2940.2476 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 230.6035  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4998.0756 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2940.2476          | 0.2160                        | 635.0935 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1752.2245          | 0.2160                        | 378.4805 (264)           |
| Space and water heating                                                                           |                    |                               | 1013.5740 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 230.6035           | 0.5190                        | 119.6832 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1172.1822 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 20.4762 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.4178 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7864 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (20.4762 * 1.00) + 2.4178 + 0.7864, rounded to 2 d.p. |                    |                               | 23.6800 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | D-3-01                                                                  |               |         | Issued on Date | 14/01/2020 |
| Assessment Reference               | ASHP 50%                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 82 B                                                                    | DER           | 17.26   | TER            | 23.68      |
| Environmental                      | 89 B                                                                    | % DER<TER     | 27.11   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.67                                                                    | DFEE          | 69.97   | TFEE           | 73.17      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 4.38    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Mid-floor flat, total floor area 50 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating: Mains gas (c), Electricity (c)  
Fuel factor: 1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 23.68 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 17.26 kgCO<sub>2</sub>/m<sup>2</sup> OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 73.2 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 70.0 kWh/m<sup>2</sup>/yr OK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.18 (max. 0.30) | 0.18 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.13 (max. 0.20) | 0.13 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -  
Secondary heating system: None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room stats OK  
Hot water controls: No cylinder stat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings: 100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing East: 7.32 m<sup>2</sup>, Overhang width less than twice window, ratio 1.00  
Windows facing West: 6.66 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.50 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 49.5000 (1b)              | x 2.5500 (2b)                   | = 126.2250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 49.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 126.2250 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000      | (6a)   |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000      | (6b)   |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000      | (7a)   |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000      | (7b)   |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000      | (7c)   |        |        |               |
|                                                                                              |                              |        |           |        |        |        | Air changes per hour        |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000      | (8)    |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        |                             | Yes         |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        |                             | 3.0000      |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        |                             | 0.1500      | (18)   |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        |                             | 1           | (19)   |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.9250      | (20)   |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1388      | (21)   |        |        |               |
|                                                                                              |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1769                       | 0.1734 | 0.1700    | 0.1526 | 0.1492 | 0.1318 | 0.1318                      | 0.1283      | 0.1388 | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2774                       | 0.2739 | 0.2705    | 0.2531 | 0.2497 | 0.2323 | 0.2323                      | 0.2288      | 0.2393 | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                    | Gross<br>m2 | Openings<br>m2 | NetArea<br>m2 | U-value<br>W/m2K     | A x U<br>W/K | K-value<br>kJ/m2K                    | A x K<br>kJ/K |       |
|------------------------------------------------------------|-------------|----------------|---------------|----------------------|--------------|--------------------------------------|---------------|-------|
| W29 (Uw = 1.40)                                            |             |                | 7.3200        | 1.3258               | 9.7045       |                                      |               | (27)  |
| W02 (Uw = 1.40)                                            |             |                | 6.6600        | 1.3258               | 8.8295       |                                      |               | (27)  |
| door                                                       |             |                | 2.1000        | 1.4000               | 2.9400       |                                      |               | (26a) |
| External Wall 1                                            | 55.6000     | 13.9800        | 41.6200       | 0.1800               | 7.4916       | 140.0000                             | 5826.8000     | (29a) |
| stair wall                                                 | 22.2000     | 2.1000         | 20.1000       | 0.1800               | 3.6180       | 140.0000                             | 2814.0000     | (29a) |
| External Roof 1                                            | 49.5000     |                | 49.5000       | 0.1300               | 6.4350       | 9.0000                               | 445.5000      | (30)  |
| Total net area of external elements Aum(A, m2)             |             |                | 127.3000      |                      |              |                                      |               | (31)  |
| Fabric heat loss, W/K = Sum (A x U)                        |             |                |               | (26)...(30) + (32) = | 39.0187      |                                      |               | (33)  |
| Party Wall 1                                               |             |                | 5.1000        | 0.0000               | 0.0000       | 140.0000                             | 714.0000      | (32)  |
| Party Floor 1                                              |             |                | 49.5000       |                      |              | 80.0000                              | 3960.0000     | (32d) |
| Internal Wall                                              |             |                | 64.4000       |                      |              | 9.0000                               | 579.6000      | (32c) |
| Heat capacity Cm = Sum(A x k)                              |             |                |               |                      |              | (28)...(30) + (32) + (32a)...(32e) = | 14339.9000    | (34)  |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K          |             |                |               |                      |              |                                      | 289.6949      | (35)  |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) |             |                |               |                      |              |                                      | 18.7175       | (36)  |
| Total fabric heat loss                                     |             |                |               |                      |              | (33) + (36) =                        | 57.7362       | (37)  |

#### 4. Water heating energy requirements (kWh/year)

|                                          |             |             |             |             |             |             |             |             |             |             |             |                  |
|------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Assumed occupancy                        |             |             |             |             |             |             |             |             |             |             |             | 1.6754 (42)      |
| Average daily hot water use (litres/day) |             |             |             |             |             |             |             |             |             |             |             | 77.8847 (43)     |
| Daily hot water use                      | Jan 85.6732 | Feb 82.5578 | Mar 79.4424 | Apr 76.3270 | May 73.2117 | Jun 70.0963 | Jul 70.0963 | Aug 73.2117 | Sep 76.3270 | Oct 79.4424 | Nov 82.5578 | Dec 85.6732 (44) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |                     |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------|----------|----------------|
| Energy content (annual)                                         | 127.0509 | 111.1195 | 114.6654 | 99.9681  | 95.9218  | 82.7732  | 76.7015  | 88.0161  | 89.0673  | 103.7994            | 113.3051 | 123.0420 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          | Total = Sum (45)m = |          | 1225.4303 (45) |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |                     |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |                     |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |                     |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |                     |          | 0.7400 (55)    |
| Total storage loss                                              |          |          |          |          |          |          |          |          |          |                     |          |                |
| If cylinder contains dedicated solar storage                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (56)   |
| Primary loss                                                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400             | 22.2000  | 22.9400 (57)   |
| Total heat required for water heating calculated for each month | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624             | 22.5120  | 23.2624 (59)   |
| Solar input                                                     | 173.2533 | 152.8507 | 160.8678 | 144.6801 | 142.1242 | 127.4852 | 122.9039 | 134.2185 | 133.7793 | 150.0018            | 158.0171 | 169.2444 (62)  |
| Output from w/h                                                 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000              | 0.0000   | 0.0000 (63)    |
| Heat gains from water heating, kWh/month                        |          |          |          |          |          |          |          |          |          |                     |          |                |
|                                                                 | 79.2063  | 70.3322  | 75.0882  | 69.0090  | 68.8559  | 63.2917  | 62.4652  | 66.2273  | 65.3845  | 71.4752             | 73.4436  | 77.8734 (65)   |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.0102  | 11.5556  | 9.3976   | 7.1146   | 5.3183   | 4.4899   | 4.8515   | 6.3062   | 8.4641   | 10.7471  | 12.5435  | 13.3718 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 145.9354 | 147.4497 | 143.6336 | 135.5095 | 125.2544 | 115.6159 | 109.1769 | 107.6625 | 111.4787 | 119.6027 | 129.8579 | 139.4963 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 (71) |
| Water heating gains (Table 5)                                                       | 106.4601 | 104.6610 | 100.9250 | 95.8458  | 92.5483  | 87.9051  | 83.9586  | 89.0152  | 90.8118  | 96.0688  | 102.0049 | 104.6685 (72) |
| Total internal gains                                                                | 313.5366 | 311.7972 | 302.0870 | 286.6008 | 271.2517 | 256.1418 | 246.1178 | 251.1147 | 258.8854 | 274.5495 | 292.5372 | 305.6675 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d | Gains<br>W   |          |               |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|----------|------------------------------|--------------|----------|---------------|
| East        |          |          |          | 7.3200     | 19.6403                        | 0.3700                            | 0.8900                             |          | 0.7700                       | 32.8083 (76) |          |               |
| West        |          |          |          | 6.6600     | 19.6403                        | 0.5600                            | 0.6800                             |          | 0.7700                       | 34.5185 (80) |          |               |
| Solar gains | 67.3268  | 131.7054 | 216.9001 | 316.3358   | 387.6814                       | 396.8609                          | 377.8278                           | 324.5485 | 252.2638                     | 156.2796     | 83.9486  | 55.3662 (83)  |
| Total gains | 380.8634 | 443.5026 | 518.9871 | 602.9366   | 658.9331                       | 653.0027                          | 623.9456                           | 575.6632 | 511.1491                     | 430.8291     | 376.4857 | 361.0338 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 57.4863 | 57.6065 | 57.7271 | 58.3379 | 58.4616 | 59.0881 | 59.0881 | 59.2150 | 58.8359 | 58.4616 | 58.2147 | 57.9699      |
| alpha                                                                       | 4.8324  | 4.8404  | 4.8485  | 4.8892  | 4.8974  | 4.9392  | 4.9392  | 4.9477  | 4.9224  | 4.8974  | 4.8810  | 4.8647       |
| util living area                                                            | 0.9969  | 0.9930  | 0.9796  | 0.9313  | 0.8138  | 0.6291  | 0.4690  | 0.5257  | 0.7917  | 0.9638  | 0.9934  | 0.9976 (86)  |
| MIT                                                                         | 19.7403 | 19.9093 | 20.2019 | 20.5698 | 20.8416 | 20.9663 | 20.9935 | 20.9889 | 20.8983 | 20.5229 | 20.0624 | 19.7109 (87) |
| Th 2                                                                        | 19.7635 | 19.7657 | 19.7679 | 19.7792 | 19.7814 | 19.7927 | 19.7927 | 19.7949 | 19.7882 | 19.7814 | 19.7769 | 19.7724 (88) |
| util rest of house                                                          | 0.9956  | 0.9902  | 0.9713  | 0.9040  | 0.7484  | 0.5243  | 0.3438  | 0.3942  | 0.6967  | 0.9436  | 0.9903  | 0.9966 (89)  |
| MIT 2                                                                       | 18.1207 | 18.3679 | 18.7908 | 19.3084 | 19.6445 | 19.7744 | 19.7909 | 19.7915 | 19.7191 | 19.2598 | 18.6001 | 18.0840 (90) |
| Living area fraction                                                        | 18.8896 | 19.0997 | 19.4607 | 19.9073 | 20.2128 | 20.3403 | 20.3618 | 20.3600 | 20.2789 | 19.8595 | 19.2943 | 18.8564 (91) |
| MIT                                                                         | 18.8896 | 19.0997 | 19.4607 | 19.9073 | 20.2128 | 20.3403 | 20.3618 | 20.3600 | 20.2789 | 19.8595 | 19.2943 | 18.8564 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 18.8896 | 19.0997 | 19.4607 | 19.9073 | 20.2128 | 20.3403 | 20.3618 | 20.3600 | 20.2789 | 19.8595 | 19.2943 | 18.8564 (93) |

#### 8. Space heating requirement

|                      |           |          |          |          |          |          |          |          |          |          |          |                           |
|----------------------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------------------|
| Utilisation          | Jan       | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec                       |
| Useful gains         | 0.9944    | 0.9882   | 0.9687   | 0.9074   | 0.7735   | 0.5735   | 0.4036   | 0.4572   | 0.7386   | 0.9453   | 0.9886   | 0.9956 (94)               |
| Ext temp.            | 378.7343  | 438.2615 | 502.7463 | 547.0783 | 509.6774 | 374.5182 | 251.8246 | 263.1880 | 377.5536 | 407.2436 | 372.1979 | 359.4543 (95)             |
| Heat loss rate W     | 4.3000    | 4.9000   | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)               |
| Month fracti         | 1010.9322 | 981.8646 | 894.3196 | 751.5743 | 580.0223 | 386.9684 | 253.5965 | 266.3821 | 418.3223 | 630.8968 | 834.3898 | 1007.0878 (97)            |
| Space heating kWh    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)              |
| Space heating        | 470.3552  | 365.3013 | 291.3306 | 147.2371 | 52.3366  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 166.3979 | 332.7782 | 481.8393 (98)             |
| Space heating per m2 |           |          |          |          |          |          |          |          |          |          |          | 2307.5762 (98)            |
|                      |           |          |          |          |          |          |          |          |          |          |          | (98) / (4) = 46.6177 (99) |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

#### 9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.5000 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5000 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.5000 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5000 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.1000 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 2307.5762 (98)   |
| Space heat from Heat pump = (98) x 0.50 x 1.00 x 1.10                                   | 1269.1669 (307a) |
| Space heat from Boilers = (98) x 0.50 x 1.00 x 1.10                                     | 1269.1669 (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1769.4263 (64)   |
| Water heat from Heat pump = (64) x 0.50 x 1.00 x 1.10                                   | 973.1845 (310a)  |
| Water heat from Boilers = (64) x 0.50 x 1.00 x 1.10                                     | 973.1845 (310b)  |
| Electricity used for heat distribution                                                  | 44.8470 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 102.0214 (330a)  |
| Total electricity for the above, kWh/year                                               | 102.0214 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 229.7650 (332)   |
| Energy saving/generation technologies (Appendices M ,N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.50 * 951 * 1.00) =                                                  | -380.2464        |
| Total delivered energy for all uses                                                     | 4436.2427 (338)  |

#### 12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Efficiency of heat source Heat pump                                                        |                    |                               | 342.0000 (367a)          |
| Space heating from Heat pump                                                               | 655.6583           | 0.5190                        | 340.2867 (367)           |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |
| Space heating from Boilers                                                                 | 2388.0206          | 0.2160                        | 515.8125 (368)           |
| Electrical energy for heat distribution                                                    | 44.8470            | 0.5190                        | 23.2756 (372)            |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 879.3747 (373)           |
| Space and water heating                                                                    |                    |                               | 879.3747 (376)           |
| Pumps and fans                                                                             | 102.0214           | 0.5190                        | 52.9491 (378)            |
| Energy for lighting                                                                        | 229.7650           | 0.5190                        | 119.2480 (379)           |
| Energy saving/generation technologies                                                      |                    |                               |                          |
| PV Unit                                                                                    | -380.2464          | 0.5190                        | -197.3479 (380)          |
| Total CO2, kg/year                                                                         |                    |                               | 854.2239 (383)           |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 17.2600 (384)            |

#### 16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |  |     |             |
|---------------------------------------------------------------------------------|--|-----|-------------|
| DER                                                                             |  |     | 17.2600 ZC1 |
| Total Floor Area                                                                |  | TFA | 49.5000     |
| Assumed number of occupants                                                     |  | N   | 1.6754      |
| CO2 emission factor in Table 12 for electricity displaced from grid             |  | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |  |     | 17.4704 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |  |     | 3.2164 ZC3  |
| Total CO2 emissions                                                             |  |     | 37.9467 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |  |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |  |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |  |     | 37.9467 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 49.5000 (1b)              | x 2.5500 (2b)                   | = 126.2250 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 49.5000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 126.2250 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m <sup>3</sup> per hour                 |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1584 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.4084 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 1 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3778 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate | 0.4817 | 0.4723 | 0.4628 | 0.4156 | 0.4061 | 0.3589 | 0.3589 | 0.3495 | 0.3778 | 0.4061 | 0.4250 | 0.4439 (22b) |
| Effective ac    | 0.6160 | 0.6115 | 0.6071 | 0.5864 | 0.5825 | 0.5644 | 0.5644 | 0.5611 | 0.5714 | 0.5825 | 0.5903 | 0.5985 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K                 | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K              |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|------------------------------|--------------------------------|----------------------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200                       |                                | (26a)                      |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 10.2700                   | 1.3258                        | 13.6155                      |                                | (27)                       |
| External Wall 1                                                | 55.6000                 | 10.2700                    | 45.3300                   | 0.1800                        | 8.1594                       |                                | (29a)                      |
| stair wall                                                     | 22.2000                 | 2.1000                     | 20.1000                   | 0.1800                        | 3.6180                       |                                | (29a)                      |
| External Roof 1                                                | 49.5000                 |                            | 49.5000                   | 0.1300                        | 6.4350                       |                                | (30)                       |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 127.3000                  |                               |                              |                                | (31)                       |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           |                               | (26)...(30) + (32) = 34.3479 |                                | (33)                       |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |                              |                                | 250.0000 (35)              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |                              |                                | 15.4685 (36)               |
| Total fabric heat loss                                         |                         |                            |                           |                               |                              |                                | (33) + (36) = 49.8164 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 25.6600 | 25.4723 | 25.2884 | 24.4244 | 24.2627 | 23.5102 | 23.5102 | 23.3708 | 23.8001 | 24.2627 | 24.5897 | 24.9316 (38) |
| Heat transfer coeff       | 75.4764 | 75.2888 | 75.1048 | 74.2408 | 74.0791 | 73.3266 | 73.3266 | 73.1873 | 73.6165 | 74.0791 | 74.4062 | 74.7481 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 74.2400 (39) |
| HLP                       | 1.5248  | 1.5210  | 1.5173  | 1.4998  | 1.4965  | 1.4813  | 1.4813  | 1.4785  | 1.4872  | 1.4965  | 1.5032  | 1.5101 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.4998 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |         |          | 1.6754 (42)                       |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|---------|----------|-----------------------------------|
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |         |          | 73.9905 (43)                      |
|                                                             | Jan      | Feb      | Mar      | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov      | Dec                               |
| Daily hot water use                                         | 81.3896  | 78.4299  | 75.4703  | 72.5107 | 69.5511 | 66.5915 | 66.5915 | 69.5511 | 72.5107 | 75.4703 | 78.4299  | 81.3896 (44)                      |
| Energy conte                                                | 120.6984 | 105.5636 | 108.9321 | 94.9697 | 91.1257 | 78.6345 | 72.8664 | 83.6153 | 84.6139 | 98.6094 | 107.6399 | 116.8899 (45)                     |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         |         |          | Total = Sum(45)m = 1164.1588 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 18.1048  | 15.8345  | 16.3398  | 14.2455 | 13.6688 | 11.7952 | 10.9300 | 12.5423 | 12.6921 | 14.7914 | 16.1460  | 17.5335 (46)                      |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |         |          | 2.0000 (47)                       |
| Store volume                                                |          |          |          |         |         |         |         |         |         |         |          | 0.2388 (48)                       |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |         |          | 0.5400 (49)                       |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |         |          | 0.1290 (55)                       |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |         |          |                                   |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501 (64) |
| Heat gains from water heating, kWh/month                        | 61.9403  | 54.7975  | 58.0280  | 52.6820  | 52.1074  | 47.2506  | 46.0362  | 49.6102  | 49.2388  | 54.5957  | 56.8949  | 60.6740 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695  | 83.7695 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.0577  | 11.5978  | 9.4319   | 7.1406   | 5.3377   | 4.5063   | 4.8692   | 6.3292   | 8.4950   | 10.7863  | 12.5893  | 13.4206 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 145.9354 | 147.4497 | 143.6336 | 135.5095 | 125.2544 | 115.6159 | 109.1769 | 107.6625 | 111.4787 | 119.6027 | 129.8579 | 139.4963 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769  | 31.3769 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 | -67.0156 (71) |
| Water heating gains (Table 5)                                                       | 83.2531  | 81.5440  | 77.9947  | 73.1695  | 70.0368  | 65.6258  | 61.8766  | 66.6804  | 68.3872  | 73.3814  | 79.0207  | 81.5511 (72)  |
| Total internal gains                                                                | 293.3771 | 291.7223 | 282.1911 | 266.9505 | 251.7597 | 236.8789 | 227.0536 | 231.8029 | 239.4917 | 254.9013 | 272.5987 | 285.5989 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W    |
|-------------|----------|----------|----------|------------|--------------------------------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|---------------|
| East        |          |          |          | 5.3800     | 19.6403                        | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 32.2925 (76)  |
| West        |          |          |          | 4.8900     | 19.6403                        | 0.6300                            |          | 0.7000                             |          | 0.7700                       |          | 29.3513 (80)  |
| -----       |          |          |          |            |                                |                                   |          |                                    |          |                              |          |               |
| Solar gains | 61.6438  | 120.5884 | 198.5919 | 289.6345   | 354.9579                       | 363.3626                          | 345.9360 | 297.1539                           | 230.9706 | 143.0883                     | 76.8626  | 50.6929 (83)  |
| Total gains | 355.0209 | 412.3107 | 480.7830 | 556.5849   | 606.7176                       | 600.2415                          | 572.9896 | 528.9568                           | 470.4623 | 397.9896                     | 349.4613 | 336.2918 (84) |
| -----       |          |          |          |            |                                |                                   |          |                                    |          |                              |          |               |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 45.5440 | 45.6575 | 45.7694 | 46.3020 | 46.4031 | 46.8793 | 46.8793 | 46.9686 | 46.6947                   | 46.4031 | 46.1991 | 45.9878      |
| alpha                                                                       | 4.0363  | 4.0438  | 4.0513  | 4.0868  | 4.0935  | 4.1253  | 4.1253  | 4.1312  | 4.1130                    | 4.0935  | 4.0799  | 4.0659       |
| util living area                                                            | 0.9957  | 0.9915  | 0.9793  | 0.9411  | 0.8511  | 0.6956  | 0.5388  | 0.5968  | 0.8340                    | 0.9665  | 0.9921  | 0.9965 (86)  |
| MIT                                                                         | 19.3892 | 19.5723 | 19.9007 | 20.3320 | 20.6921 | 20.9074 | 20.9751 | 20.9624 | 20.7934                   | 20.3115 | 19.7743 | 19.3608 (87) |
| Th 2                                                                        | 19.6690 | 19.6718 | 19.6746 | 19.6876 | 19.6901 | 19.7015 | 19.7015 | 19.7036 | 19.6971                   | 19.6901 | 19.6851 | 19.6800 (88) |
| util rest of house                                                          | 0.9942  | 0.9885  | 0.9716  | 0.9182  | 0.7936  | 0.5866  | 0.3916  | 0.4471  | 0.7478                    | 0.9490  | 0.9887  | 0.9953 (89)  |
| MIT 2                                                                       | 17.5696 | 17.8378 | 18.3141 | 18.9305 | 19.4015 | 19.6439 | 19.6935 | 19.6898 | 19.5394                   | 18.9172 | 18.1423 | 17.5353 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4747 (91)  |
| MIT                                                                         | 18.4334 | 18.6613 | 19.0673 | 19.5958 | 20.0142 | 20.2437 | 20.3019 | 20.2940 | 20.1347                   | 19.5791 | 18.9171 | 18.4020 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.4334 | 18.6613 | 19.0673 | 19.5958 | 20.0142 | 20.2437 | 20.3019 | 20.2940 | 20.1347                   | 19.5791 | 18.9171 | 18.4020 (93) |

#### 8. Space heating requirement

|                      |           |           |          |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
|                      | 0.9921    | 0.9854    | 0.9670   | 0.9163   | 0.8097   | 0.6352   | 0.4621   | 0.5186   | 0.7807   | 0.9471       | 0.9859   | 0.9936 (94)    |
| Useful gains         | 352.2176  | 406.2735  | 464.9174 | 509.9808 | 491.2399 | 381.2791 | 264.7523 | 274.3318 | 367.2934 | 376.9226     | 344.5353 | 334.1402 (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 1066.7409 | 1036.0695 | 943.8668 | 794.0681 | 615.9100 | 413.8365 | 271.4504 | 284.9905 | 444.2548 | 665.1670     | 879.2667 | 1061.5690 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 531.6053  | 423.2230  | 356.3383 | 204.5428 | 92.7546  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 214.4538     | 385.0066 | 541.2070 (98)  |
| Space heating        |           |           |          |          |          |          |          |          |          |              |          | 2749.1315 (98) |
| Space heating per m2 |           |           |          |          |          |          |          |          |          | (98) / (4) = |          | 55.5380 (99)   |

#### 8c. Space cooling requirement

Not applicable

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2940.2476 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 531.6053 | 423.2230 | 356.3383 | 204.5428 | 92.7546  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 214.4538 | 385.0066 | 541.2070  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 568.5619 | 452.6449 | 381.1105 | 218.7624 | 99.2028  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 229.3623 | 411.7718 | 578.8311  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 147.9585 | 130.1856 | 136.1923 | 121.3505 | 118.3858 | 105.0153 | 100.1266 | 110.8755 | 110.9947 | 125.8695 | 134.0206 | 144.1501  | (64)            |
| Efficiency of water heater (217)m                                     | 87.9329  | 87.7327  | 87.2645  | 86.1964  | 84.1719  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 86.2240  | 87.4715  | 88.0177   | (217)           |
| Fuel for water heating, kWh/month                                     | 168.2630 | 148.3890 | 156.0683 | 140.7837 | 140.6477 | 131.5981 | 125.4719 | 138.9417 | 139.0911 | 145.9797 | 153.2164 | 163.7739  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1752.2245 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2940.2476 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 230.6035  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4998.0756 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2940.2476          | 0.2160                        | 635.0935 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1752.2245          | 0.2160                        | 378.4805 (264)           |
| Space and water heating                                                                           |                    |                               | 1013.5740 (265)          |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 230.6035           | 0.5190                        | 119.6832 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1172.1822 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 20.4762 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.4178 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7864 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (20.4762 * 1.00) + 2.4178 + 0.7864, rounded to 2 d.p. |                    |                               | 23.6800 (273)            |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

|                                    |                                                                         |               |         |                |            |
|------------------------------------|-------------------------------------------------------------------------|---------------|---------|----------------|------------|
| Property Reference                 | D-3-02                                                                  |               |         | Issued on Date | 05/02/2020 |
| Assessment Reference               | ASHP-1-2                                                                | Prop Type Ref | 2bed 3F |                |            |
| Property                           |                                                                         |               |         |                |            |
|                                    |                                                                         |               |         |                |            |
| SAP Rating                         | 84 B                                                                    | DER           | 14.67   | TER            | 21.72      |
| Environmental                      | 91 B                                                                    | % DER<TER     | 32.46   |                |            |
| CO <sub>2</sub> Emissions (t/year) | 0.60                                                                    | DFEE          | 61.35   | TFEE           | 63.85      |
| General Requirements Compliance    | Fail                                                                    | % DFEE<TFEE   | 3.90    |                |            |
|                                    |                                                                         |               |         |                |            |
| Assessor Details                   | Miss Claudia Cioli, Claudia Cioli, Tel: 07481524839, clacioli@gmail.com |               |         | Assessor ID    | R479-0001  |
| Client                             |                                                                         |               |         |                |            |



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

#### DWELLING AS DESIGNED

Top-floor flat, total floor area 51 m<sup>2</sup>

This report covers items included within the SAP calculations.  
It is not a complete report of regulations compliance.

#### 1a TER and DER

Fuels for main heating:Mains gas (c), Electricity (c)  
Fuel factor:1.00 (mains gas)  
Target Carbon Dioxide Emission Rate (TER) 21.72 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 14.67 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)63.8 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE)61.4 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

| Element       | Average          | Highest          |    |
|---------------|------------------|------------------|----|
| External wall | 0.18 (max. 0.30) | 0.18 (max. 0.70) | OK |
| Party wall    | 0.00 (max. 0.20) | -                | OK |
| Floor         | (no floor)       |                  |    |
| Roof          | 0.13 (max. 0.20) | 0.13 (max. 0.35) | OK |
| Openings      | 1.40 (max. 2.00) | 1.40 (max. 3.30) | OK |

#### 2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

#### 3 Air permeability

Air permeability at 50 pascals: 3.00 (design value)  
Maximum 10.0 OK

#### 4 Heating efficiency

Main heating system: Community heating scheme -

Secondary heating system:

None

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 0.74 kWh/day  
Permitted by DBSCG 0.32 Fail  
Primary pipework insulated: No primary pipework

#### 6 Controls

Space heating controls: Charging system linked to use of community heating, programmer and at least two room statsOK

Hot water controls: No cylinderstat

#### 7 Low energy lights

Percentage of fixed lights with low-energy fittings:100%  
Minimum 75% OK

#### 8 Mechanical ventilation

Continuous supply and extract system  
Specific fan power: 0.53  
Maximum 1.5 OK  
MVHR efficiency: 94%  
Minimum: 70% OK

#### 9 Summertime temperature

Overheating risk (Thames Valley): High Fail  
Based on:  
Overshading: Average  
Windows facing East: 3.33 m<sup>2</sup>, No overhang  
Windows facing South: 12.19 m<sup>2</sup>, No overhang  
Air change rate: 0.50 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Air permeability 3.0 m<sup>3</sup>/m<sup>2</sup>h  
Photovoltaic array 0.50 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 51.4000 (1b)              | x 2.5500 (2b)                   | = 131.0700 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 131.0700 (5)              |

#### 2. Ventilation rate

|                                                                                              | main                         |        | secondary |        | other  |        | total                       | m3 per hour |        |        |        |               |
|----------------------------------------------------------------------------------------------|------------------------------|--------|-----------|--------|--------|--------|-----------------------------|-------------|--------|--------|--------|---------------|
|                                                                                              | heating                      |        | heating   |        |        |        |                             |             |        |        |        |               |
| Number of chimneys                                                                           | 0                            | +      | 0         | +      | 0      | =      | 0 * 40 =                    | 0.0000 (6a) |        |        |        |               |
| Number of open flues                                                                         | 0                            | +      | 0         | +      | 0      | =      | 0 * 20 =                    | 0.0000 (6b) |        |        |        |               |
| Number of intermittent fans                                                                  |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7a) |        |        |        |               |
| Number of passive vents                                                                      |                              |        |           |        |        |        | 0 * 10 =                    | 0.0000 (7b) |        |        |        |               |
| Number of flueless gas fires                                                                 |                              |        |           |        |        |        | 0 * 40 =                    | 0.0000 (7c) |        |        |        |               |
| Air changes per hour                                                                         |                              |        |           |        |        |        |                             |             |        |        |        |               |
| Infiltration due to chimneys, flues and fans                                                 | = (6a)+(6b)+(7a)+(7b)+(7c) = |        |           |        |        |        | 0.0000 / (5) =              | 0.0000 (8)  |        |        |        |               |
| Pressure test                                                                                |                              |        |           |        |        |        | Yes                         |             |        |        |        |               |
| Measured/design AP50                                                                         |                              |        |           |        |        |        | 3.0000                      |             |        |        |        |               |
| Infiltration rate                                                                            |                              |        |           |        |        |        | 0.1500                      | (18)        |        |        |        |               |
| Number of sides sheltered                                                                    |                              |        |           |        |        |        | 1                           | (19)        |        |        |        |               |
| Shelter factor                                                                               |                              |        |           |        |        |        | (20) = 1 - [0.075 x (19)] = | 0.9250 (20) |        |        |        |               |
| Infiltration rate adjusted to include shelter factor                                         |                              |        |           |        |        |        | (21) = (18) x (20) =        | 0.1388 (21) |        |        |        |               |
| Wind speed                                                                                   | Jan                          | Feb    | Mar       | Apr    | May    | Jun    | Jul                         | Aug         | Sep    | Oct    | Nov    | Dec           |
| Wind factor                                                                                  | 5.1000                       | 5.0000 | 4.9000    | 4.4000 | 4.3000 | 3.8000 | 3.8000                      | 3.7000      | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)   |
| Adj infilt rate                                                                              | 1.2750                       | 1.2500 | 1.2250    | 1.1000 | 1.0750 | 0.9500 | 0.9500                      | 0.9250      | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a)  |
|                                                                                              | 0.1769                       | 0.1734 | 0.1700    | 0.1526 | 0.1492 | 0.1318 | 0.1318                      | 0.1283      | 0.1388 | 0.1492 | 0.1561 | 0.1630 (22b)  |
| Balanced mechanical ventilation with heat recovery                                           |                              |        |           |        |        |        |                             |             |        |        |        |               |
| If mechanical ventilation:                                                                   |                              |        |           |        |        |        |                             |             |        |        |        | 0.5000 (23a)  |
| If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = |                              |        |           |        |        |        |                             |             |        |        |        | 79.9000 (23c) |
| Effective ac                                                                                 | 0.2774                       | 0.2739 | 0.2705    | 0.2531 | 0.2497 | 0.2323 | 0.2323                      | 0.2288      | 0.2393 | 0.2497 | 0.2566 | 0.2635 (25)   |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K       | A x K<br>kJ/K   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| W03 (Uw = 1.40)                                                |                         |                            | 8.3900                    | 1.3258                        | 11.1231      |                                      | (27)            |
| W02 (Uw = 1.40)                                                |                         |                            | 7.1300                    | 1.3258                        | 9.4527       |                                      | (27)            |
| door                                                           |                         |                            | 2.1000                    | 1.4000                        | 2.9400       |                                      | (26a)           |
| External Wall 1                                                | 57.1000                 | 15.5200                    | 41.5800                   | 0.1800                        | 7.4844       | 140.0000                             | 5821.2000 (29a) |
| stair wall                                                     | 13.5000                 | 2.1000                     | 11.4000                   | 0.1800                        | 2.0520       | 140.0000                             | 1596.0000 (29a) |
| External Roof 1                                                | 51.4000                 |                            | 51.4000                   | 0.1300                        | 6.6820       | 9.0000                               | 462.6000 (30)   |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 122.0000                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 39.7342      |                                      | (33)            |
| Party Wall 1                                                   |                         |                            | 8.4000                    | 0.0000                        | 0.0000       | 140.0000                             | 1176.0000 (32)  |
| Party Floor 1                                                  |                         |                            | 51.4000                   |                               |              | 80.0000                              | 4112.0000 (32d) |
| Internal Wall                                                  |                         |                            | 95.0000                   |                               |              | 9.0000                               | 855.0000 (32c)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 14022.8000 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 272.8171 (35)   |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |              |                                      | 19.6885 (36)    |
| Total fabric heat loss                                         |                         |                            |                           |                               |              | (33) + (36) =                        | 59.4227 (37)    |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 11.9987 | 11.8486 | 11.6986 | 10.9484 | 10.7984 | 10.0482 | 10.0482 | 9.8982  | 10.3483 | 10.7984 | 11.0985 | 11.3985 (38) |
| Heat transfer coeff       | 71.4213 | 71.2713 | 71.1213 | 70.3711 | 70.2211 | 69.4709 | 69.4709 | 69.3209 | 69.7710 | 70.2211 | 70.5211 | 70.8212 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 70.3336 (39) |
| HLP                       | 1.3895  | 1.3866  | 1.3837  | 1.3691  | 1.3662  | 1.3516  | 1.3516  | 1.3487  | 1.3574  | 1.3662  | 1.3720  | 1.3778 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.3684 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                          |         |         |         |         |         |         |         |         |         |         |         |              |
|------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Assumed occupancy                        |         |         |         |         |         |         |         |         |         |         |         | 1.7314 (42)  |
| Average daily hot water use (litres/day) |         |         |         |         |         |         |         |         |         |         |         | 79.2842 (43) |
| Daily hot water use                      | 87.2127 | 84.0413 | 80.8699 | 77.6986 | 74.5272 | 71.3558 | 71.3558 | 74.5272 | 77.6986 | 80.8699 | 84.0413 | 87.2127 (44) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Energy content (annual)                                         | 129.3339 | 113.1162 | 116.7258 | 101.7644 | 97.6454  | 84.2605  | 78.0798  | 89.5977  | 90.6677  | 105.6645 | 115.3411 | 125.2529 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          | 19.4001  | 16.9674  | 17.5089  | 15.2647  | 14.6468  | 12.6391  | 11.7120  | 13.4396  | 13.6002  | 15.8497  | 17.3012  | 1247.4498 (45) |
| Water storage loss:                                             |          |          |          |          |          |          |          |          |          |          |          |                |
| Store volume                                                    |          |          |          |          |          |          |          |          |          |          |          | 2.0000 (47)    |
| a) If manufacturer declared loss factor is known (kWh/day):     |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (48)    |
| Temperature factor from Table 2b                                |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (49)    |
| Enter (49) or (54) in (55)                                      |          |          |          |          |          |          |          |          |          |          |          | 0.7400 (55)    |
| Total storage loss                                              | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (56)   |
| If cylinder contains dedicated solar storage                    | 22.9400  | 20.7200  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400  | 22.9400  | 22.2000  | 22.9400  | 22.2000  | 22.9400 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)   |
| Total heat required for water heating calculated for each month | 175.5363 | 154.8474 | 162.9282 | 146.4764 | 143.8478 | 128.9725 | 124.2822 | 135.8001 | 135.3797 | 151.8669 | 160.0531 | 171.4553 (62)  |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)    |
| Solar input (sum of months) = Sum(63)m =                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (63)    |
| Output from w/h                                                 | 175.5363 | 154.8474 | 162.9282 | 146.4764 | 143.8478 | 128.9725 | 124.2822 | 135.8001 | 135.3797 | 151.8669 | 160.0531 | 171.4553 (64)  |
| Heat gains from water heating, kWh/month                        | 79.9654  | 70.9961  | 75.7733  | 69.6063  | 69.4290  | 63.7862  | 62.9234  | 66.7531  | 65.9166  | 72.0954  | 74.1205  | 78.6085 (65)   |
| Total per year (kWh/year) = Sum(64)m =                          |          |          |          |          |          |          |          |          |          |          |          | 1791.4458 (64) |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.4501  | 11.9463  | 9.7153   | 7.3551   | 5.4981   | 4.6417   | 5.0155   | 6.5193   | 8.7503   | 11.1105  | 12.9675  | 13.8239 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 150.8691 | 152.4347 | 148.4896 | 140.0908 | 129.4890 | 119.5247 | 112.8679 | 111.3024 | 115.2475 | 123.6462 | 134.2481 | 144.2124 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568 (69)  |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 (71) |
| Water heating gains (Table 5)                                                       | 107.4804 | 105.6490 | 101.8458 | 96.6754  | 93.3185  | 88.5920  | 84.5745  | 89.7220  | 91.5509  | 96.9024  | 102.9451 | 105.6566 (72) |
| Total internal gains                                                                | 320.7702 | 319.0005 | 309.0212 | 293.0919 | 277.2761 | 261.7289 | 251.4285 | 256.5142 | 264.5192 | 280.6296 | 299.1314 | 312.6635 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 |          | g<br>Specific data<br>or Table 6b |          | FF<br>Specific data<br>or Table 6c |          | Access<br>factor<br>Table 6d |          | Gains<br>W   |
|-------------|----------|----------|----------|------------|--------------------------------|----------|-----------------------------------|----------|------------------------------------|----------|------------------------------|----------|--------------|
|             |          |          |          |            |                                |          |                                   |          |                                    |          |                              |          |              |
| South       |          |          |          | 8.3900     | 46.7521                        |          | 0.3700                            |          | 0.8900                             |          | 0.7700                       |          | 89.5133 (78) |
| East        |          |          |          | 3.3300     | 19.6403                        |          | 0.5600                            |          | 0.6800                             |          | 0.7700                       |          | 17.2592 (76) |
| South       |          |          |          | 3.8000     | 46.7521                        |          | 0.5600                            |          | 0.6800                             |          | 0.7700                       |          | 46.8829 (78) |
|             |          |          |          |            |                                |          |                                   |          |                                    |          |                              |          |              |
| Solar gains | 153.6555 | 257.1446 | 340.1513 | 402.6949   | 434.5115                       | 424.2517 | 411.9743                          | 389.2214 | 361.9129                           | 281.0007 | 183.1963                     | 132.0521 | (83)         |
| Total gains | 474.4257 | 576.1451 | 649.1726 | 695.7867   | 711.7876                       | 685.9806 | 663.4028                          | 645.7356 | 626.4320                           | 561.6303 | 482.3277                     | 444.7155 | (84)         |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |         |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |         |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
| tau                                                                         | 54.5386 | 54.6534 | 54.7687 | 55.3526 | 55.4709 | 56.0698 | 56.0698 | 56.1912 | 55.8287 | 55.4709 | 55.2348 | 55.0008      |
| alpha                                                                       | 4.6359  | 4.6436  | 4.6512  | 4.6902  | 4.6981  | 4.7380  | 4.7380  | 4.7461  | 4.7219  | 4.6981  | 4.6823  | 4.6667       |
| util living area                                                            | 0.9916  | 0.9793  | 0.9536  | 0.8962  | 0.7872  | 0.6163  | 0.4544  | 0.4849  | 0.7026  | 0.9133  | 0.9813  | 0.9936 (86)  |
| MIT                                                                         | 19.8172 | 20.0444 | 20.3243 | 20.6255 | 20.8476 | 20.9640 | 20.9930 | 20.9905 | 20.9320 | 20.6427 | 20.1675 | 19.7729 (87) |
| Th 2                                                                        | 19.7714 | 19.7736 | 19.7759 | 19.7871 | 19.7894 | 19.8007 | 19.8007 | 19.8029 | 19.7961 | 19.7894 | 19.7849 | 19.7804 (88) |
| util rest of house                                                          | 0.9886  | 0.9722  | 0.9378  | 0.8615  | 0.7209  | 0.5144  | 0.3339  | 0.3634  | 0.6052  | 0.8765  | 0.9737  | 0.9914 (89)  |
| MIT                                                                         | 18.2460 | 18.5740 | 18.9707 | 19.3859 | 19.6571 | 19.7804 | 19.7986 | 19.7999 | 19.7520 | 19.4209 | 18.7628 | 18.1882 (90) |
| Living area fraction                                                        | 18.9277 | 19.2119 | 19.5579 | 19.9237 | 20.1736 | 20.2939 | 20.3168 | 20.3164 | 20.2640 | 19.9510 | 19.3722 | 18.8757 (92) |
| MIT                                                                         | 18.9277 | 19.2119 | 19.5579 | 19.9237 | 20.1736 | 20.2939 | 20.3168 | 20.3164 | 20.2640 | 19.9510 | 19.3722 | 18.8757 (93) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 18.9277 | 19.2119 | 19.5579 | 19.9237 | 20.1736 | 20.2939 | 20.3168 | 20.3164 | 20.2640 | 19.9510 | 19.3722 | 18.8757 (93) |

#### 8. Space heating requirement

|                   |           |           |          |          |          |          |          |          |          |          |          |                |
|-------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Utilisation       | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Useful gains      | 0.9858    | 0.9681    | 0.9344   | 0.8659   | 0.7436   | 0.5579   | 0.3865   | 0.4164   | 0.6453   | 0.8822   | 0.9703   | 0.9890 (94)    |
| Ext temp.         | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000  | 7.1000   | 4.2000 (96)    |
| Heat loss rate W  | 1044.7268 | 1020.0298 | 928.6975 | 775.7482 | 595.0239 | 395.5584 | 258.2108 | 271.4898 | 430.0652 | 656.6383 | 865.4502 | 1039.3540 (97) |
| Month fracti      | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000   | 1.0000   | 1.0000 (97a)   |
| Space heating kWh | 429.3228  | 310.6563  | 239.6413 | 124.7450 | 48.9179  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 119.8944 | 286.1731 | 446.0432 (98)  |
| Space heating     |           |           |          |          |          |          |          |          |          |          |          | 2005.3940 (98) |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 39.0154 (99)

8c. Space cooling requirement

Not applicable

9b. Energy requirements

|                                                                                         |                  |
|-----------------------------------------------------------------------------------------|------------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                   | 0.0000 (301)     |
| Fraction of space heat from community system                                            | 1.0000 (302)     |
| Fraction of heat from community Heat pump                                               | 0.4600 (303a)    |
| Fraction of heat from community Boilers                                                 | 0.5400 (303b)    |
| Fraction of total space heat from community Heat pump                                   | 0.4600 (304a)    |
| Fraction of total space heat from community Boilers                                     | 0.5400 (304b)    |
| Factor for control and charging method (Table 4c(3)) for community space heating        | 1.0000 (305)     |
| Factor for control and charging method (Table 4c(3)) for community water heating        | 1.0000 (305a)    |
| Distribution loss factor (Table 12c) for community heating system                       | 1.0500 (306)     |
| Space heating:                                                                          |                  |
| Annual space heating requirement                                                        | 2005.3940 (98)   |
| Space heat from Heat pump = (98) x 0.46 x 1.00 x 1.05                                   | 968.6053 (307a)  |
| Space heat from Boilers = (98) x 0.54 x 1.00 x 1.05                                     | 1137.0584 (307b) |
| Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) | 0.0000 (308)     |
| Space heating fuel for secondary/supplementary system                                   | 0.0000 (309)     |
| Water heating                                                                           |                  |
| Annual water heating requirement                                                        | 1791.4458 (64)   |
| Water heat from Heat pump = (64) x 0.46 x 1.00 x 1.05                                   | 865.2683 (310a)  |
| Water heat from Boilers = (64) x 0.54 x 1.00 x 1.05                                     | 1015.7498 (310b) |
| Electricity used for heat distribution                                                  | 39.8668 (313)    |
| Annual totals kWh/year                                                                  |                  |
| Electricity for pumps and fans:                                                         |                  |
| (BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6625)             |                  |
| mechanical ventilation fans (SFP = 0.6625)                                              | 105.9373 (330a)  |
| Total electricity for the above, kWh/year                                               | 105.9373 (331)   |
| Electricity for lighting (calculated in Appendix L)                                     | 237.5329 (332)   |
| Energy saving/generation technologies (Appendices M, N and Q)                           |                  |
| PV Unit 0 (0.80 * 0.50 * 951 * 1.00) =                                                  | -380.2464        |
| Total delivered energy for all uses                                                     | 3949.9055 (338)  |

12b. Carbon dioxide emissions - Community heating scheme

|                                                                                            | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |  |
|--------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|--|
| Efficiency of heat source Heat pump                                                        |                    |                               | 370.0000 (367a)          |  |
| Space heating from Heat pump                                                               | 495.6415           | 0.5190                        | 257.2379 (367)           |  |
| Efficiency of heat source Boilers                                                          |                    |                               | 93.9000 (367b)           |  |
| Space heating from Boilers                                                                 | 2292.6604          | 0.2160                        | 495.2147 (368)           |  |
| Electrical energy for heat distribution                                                    | 39.8668            | 0.5190                        | 20.6909 (372)            |  |
| Total CO2 associated with community systems<br>(negative value allowed since DFEE <= TFEE) |                    |                               | 773.1435 (373)           |  |
| Space and water heating                                                                    |                    |                               | 773.1435 (376)           |  |
| Pumps and fans                                                                             | 105.9373           | 0.5190                        | 54.9815 (378)            |  |
| Energy for lighting                                                                        | 237.5329           | 0.5190                        | 123.2796 (379)           |  |
| Energy saving/generation technologies                                                      |                    |                               |                          |  |
| PV Unit                                                                                    | -380.2464          | 0.5190                        | -197.3479 (380)          |  |
| Total CO2, kg/year                                                                         |                    |                               | 754.0566 (383)           |  |
| Dwelling Carbon Dioxide Emission Rate (DER)                                                |                    |                               | 14.6700 (384)            |  |

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

|                                                                                 |  |     |             |
|---------------------------------------------------------------------------------|--|-----|-------------|
| DER                                                                             |  |     | 14.6700 ZC1 |
| Total Floor Area                                                                |  | TFA | 51.4000     |
| Assumed number of occupants                                                     |  | N   | 1.7314      |
| CO2 emission factor in Table 12 for electricity displaced from grid             |  | EF  | 0.5190      |
| CO2 emissions from appliances, equation (L14)                                   |  |     | 17.3934 ZC2 |
| CO2 emissions from cooking, equation (L16)                                      |  |     | 3.1236 ZC3  |
| Total CO2 emissions                                                             |  |     | 35.1870 ZC4 |
| Residual CO2 emissions offset from biofuel CHP                                  |  |     | 0.0000 ZC5  |
| Additional allowable electricity generation, kWh/m²/year                        |  |     | 0.0000 ZC6  |
| Resulting CO2 emissions offset from additional allowable electricity generation |  |     | 0.0000 ZC7  |
| Net CO2 emissions                                                               |  |     | 35.1870 ZC8 |

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)  
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 1. Overall dwelling dimensions

|                                                        | Area<br>(m <sup>2</sup> ) | Storey height<br>(m)            | Volume<br>(m <sup>3</sup> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Ground floor                                           | 51.4000 (1b)              | x 2.5500 (2b)                   | = 131.0700 (1b) - (3b)      |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 51.4000                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 131.0700 (5)              |

#### 2. Ventilation rate

|                                                                           | main<br>heating | secondary<br>heating | other | total | m3 per hour                             |
|---------------------------------------------------------------------------|-----------------|----------------------|-------|-------|-----------------------------------------|
| Number of chimneys                                                        | 0               | +                    | 0     | =     | 0 * 40 = 0.0000 (6a)                    |
| Number of open flues                                                      | 0               | +                    | 0     | =     | 0 * 20 = 0.0000 (6b)                    |
| Number of intermittent fans                                               |                 |                      |       |       | 2 * 10 = 20.0000 (7a)                   |
| Number of passive vents                                                   |                 |                      |       |       | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                              |                 |                      |       |       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = |                 |                      |       |       | 20.0000 / (5) = 0.1526 (8)              |
| Pressure test                                                             |                 |                      |       |       | Yes                                     |
| Measured/design AP50                                                      |                 |                      |       |       | 5.0000                                  |
| Infiltration rate                                                         |                 |                      |       |       | 0.4026 (18)                             |
| Number of sides sheltered                                                 |                 |                      |       |       | 1 (19)                                  |
| Shelter factor                                                            |                 |                      |       |       | (20) = 1 - [0.075 x (19)] = 0.9250 (20) |
| Infiltration rate adjusted to include shelter factor                      |                 |                      |       |       | (21) = (18) x (20) = 0.3724 (21)        |

|                 | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec          |
|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|
| Wind speed      | 5.1000 | 5.0000 | 4.9000 | 4.4000 | 4.3000 | 3.8000 | 3.8000 | 3.7000 | 4.0000 | 4.3000 | 4.5000 | 4.7000 (22)  |
| Wind factor     | 1.2750 | 1.2500 | 1.2250 | 1.1000 | 1.0750 | 0.9500 | 0.9500 | 0.9250 | 1.0000 | 1.0750 | 1.1250 | 1.1750 (22a) |
| Adj infilt rate |        |        |        |        |        |        |        |        |        |        |        |              |
| Effective ac    | 0.4748 | 0.4655 | 0.4562 | 0.4096 | 0.4003 | 0.3538 | 0.3538 | 0.3445 | 0.3724 | 0.4003 | 0.4189 | 0.4376 (22b) |
|                 | 0.6127 | 0.6083 | 0.6041 | 0.5839 | 0.5801 | 0.5626 | 0.5626 | 0.5593 | 0.5693 | 0.5801 | 0.5878 | 0.5957 (25)  |

#### 3. Heat losses and heat loss parameter

| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K                 | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K              |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|------------------------------|--------------------------------|----------------------------|
| TER Semi-glazed door                                           |                         |                            | 2.1000                    | 1.2000                        | 2.5200                       |                                | (26a)                      |
| TER Opening Type (Uw = 1.40)                                   |                         |                            | 10.7500                   | 1.3258                        | 14.2519                      |                                | (27)                       |
| External Wall 1                                                | 57.1000                 | 10.7500                    | 46.3500                   | 0.1800                        | 8.3430                       |                                | (29a)                      |
| stair wall                                                     | 13.5000                 | 2.1000                     | 11.4000                   | 0.1800                        | 2.0520                       |                                | (29a)                      |
| External Roof 1                                                | 51.4000                 |                            | 51.4000                   | 0.1300                        | 6.6820                       |                                | (30)                       |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 122.0000                  |                               |                              |                                | (31)                       |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           |                               | (26)...(30) + (32) = 33.8489 |                                | (33)                       |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |                              |                                | 250.0000 (35)              |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)     |                         |                            |                           |                               |                              |                                | 16.2370 (36)               |
| Total fabric heat loss                                         |                         |                            |                           |                               |                              |                                | (33) + (36) = 50.0859 (37) |

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

|                           | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep     | Oct     | Nov     | Dec          |
|---------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------------|
| (38)m                     | 26.5020 | 26.3127 | 26.1271 | 25.2555 | 25.0924 | 24.3333 | 24.3333 | 24.1927 | 24.6257 | 25.0924 | 25.4223 | 25.7672 (38) |
| Heat transfer coeff       | 76.5879 | 76.3986 | 76.2130 | 75.3414 | 75.1783 | 74.4192 | 74.4192 | 74.2786 | 74.7116 | 75.1783 | 75.5082 | 75.8531 (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 75.3406 (39) |
| HLP                       | 1.4900  | 1.4864  | 1.4827  | 1.4658  | 1.4626  | 1.4478  | 1.4478  | 1.4451  | 1.4535  | 1.4626  | 1.4690  | 1.4757 (40)  |
| HLP (average)             |         |         |         |         |         |         |         |         |         |         |         | 1.4658 (40)  |
| Days in month             | 31      | 28      | 31      | 30      | 31      | 30      | 31      | 31      | 30      | 31      | 30      | 31 (41)      |

#### 4. Water heating energy requirements (kWh/year)

|                                                             |          |          |          |         |         |         |         |         |         |                    |          |                |
|-------------------------------------------------------------|----------|----------|----------|---------|---------|---------|---------|---------|---------|--------------------|----------|----------------|
| Assumed occupancy                                           |          |          |          |         |         |         |         |         |         |                    |          | 1.7314 (42)    |
| Average daily hot water use (litres/day)                    |          |          |          |         |         |         |         |         |         |                    |          | 75.3200 (43)   |
| Daily hot water use                                         | 82.8520  | 79.8392  | 76.8264  | 73.8136 | 70.8008 | 67.7880 | 67.7880 | 70.8008 | 73.8136 | 76.8264            | 79.8392  | 82.8520 (44)   |
| Energy conte                                                | 122.8672 | 107.4604 | 110.8895 | 96.6762 | 92.7631 | 80.0475 | 74.1758 | 85.1178 | 86.1344 | 100.3813           | 109.5740 | 118.9903 (45)  |
| Energy content (annual)                                     |          |          |          |         |         |         |         |         |         | Total = Sum(45)m = |          | 1185.0773 (45) |
| Distribution loss (46)m = 0.15 x (45)m                      | 18.4301  | 16.1191  | 16.6334  | 14.5014 | 13.9145 | 12.0071 | 11.1264 | 12.7677 | 12.9202 | 15.0572            | 16.4361  | 17.8485 (46)   |
| Water storage loss:                                         |          |          |          |         |         |         |         |         |         |                    |          | 2.0000 (47)    |
| Store volume                                                |          |          |          |         |         |         |         |         |         |                    |          | 0.2388 (48)    |
| a) If manufacturer declared loss factor is known (kWh/day): |          |          |          |         |         |         |         |         |         |                    |          | 0.5400 (49)    |
| Temperature factor from Table 2b                            |          |          |          |         |         |         |         |         |         |                    |          | 0.1290 (55)    |
| Enter (49) or (54) in (55)                                  |          |          |          |         |         |         |         |         |         |                    |          |                |

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## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |               |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Total storage loss                                              | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (56)   |
| If cylinder contains dedicated solar storage                    | 3.9977   | 3.6109   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977   | 3.9977   | 3.8688   | 3.9977   | 3.8688   | 3.9977 (57)   |
| Primary loss                                                    | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624 (59)  |
| Total heat required for water heating calculated for each month | 150.1273 | 132.0825 | 138.1497 | 123.0570 | 120.0232 | 106.4283 | 101.4359 | 112.3779 | 112.5151 | 127.6414 | 135.9548 | 146.2504 (62) |
| Solar input                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (63)   |
| Output from w/h                                                 | 150.1273 | 132.0825 | 138.1497 | 123.0570 | 120.0232 | 106.4283 | 101.4359 | 112.3779 | 112.5151 | 127.6414 | 135.9548 | 146.2504 (64) |
| Heat gains from water heating, kWh/month                        | 62.6614  | 55.4282  | 58.6789  | 53.2495  | 52.6518  | 47.7204  | 46.4716  | 50.1098  | 49.7443  | 55.1849  | 57.5380  | 61.3724 (65)  |

#### 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685  | 86.5685 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 13.4909  | 11.9825  | 9.7448   | 7.3775   | 5.5147   | 4.6558   | 5.0307   | 6.5391   | 8.7768   | 11.1442  | 13.0069  | 13.8659 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 150.8691 | 152.4347 | 148.4896 | 140.0908 | 129.4890 | 119.5247 | 112.8679 | 111.3024 | 115.2475 | 123.6462 | 134.2481 | 144.2124 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568  | 31.6568 (69)  |
| Pumps, fans                                                                         | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000 (70)   |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 | -69.2548 (71) |
| Water heating gains (Table 5)                                                       | 84.2224  | 82.4825  | 78.8695  | 73.9576  | 70.7686  | 66.2784  | 62.4618  | 67.3518  | 69.0893  | 74.1732  | 79.9139  | 82.4898 (72)  |
| Total internal gains                                                                | 300.5530 | 298.8703 | 289.0744 | 273.3964 | 257.7429 | 242.4294 | 232.3310 | 237.1639 | 245.0842 | 260.9342 | 279.1395 | 292.5386 (73) |

#### 6. Solar gains

| [Jan]       |          |          |          |          | Area<br>m2 | Solar flux<br>Table 6a<br>W/m2 | g<br>Specific data<br>or Table 6b | FF<br>Specific data<br>or Table 6c | Access<br>factor<br>Table 6d |          | Gains<br>W    |               |
|-------------|----------|----------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|----------|---------------|---------------|
| East        |          |          |          |          | 2.3100     | 19.6403                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 13.8654 (76)  |               |
| South       |          |          |          |          | 8.4400     | 46.7521                        | 0.6300                            | 0.7000                             | 0.7700                       |          | 120.5910 (78) |               |
| -----       |          |          |          |          |            |                                |                                   |                                    |                              |          |               |               |
| Solar gains | 134.4564 | 224.6206 | 296.2449 | 349.4824 | 376.1350   | 366.8741                       | 356.4134                          | 337.4001                           | 314.7526                     | 245.2035 | 160.2300      | 115.6040 (83) |
| Total gains | 435.0094 | 523.4909 | 585.3193 | 622.8788 | 633.8779   | 609.3035                       | 588.7444                          | 574.5640                           | 559.8368                     | 506.1378 | 439.3695      | 408.1426 (84) |

#### 7. Mean internal temperature (heating season)

|                                                                             |         |         |         |         |         |         |         |         |                           |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------------|---------|---------|--------------|
| Temperature during heating periods in the living area from Table 9, Th1 (C) |         |         |         |         |         |         |         |         |                           |         |         | 21.0000 (85) |
| Utilisation factor for gains for living area, nil,m (see Table 9a)          | Jan     | Feb     | Mar     | Apr     | May     | Jun     | Jul     | Aug     | Sep                       | Oct     | Nov     | Dec          |
| tau                                                                         | 46.6058 | 46.7213 | 46.8351 | 47.3769 | 47.4797 | 47.9640 | 47.9640 | 48.0548 | 47.7763                   | 47.4797 | 47.2723 | 47.0573      |
| alpha                                                                       | 4.1071  | 4.1148  | 4.1223  | 4.1585  | 4.1653  | 4.1976  | 4.1976  | 4.2037  | 4.1851                    | 4.1653  | 4.1515  | 4.1372       |
| util living area                                                            | 0.9921  | 0.9827  | 0.9644  | 0.9244  | 0.8438  | 0.6976  | 0.5341  | 0.5656  | 0.7725                    | 0.9355  | 0.9842  | 0.9939 (86)  |
| MIT                                                                         | 19.5419 | 19.7680 | 20.0686 | 20.4198 | 20.7159 | 20.9112 | 20.9775 | 20.9710 | 20.8562                   | 20.4670 | 19.9343 | 19.5017 (87) |
| Th 2                                                                        | 19.6950 | 19.6977 | 19.7005 | 19.7133 | 19.7157 | 19.7268 | 19.7268 | 19.7289 | 19.7225                   | 19.7157 | 19.7108 | 19.7057 (88) |
| util rest of house                                                          | 0.9894  | 0.9770  | 0.9522  | 0.8971  | 0.7855  | 0.5902  | 0.3903  | 0.4232  | 0.6776                    | 0.9065  | 0.9779  | 0.9918 (89)  |
| MIT 2                                                                       | 17.8083 | 18.1366 | 18.5682 | 19.0658 | 19.4505 | 19.6712 | 19.7195 | 19.7185 | 19.6193                   | 19.1421 | 18.3891 | 17.7571 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.4339 (91)  |
| MIT                                                                         | 18.5604 | 18.8444 | 19.2192 | 19.6532 | 19.9995 | 20.2092 | 20.2653 | 20.2619 | 20.1559                   | 19.7169 | 19.0595 | 18.5140 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.5604 | 18.8444 | 19.2192 | 19.6532 | 19.9995 | 20.2092 | 20.2653 | 20.2619 | 20.1559                   | 19.7169 | 19.0595 | 18.5140 (93) |

#### 8. Space heating requirement

|                      |           |           |          |          |          |          |          |          |          |              |          |                |
|----------------------|-----------|-----------|----------|----------|----------|----------|----------|----------|----------|--------------|----------|----------------|
| Utilisation          | Jan       | Feb       | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct          | Nov      | Dec            |
| Useful gains         | 428.9857  | 508.7947  | 553.9737 | 557.8700 | 507.0898 | 386.1825 | 266.8658 | 278.8945 | 399.2082 | 458.8118     | 427.7503 | 403.6659 (95)  |
| Ext temp.            | 4.3000    | 4.9000    | 6.5000   | 8.9000   | 11.7000  | 14.6000  | 16.6000  | 16.4000  | 14.1000  | 10.6000      | 7.1000   | 4.2000 (96)    |
| Heat loss rate W     | 1092.1765 | 1065.3307 | 969.3684 | 810.1605 | 623.9452 | 417.4322 | 272.7678 | 286.8561 | 452.4491 | 685.3951     | 903.0411 | 1085.7582 (97) |
| Month fracti         | 1.0000    | 1.0000    | 1.0000   | 1.0000   | 1.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 1.0000       | 1.0000   | 1.0000 (97a)   |
| Space heating kWh    | 493.4140  | 373.9922  | 309.0537 | 181.6491 | 86.9404  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 168.5780     | 342.2094 | 507.4767 (98)  |
| Space heating        |           |           |          |          |          |          |          |          |          |              |          | 2463.3134 (98) |
| Space heating per m2 |           |           |          |          |          |          |          |          |          | (98) / (4) = |          | 47.9244 (99)   |

#### 8c. Space cooling requirement

Not applicable

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

#### 9a. Energy requirements - Individual heating systems, including micro-CHP

|                                                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
|-----------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11) |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (201)    |
| Fraction of space heat from main system(s)                            |          |          |          |          |          |          |          |          |          |          |          |           | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                      |          |          |          |          |          |          |          |          |          |          |          |           | 93.5000 (206)   |
| Efficiency of secondary/supplementary heating system, %               |          |          |          |          |          |          |          |          |          |          |          |           | 0.0000 (208)    |
| Space heating requirement                                             |          |          |          |          |          |          |          |          |          |          |          |           | 2634.5598 (211) |
|                                                                       | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |                 |
| Space heating requirement                                             | 493.4140 | 373.9922 | 309.0537 | 181.6491 | 86.9404  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 168.5780 | 342.2094 | 507.4767  | (98)            |
| Space heating efficiency (main heating system 1)                      | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 93.5000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.5000  | 93.5000  | 93.5000   | (210)           |
| Space heating fuel (main heating system)                              | 527.7155 | 399.9917 | 330.5387 | 194.2772 | 92.9844  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 180.2973 | 365.9993 | 542.7558  | (211)           |
| Water heating requirement                                             | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (215)           |
| Water heating requirement                                             | 150.1273 | 132.0825 | 138.1497 | 123.0570 | 120.0232 | 106.4283 | 101.4359 | 112.3779 | 112.5151 | 127.6414 | 135.9548 | 146.2504  | (64)            |
| Efficiency of water heater (217)m                                     | 87.7550  | 87.4400  | 86.9005  | 85.8511  | 83.9705  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.5567  | 87.1765  | 79.8000   | (216)           |
| Fuel for water heating, kWh/month                                     | 171.0754 | 151.0550 | 158.9746 | 143.3377 | 142.9350 | 133.3688 | 127.1127 | 140.8245 | 140.9964 | 149.1892 | 155.9535 | 166.4503  | (219)           |
| Water heating fuel used                                               |          |          |          |          |          |          |          |          |          |          |          | 1781.2730 | (219)           |
| Annual totals kWh/year                                                |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| Space heating fuel - main system                                      |          |          |          |          |          |          |          |          |          |          |          | 2634.5598 | (211)           |
| Space heating fuel - secondary                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000    | (215)           |
| Electricity for pumps and fans:                                       |          |          |          |          |          |          |          |          |          |          |          |           |                 |
| central heating pump                                                  |          |          |          |          |          |          |          |          |          |          |          | 30.0000   | (230c)          |
| main heating flue fan                                                 |          |          |          |          |          |          |          |          |          |          |          | 45.0000   | (230e)          |
| Total electricity for the above, kWh/year                             |          |          |          |          |          |          |          |          |          |          |          | 75.0000   | (231)           |
| Electricity for lighting (calculated in Appendix L)                   |          |          |          |          |          |          |          |          |          |          |          | 238.2541  | (232)           |
| Total delivered energy for all uses                                   |          |          |          |          |          |          |          |          |          |          |          | 4729.0870 | (238)           |

#### 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                                                                                   | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|---------------------------------------------------------------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                                                                     | 2634.5598          | 0.2160                        | 569.0649 (261)           |
| Space heating - secondary                                                                         | 0.0000             | 0.0000                        | 0.0000 (263)             |
| Water heating (other fuel)                                                                        | 1781.2730          | 0.2160                        | 384.7550 (264)           |
| Space and water heating                                                                           |                    |                               | 953.8199 (265)           |
| Pumps and fans                                                                                    | 75.0000            | 0.5190                        | 38.9250 (267)            |
| Energy for lighting                                                                               | 238.2541           | 0.5190                        | 123.6539 (268)           |
| Total CO2, kg/m2/year                                                                             |                    |                               | 1116.3988 (272)          |
| Emissions per m2 for space and water heating                                                      |                    |                               | 18.5568 (272a)           |
| Fuel factor (mains gas)                                                                           |                    |                               | 1.0000                   |
| Emissions per m2 for lighting                                                                     |                    |                               | 2.4057 (272b)            |
| Emissions per m2 for pumps and fans                                                               |                    |                               | 0.7573 (272c)            |
| Target Carbon Dioxide Emission Rate (TER) = (18.5568 * 1.00) + 2.4057 + 0.7573, rounded to 2 d.p. |                    |                               | 21.7200 (273)            |

## APPENDIX C1 - COMMUNITY CENTRE - PART L RESULTS “LEAN”



## Project name

**Highgate Newton Community Centre**

As designed

Date: Fri Feb 07 19:06:40 2020

## Administrative information

## Building Details

Address: Highgate Newton Community Centre, London,

## Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.4"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.4

BRUKL compliance check version: v5.6.a.1

## Owner Details

Name:

Telephone number:

Address: , ,

## Certifier details

Name: Paul Bacon

Telephone number: 01908 261461

Address: 13-14 Coffridge Close, Stony Stratford, Milton Keynes, MK11 1BY

Criterion 1: The calculated CO<sub>2</sub> emission rate for the building must not exceed the target

The building does not comply with England Building Regulations Part L 2013

|                                                                                                    |                     |
|----------------------------------------------------------------------------------------------------|---------------------|
| CO <sub>2</sub> emission rate from the notional building, kgCO <sub>2</sub> /m <sup>2</sup> .annum | 16.7                |
| Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> .annum               | 16.7                |
| Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> .annum             | 17.9                |
| Are emissions from the building less than or equal to the target?                                  | BER > TER           |
| Are as built details the same as used in the BER calculations?                                     | Separate submission |

## Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

## Building fabric

| Element                                  | U <sub>a</sub> -Limit | U <sub>a</sub> -Calc | U <sub>i</sub> -Calc | Surface where the maximum value occurs* |
|------------------------------------------|-----------------------|----------------------|----------------------|-----------------------------------------|
| Wall**                                   | 0.35                  | 0.22                 | 0.22                 | External Wall                           |
| Floor                                    | 0.25                  | 0.14                 | 0.18                 | Ground Floor Hall                       |
| Roof                                     | 0.25                  | 0.16                 | 0.18                 | Roof Hall                               |
| Windows***, roof windows, and rooflights | 2.2                   | 1.65                 | 1.9                  | 1F CW part 1                            |
| Personnel doors                          | 2.2                   | 1.7                  | 1.74                 | D12                                     |
| Vehicle access & similar large doors     | 1.5                   | -                    | -                    | No vehicle doors in project             |
| High usage entrance doors                | 3.5                   | -                    | -                    | No high usage entrance doors in project |

U<sub>a</sub>-Limit = Limiting area-weighted average U-values [W/(m<sup>2</sup>K)]U<sub>a</sub>-Calc = Calculated area-weighted average U-values [W/(m<sup>2</sup>K)]U<sub>i</sub>-Calc = Calculated maximum individual element U-values [W/(m<sup>2</sup>K)]

\* There might be more than one surface where the maximum U-value occurs.

\*\* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

\*\*\* Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

| Air Permeability                             | Worst acceptable standard | This building |
|----------------------------------------------|---------------------------|---------------|
| m <sup>3</sup> /(h.m <sup>2</sup> ) at 50 Pa | 10                        | 3             |

## Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

|                                                                                              |             |
|----------------------------------------------------------------------------------------------|-------------|
| Whole building lighting automatic monitoring & targeting with alarms for out-of-range values | NO          |
| Whole building electric power factor achieved by power factor correction                     | 0.9 to 0.95 |

### 1- Gym (B.0.10 Gym)

|                                                                                                                                                                                                                                                   | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| This system                                                                                                                                                                                                                                       | 4.7                | 5.44               | -                  | 1.22          | 0.83          |
| Standard value                                                                                                                                                                                                                                    | 0.91*              | 2.6                | N/A                | 1.6^          | 0.5           |
| Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system                                                                                                                                                         |                    |                    |                    |               | YES           |
| * Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82. |                    |                    |                    |               |               |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.                                                               |                    |                    |                    |               |               |

### 2- NV + UFH

|                                                                                           | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| This system                                                                               | 0.94               | -                  | -                  | -             | -             |
| Standard value                                                                            | N/A                | N/A                | N/A                | N/A           | N/A           |
| Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system |                    |                    |                    |               | YES           |

### 3- NV + Rads

|                                                                                           | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| This system                                                                               | 0.94               | -                  | -                  | -             | -             |
| Standard value                                                                            | N/A                | N/A                | N/A                | N/A           | N/A           |
| Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system |                    |                    |                    |               | YES           |

### 4- Recording Studio (B.3.06 Recording Studio)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| This system                                                                                                                                                                         | 4.7                | -                  | -                  | 1.4           | 0.5           |
| Standard value                                                                                                                                                                      | 2.5*               | N/A                | N/A                | 1.6^          | 0.5           |
| Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system                                                                                           |                    |                    |                    |               | YES           |
| * Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.                   |                    |                    |                    |               |               |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

### 5- B.0.01 Office - UFH + Supply only (B.0.01 Office)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| This system                                                                                                                                                                         | 0.94               | -                  | -                  | 0.51          | -             |
| Standard value                                                                                                                                                                      | N/A                | N/A                | N/A                | 1.1^          | N/A           |
| Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system                                                                                           |                    |                    |                    |               | YES           |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

### 6- Extract Only Local (B.0.06 Laundrette)

|                                                                                           | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| This system                                                                               | 0                  | -                  | -                  | -             | -             |
| Standard value                                                                            | N/A                | N/A                | N/A                | N/A           | N/A           |
| Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system |                    |                    |                    |               | YES           |



### 7- Extract Only Central (6 Zones)

|                                                                                                      | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                   | 0.94               | -                  | -                  | -             | -             |
| <b>Standard value</b>                                                                                | N/A                | N/A                | N/A                | N/A           | N/A           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b> |                    |                    |                    |               | YES           |

### 8- Hall (2 Zones)

|                                                                                                                                                                                                                                                   | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                                                                                                                                                                | 0.94               | -                  | -                  | 1.8           | 0.73          |
| <b>Standard value</b>                                                                                                                                                                                                                             | 0.91*              | N/A                | N/A                | 1.5^          | 0.5           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b>                                                                                                                                              |                    |                    |                    |               | YES           |
| * Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82. |                    |                    |                    |               |               |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.                                                               |                    |                    |                    |               |               |

### 9- B.0.05 Toilets (4 Zones)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                                                                                                  | 0.94               | -                  | -                  | 0.78          | 0.5           |
| <b>Standard value</b>                                                                                                                                                               | N/A                | N/A                | N/A                | 1.1^          | N/A           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b>                                                                                |                    |                    |                    |               | YES           |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

### 10- B.1.03 Activity room Kit (B.1.03 Activity Room)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                                                                                                  | 0.94               | -                  | -                  | 1.43          | 0.5           |
| <b>Standard value</b>                                                                                                                                                               | N/A                | N/A                | N/A                | 1.1^          | N/A           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b>                                                                                |                    |                    |                    |               | YES           |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

### 11- B.3.02 Juice bar (B.3.02 Juice Bar)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                                                                                                  | 0                  | -                  | -                  | 1.43          | 0.8           |
| <b>Standard value</b>                                                                                                                                                               | N/A                | N/A                | N/A                | 1.1^          | 0.5           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b>                                                                                |                    |                    |                    |               | YES           |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

### 12- GF meeting rooms (3 Zones)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                                                                                                  | 0.94               | -                  | -                  | 1.4           | 0.5           |
| <b>Standard value</b>                                                                                                                                                               | N/A                | N/A                | N/A                | 1.1^          | 0.5           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b>                                                                                |                    |                    |                    |               | YES           |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

## 13- Kitchen (B.0.07 Kitchen)

|                                                                                                                                                                                                                                                   | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                                                                                                                                                                | 0.94               | -                  | -                  | 0.78          | -             |
| <b>Standard value</b>                                                                                                                                                                                                                             | 0.91*              | N/A                | N/A                | 1.1^          | N/A           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b>                                                                                                                                              |                    |                    |                    |               | YES           |
| * Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82. |                    |                    |                    |               |               |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.                                                               |                    |                    |                    |               |               |

## 14- plantroom (LG\_Plantroom)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                                                                                                  | 0                  | -                  | -                  | 1.39          | 0.7           |
| <b>Standard value</b>                                                                                                                                                               | N/A                | N/A                | N/A                | 1.1^          | 0.5           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b>                                                                                |                    |                    |                    |               | YES           |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

## 15- kiln room (B.1.04 Activity Room)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                                                                                                  | 0.94               | -                  | -                  | 0.97          | 0.7           |
| <b>Standard value</b>                                                                                                                                                               | N/A                | N/A                | N/A                | 1.1^          | 0.5           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b>                                                                                |                    |                    |                    |               | YES           |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

## 1- New HWS Circuit

|                       | Water heating efficiency | Storage loss factor [kWh/litre per day] |
|-----------------------|--------------------------|-----------------------------------------|
| <b>This building</b>  | 0.94                     | 0                                       |
| <b>Standard value</b> | N/A                      | N/A                                     |

## Local mechanical ventilation, exhaust, and terminal units

| ID | System type in Non-domestic Building Services Compliance Guide                                          |
|----|---------------------------------------------------------------------------------------------------------|
| A  | Local supply or extract ventilation units serving a single area                                         |
| B  | Zonal supply system where the fan is remote from the zone                                               |
| C  | Zonal extract system where the fan is remote from the zone                                              |
| D  | Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery |
| E  | Local supply and extract ventilation system serving a single area with heating and heat recovery        |
| F  | Other local ventilation units                                                                           |
| G  | Fan-assisted terminal VAV unit                                                                          |
| H  | Fan coil units                                                                                          |
| I  | Zonal extract system where the fan is remote from the zone with grease filter                           |

| Zone name         | SFP [W/(l/s)] |     |     |     |     |     |     |     |   |   | HR efficiency |          |
|-------------------|---------------|-----|-----|-----|-----|-----|-----|-----|---|---|---------------|----------|
| ID of system type | A             | B   | C   | D   | E   | F   | G   | H   | I |   | Zone          | Standard |
| Standard value    | 0.3           | 1.1 | 0.5 | 1.9 | 1.6 | 0.5 | 1.1 | 0.5 | 1 |   |               |          |
| B.0.06 Laundrette | 0.4           | -   | -   | -   | -   | -   | -   | -   | - | - | -             | N/A      |
| B.1.06 WC         | -             | -   | 0.5 | -   | -   | -   | -   | -   | - | - | -             | N/A      |
| B.1.05 Dis WC     | -             | -   | 0.3 | -   | -   | -   | -   | -   | - | - | -             | N/A      |
| B.2.06 Dis WC     | -             | -   | 0.5 | -   | -   | -   | -   | -   | - | - | -             | N/A      |



| Zone name         | SFP [W/(l/s)] |     |     |     |     |     |     |     |   |      | HR efficiency |  |
|-------------------|---------------|-----|-----|-----|-----|-----|-----|-----|---|------|---------------|--|
| ID of system type | A             | B   | C   | D   | E   | F   | G   | H   | I |      |               |  |
| Standard value    | 0.3           | 1.1 | 0.5 | 1.9 | 1.6 | 0.5 | 1.1 | 0.5 | 1 | Zone | Standard      |  |
| B.2.07 WC         | -             | -   | 0.5 | -   | -   | -   | -   | -   | - | -    | N/A           |  |
| B.3.09 WC         | -             | -   | 0.5 | -   | -   | -   | -   | -   | - | -    | N/A           |  |
| B.3.08 Dis WC     | -             | -   | 0.5 | -   | -   | -   | -   | -   | - | -    | N/A           |  |

| General lighting and display lighting |                | Luminous efficacy [lm/W] |      |              | General lighting [W] |
|---------------------------------------|----------------|--------------------------|------|--------------|----------------------|
| Zone name                             |                | Luminaire                | Lamp | Display lamp |                      |
|                                       | Standard value | 60                       | 60   | 22           |                      |
| Hall A                                |                | -                        | 60   | -            | 632                  |
| B.0.01 Office                         |                | 60                       | -    | -            | 164                  |
| B.0.02 Cafe Seating                   |                | -                        | 60   | -            | 132                  |
| B.0.03 Seating                        |                | -                        | 60   | -            | 180                  |
| B.0.05 Toilets - Lobby                |                | -                        | 60   | -            | 48                   |
| B.0.05 Toilets - Dis WC               |                | -                        | 60   | -            | 46                   |
| B.0.05 Toilets - WCs                  |                | -                        | 60   | -            | 101                  |
| B.0.05 Toilets - Serperate WC         |                | -                        | 60   | -            | 25                   |
| B.0.06 Laundrette                     |                | -                        | 60   | -            | 60                   |
| B.0.07 Kitchen                        |                | -                        | 60   | -            | 175                  |
| B.0.08 Servery                        |                | -                        | 60   | -            | 276                  |
| B.0.0X Stairs 1                       |                | -                        | 60   | -            | 104                  |
| B.0.0X Stairs 2                       |                | -                        | 60   | -            | 187                  |
| B.0.0X Second entrance                |                | -                        | 60   | -            | 47                   |
| B.0.0X Entrance Circ A                |                | -                        | 60   | -            | 533                  |
| B.0.09 Main Hall Store                |                | 60                       | -    | -            | 58                   |
| B.0.10 Gym                            |                | -                        | 60   | -            | 387                  |
| B.0.10 Gym WC                         |                | -                        | 60   | -            | 35                   |
| B.1.01 Office                         |                | 60                       | -    | -            | 348                  |
| B.1.02 Office                         |                | 60                       | -    | -            | 305                  |
| B.1.03 Activity Room                  |                | 60                       | -    | -            | 788                  |
| B.1.04 Activity Room                  |                | 60                       | -    | -            | 710                  |
| B.1.0X Stair 1                        |                | -                        | 60   | -            | 317                  |
| B.1.0X Stair 2                        |                | -                        | 60   | -            | 212                  |
| B.1.07 Circulation                    |                | -                        | 60   | -            | 124                  |
| B.1.06 WC                             |                | -                        | 60   | -            | 39                   |
| B.1.05 Dis WC                         |                | -                        | 60   | -            | 47                   |
| B.1.08 Store                          |                | 60                       | -    | -            | 8                    |
| B.2.01 Activity Room                  |                | 60                       | -    | -            | 329                  |
| B.2.02 Activity Room                  |                | 60                       | -    | -            | 361                  |
| B.2.03 Activity Room                  |                | 60                       | -    | -            | 634                  |
| B.2.04 Activity Room                  |                | 60                       | -    | -            | 570                  |
| B.2.05 Office                         |                | 60                       | -    | -            | 332                  |
| B.2.08 Circulation                    |                | -                        | 60   | -            | 109                  |
| B.2.0X Stairs 1                       |                | -                        | 60   | -            | 312                  |
| B.2.0X Stairs 2                       |                | -                        | 60   | -            | 212                  |

| General lighting and display lighting |                | Luminous efficacy [lm/W] |      |              | General lighting [W] |
|---------------------------------------|----------------|--------------------------|------|--------------|----------------------|
| Zone name                             |                | Luminaire                | Lamp | Display lamp |                      |
|                                       | Standard value | 60                       | 60   | 22           |                      |
| B.2.06 Dis WC                         |                | -                        | 60   | -            | 47                   |
| B.2.07 WC                             |                | -                        | 60   | -            | 39                   |
| B.2.09 Store                          |                | 60                       | -    | -            | 8                    |
| B.3.01 Activity Space                 |                | 60                       | -    | -            | 750                  |
| B.3.02 Juice Bar                      |                | -                        | 60   | -            | 216                  |
| B.3.03 Office                         |                | 60                       | -    | -            | 458                  |
| B.3.04 1 to 1                         |                | 60                       | -    | -            | 131                  |
| B.3.05 Large 1 to 1                   |                | 60                       | -    | -            | 158                  |
| B.3.06 Recording Studio               |                | 60                       | -    | -            | 182                  |
| B.3.07 Open Plan Classroom            |                | -                        | 60   | -            | 241                  |
| B.3.0X Stairs 1                       |                | -                        | 60   | -            | 313                  |
| B.3.0X Stairs 2                       |                | -                        | 60   | -            | 212                  |
| B.3.09 WC                             |                | -                        | 60   | -            | 39                   |
| B.3.08 Dis WC                         |                | -                        | 60   | -            | 47                   |
| B.3.12 Circulation                    |                | -                        | 60   | -            | 169                  |
| B.3.02 Juice Bar - Seating area       |                | -                        | 60   | -            | 43                   |
| B.0.0X Entrance Circ B                |                | -                        | 60   | -            | 196                  |
| Hall B                                |                | -                        | 60   | -            | 1589                 |
| B.0.18 Cleaners                       |                | 60                       | -    | -            | 18                   |
| B.0.21 Activity room 1                |                | 60                       | -    | -            | 168                  |
| B.0.22 Activity room 2                |                | 60                       | -    | -            | 175                  |
| B.0.23 Activity room 3                |                | 60                       | -    | -            | 150                  |
| B.3.13 Store                          |                | 60                       | -    | -            | 8                    |
| LG_Plantroom                          |                | 60                       | -    | -            | 514                  |
| LG_Corridor                           |                | -                        | 60   | -            | 107                  |

**Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains**

| Zone                  | Solar gain limit exceeded? (%) | Internal blinds used? |
|-----------------------|--------------------------------|-----------------------|
| Hall A                | YES (+1%)                      | NO                    |
| B.0.01 Office         | NO (-99%)                      | NO                    |
| B.0.02 Cafe Seating   | NO (-38%)                      | NO                    |
| B.0.10 Gym            | NO (-23%)                      | NO                    |
| B.1.01 Office         | NO (-68%)                      | NO                    |
| B.1.02 Office         | NO (-76%)                      | NO                    |
| B.1.03 Activity Room  | NO (-73%)                      | NO                    |
| B.1.04 Activity Room  | NO (-89%)                      | NO                    |
| B.2.01 Activity Room  | NO (-82%)                      | NO                    |
| B.2.02 Activity Room  | NO (-86%)                      | NO                    |
| B.2.03 Activity Room  | NO (-79%)                      | NO                    |
| B.2.04 Activity Room  | NO (-85%)                      | NO                    |
| B.2.05 Office         | NO (-67%)                      | NO                    |
| B.3.01 Activity Space | NO (-78%)                      | NO                    |
| B.3.03 Office         | NO (-85%)                      | NO                    |

| Zone                            | Solar gain limit exceeded? (%) | Internal blinds used? |
|---------------------------------|--------------------------------|-----------------------|
| B.3.04 1 to 1                   | NO (-73%)                      | NO                    |
| B.3.05 Large 1 to 1             | NO (-79%)                      | NO                    |
| B.3.06 Recording Studio         | N/A                            | N/A                   |
| B.3.07 Open Plan Classroom      | NO (-77%)                      | NO                    |
| B.3.02 Juice Bar - Seating area | NO (-95%)                      | NO                    |
| Hall B                          | NO (-76%)                      | NO                    |
| B.0.21 Activity room 1          | NO (-48%)                      | NO                    |
| B.0.22 Activity room 2          | NO (-51%)                      | NO                    |
| B.0.23 Activity room 3          | NO (-39%)                      | NO                    |

#### Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

#### Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

#### EPBD (Recast): Consideration of alternative energy systems

|                                                                                        |    |
|----------------------------------------------------------------------------------------|----|
| Were alternative energy systems considered and analysed as part of the design process? | NO |
| Is evidence of such assessment available as a separate submission?                     | NO |
| Are any such measures included in the proposed design?                                 | NO |



# Technical Data Sheet (Actual vs. Notional Building)

## Building Global Parameters

|                                                       | Actual | Notional |
|-------------------------------------------------------|--------|----------|
| Area [m <sup>2</sup> ]                                | 1688   | 1688     |
| External area [m <sup>2</sup> ]                       | 3018   | 3018     |
| Weather                                               | LON    | LON      |
| Infiltration [m <sup>3</sup> /hm <sup>2</sup> @ 50Pa] | 3      | 4        |
| Average conductance [W/K]                             | 952    | 1181     |
| Average U-value [W/m <sup>2</sup> K]                  | 0.32   | 0.39     |
| Alpha value* [%]                                      | 21.53  | 21.53    |

\* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

## Building Use

| % Area | Building Type                                                      |
|--------|--------------------------------------------------------------------|
|        | A1/A2 Retail/Financial and Professional services                   |
|        | A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways             |
|        | B1 Offices and Workshop businesses                                 |
|        | B2 to B7 General Industrial and Special Industrial Groups          |
|        | B8 Storage or Distribution                                         |
|        | C1 Hotels                                                          |
|        | C2 Residential Institutions: Hospitals and Care Homes              |
|        | C2 Residential Institutions: Residential schools                   |
|        | C2 Residential Institutions: Universities and colleges             |
|        | C2A Secure Residential Institutions                                |
|        | Residential spaces                                                 |
| 100    | <b>D1 Non-residential Institutions: Community/Day Centre</b>       |
|        | D1 Non-residential Institutions: Libraries, Museums, and Galleries |
|        | D1 Non-residential Institutions: Education                         |
|        | D1 Non-residential Institutions: Primary Health Care Building      |
|        | D1 Non-residential Institutions: Crown and County Courts           |
|        | D2 General Assembly and Leisure, Night Clubs, and Theatres         |
|        | Others: Passenger terminals                                        |
|        | Others: Emergency services                                         |
|        | Others: Miscellaneous 24hr activities                              |
|        | Others: Car Parks 24 hrs                                           |
|        | Others: Stand alone utility block                                  |

## Energy Consumption by End Use [kWh/m<sup>2</sup>]

|                | Actual       | Notional     |
|----------------|--------------|--------------|
| Heating        | 7.31         | 12.88        |
| Cooling        | 0.03         | 0.01         |
| Auxiliary      | 1.83         | 2.05         |
| Lighting       | 18.52        | 14.14        |
| Hot water      | 26.86        | 26.26        |
| Equipment*     | 28.18        | 28.18        |
| <b>TOTAL**</b> | <b>54.55</b> | <b>55.33</b> |

\* Energy used by equipment does not count towards the total for consumption or calculating emissions.

\*\* Total is net of any electrical energy displaced by CHP generators, if applicable.

## Energy Production by Technology [kWh/m<sup>2</sup>]

|                       | Actual | Notional |
|-----------------------|--------|----------|
| Photovoltaic systems  | 0      | 0        |
| Wind turbines         | 0      | 0        |
| CHP generators        | 0      | 0        |
| Solar thermal systems | 0      | 0        |

## Energy & CO<sub>2</sub> Emissions Summary

|                                               | Actual | Notional |
|-----------------------------------------------|--------|----------|
| Heating + cooling demand [MJ/m <sup>2</sup> ] | 25.49  | 40.93    |
| Primary energy* [kWh/m <sup>2</sup> ]         | 103.66 | 96.32    |
| Total emissions [kg/m <sup>2</sup> ]          | 17.9   | 16.7     |

\* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.



## HVAC Systems Performance

| System Type                                                                                                   |          | Heat dem<br>MJ/m2 | Cool dem<br>MJ/m2 | Heat con<br>kWh/m2 | Cool con<br>kWh/m2 | Aux con<br>kWh/m2 | Heat<br>SSEEF | Cool<br>SSEER | Heat gen<br>SEFF | Cool gen<br>SEER |
|---------------------------------------------------------------------------------------------------------------|----------|-------------------|-------------------|--------------------|--------------------|-------------------|---------------|---------------|------------------|------------------|
| [ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity                      |          |                   |                   |                    |                    |                   |               |               |                  |                  |
|                                                                                                               | Actual   | 4.8               | 19.9              | 0.3                | 1                  | 1.6               | 4.7           | 5.44          | 4.7              | 5.44             |
|                                                                                                               | Notional | 12.7              | 4.1               | 1.5                | 0.3                | 1.2               | 2.43          | 3.6           | ----             | ----             |
| [ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity       |          |                   |                   |                    |                    |                   |               |               |                  |                  |
|                                                                                                               | Actual   | 28.5              | 0                 | 8.9                | 0                  | 1                 | 0.89          | 0             | 0.94             | 0                |
|                                                                                                               | Notional | 64.2              | 0                 | 21.8               | 0                  | 1.1               | 0.82          | 0             | ----             | ----             |
| [ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity           |          |                   |                   |                    |                    |                   |               |               |                  |                  |
|                                                                                                               | Actual   | 39.3              | 0                 | 12.2               | 0                  | 1.1               | 0.89          | 0             | 0.94             | 0                |
|                                                                                                               | Notional | 48.2              | 0                 | 16.4               | 0                  | 1.1               | 0.82          | 0             | ----             | ----             |
| [ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity |          |                   |                   |                    |                    |                   |               |               |                  |                  |
|                                                                                                               | Actual   | 0.5               | 0                 | 0                  | 0                  | 3.2               | 4.7           | 0             | 4.7              | 0                |
|                                                                                                               | Notional | 8.6               | 0                 | 1                  | 0                  | 2.1               | 2.43          | 0             | ----             | ----             |
| [ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity       |          |                   |                   |                    |                    |                   |               |               |                  |                  |
|                                                                                                               | Actual   | 27.9              | 0                 | 8.7                | 0                  | 2.8               | 0.89          | 0             | 0.94             | 0                |
|                                                                                                               | Notional | 22.8              | 0                 | 7.7                | 0                  | 6.3               | 0.82          | 0             | ----             | ----             |
| [ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity       |          |                   |                   |                    |                    |                   |               |               |                  |                  |
|                                                                                                               | Actual   | 0                 | 0                 | 0                  | 0                  | 18.9              | 0             | 0             | 0                | 0                |
|                                                                                                               | Notional | 0                 | 0                 | 0                  | 0                  | 18.1              | 0             | 0             | ----             | ----             |
| [ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity           |          |                   |                   |                    |                    |                   |               |               |                  |                  |
|                                                                                                               | Actual   | 16.8              | 0                 | 5.2                | 0                  | 9.1               | 0.89          | 0             | 0.94             | 0                |
|                                                                                                               | Notional | 22.9              | 0                 | 7.8                | 0                  | 11.3              | 0.82          | 0             | ----             | ----             |
| [ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity           |          |                   |                   |                    |                    |                   |               |               |                  |                  |
|                                                                                                               | Actual   | 23.1              | 0                 | 7.2                | 0                  | 3.2               | 0.89          | 0             | 0.94             | 0                |
|                                                                                                               | Notional | 63                | 0                 | 20.3               | 0                  | 3.6               | 0.86          | 0             | ----             | ----             |
| [ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity       |          |                   |                   |                    |                    |                   |               |               |                  |                  |
|                                                                                                               | Actual   | 8                 | 0                 | 2.5                | 0                  | 4.9               | 0.89          | 0             | 0.94             | 0                |
|                                                                                                               | Notional | 3.4               | 0                 | 1.2                | 0                  | 9.5               | 0.82          | 0             | ----             | ----             |
| [ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity           |          |                   |                   |                    |                    |                   |               |               |                  |                  |
|                                                                                                               | Actual   | 0.1               | 0                 | 0                  | 0                  | 4.3               | 0.89          | 0             | 0.94             | 0                |
|                                                                                                               | Notional | 0.5               | 0                 | 0.2                | 0                  | 3.9               | 0.82          | 0             | ----             | ----             |
| [ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity           |          |                   |                   |                    |                    |                   |               |               |                  |                  |
|                                                                                                               | Actual   | 0                 | 0                 | 0                  | 0                  | 8.2               | 0             | 0             | 0                | 0                |
|                                                                                                               | Notional | 0                 | 0                 | 0                  | 0                  | 6.5               | 0             | 0             | ----             | ----             |
| [ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity       |          |                   |                   |                    |                    |                   |               |               |                  |                  |
|                                                                                                               | Actual   | 39.7              | 0                 | 12.4               | 0                  | 5.9               | 0.89          | 0             | 0.94             | 0                |
|                                                                                                               | Notional | 20.5              | 0                 | 6.9                | 0                  | 7.4               | 0.82          | 0             | ----             | ----             |
| [ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity           |          |                   |                   |                    |                    |                   |               |               |                  |                  |
|                                                                                                               | Actual   | 0.1               | 0                 | 0                  | 0                  | 4.7               | 0.89          | 0             | 0.94             | 0                |
|                                                                                                               | Notional | 0                 | 0                 | 0                  | 0                  | 6.5               | 0             | 0             | ----             | ----             |
| [ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity           |          |                   |                   |                    |                    |                   |               |               |                  |                  |
|                                                                                                               | Actual   | 0                 | 0                 | 0                  | 0                  | 0                 | 0             | 0             | 0                | 0                |
|                                                                                                               | Notional | 0                 | 0                 | 0                  | 0                  | 0                 | 0             | 0             | ----             | ----             |
| [ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity           |          |                   |                   |                    |                    |                   |               |               |                  |                  |
|                                                                                                               | Actual   | 0.1               | 0                 | 0                  | 0                  | 3.3               | 0.89          | 0             | 0.94             | 0                |
|                                                                                                               | Notional | 1.4               | 0                 | 0.5                | 0                  | 4.6               | 0.82          | 0             | ----             | ----             |

## Key to terms

|                                |                                                                                                       |
|--------------------------------|-------------------------------------------------------------------------------------------------------|
| Heat dem [MJ/m <sup>2</sup> ]  | = Heating energy demand                                                                               |
| Cool dem [MJ/m <sup>2</sup> ]  | = Cooling energy demand                                                                               |
| Heat con [kWh/m <sup>2</sup> ] | = Heating energy consumption                                                                          |
| Cool con [kWh/m <sup>2</sup> ] | = Cooling energy consumption                                                                          |
| Aux con [kWh/m <sup>2</sup> ]  | = Auxiliary energy consumption                                                                        |
| Heat SSEFF                     | = Heating system seasonal efficiency (for notional building, value depends on activity glazing class) |
| Cool SSEER                     | = Cooling system seasonal energy efficiency ratio                                                     |
| Heat gen SSEFF                 | = Heating generator seasonal efficiency                                                               |
| Cool gen SSEER                 | = Cooling generator seasonal energy efficiency ratio                                                  |
| ST                             | = System type                                                                                         |
| HS                             | = Heat source                                                                                         |
| HFT                            | = Heating fuel type                                                                                   |
| CFT                            | = Cooling fuel type                                                                                   |

## Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

### Building fabric

| Element                                                                                                                                    | U <sub>i-Typ</sub> | U <sub>i-Min</sub> | Surface where the minimum value occurs* |
|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|-----------------------------------------|
| Wall                                                                                                                                       | 0.23               | 0.22               | External Wall                           |
| Floor                                                                                                                                      | 0.2                | 0.11               | Ground Floor                            |
| Roof                                                                                                                                       | 0.15               | 0.14               | Roof                                    |
| Windows, roof windows, and rooflights                                                                                                      | 1.5                | 1.5                | Curtain wall                            |
| Personnel doors                                                                                                                            | 1.5                | 1.59               | Gym Door                                |
| Vehicle access & similar large doors                                                                                                       | 1.5                | -                  | No vehicle doors in project             |
| High usage entrance doors                                                                                                                  | 1.5                | -                  | No high usage entrance doors in project |
| U <sub>i-Typ</sub> = Typical individual element U-values [W/(m²K)]      U <sub>i-Min</sub> = Minimum individual element U-values [W/(m²K)] |                    |                    |                                         |
| * There might be more than one surface where the minimum U-value occurs.                                                                   |                    |                    |                                         |

| Air Permeability   | Typical value | This building |
|--------------------|---------------|---------------|
| m³/(h.m²) at 50 Pa | 5             | 3             |

## APPENDIX C2 - COMMUNITY CENTRE - PART L RESULTS “GREEN”



## Project name

**Highgate Newton Community Centre**

As designed

Date: Fri Feb 07 18:51:59 2020

## Administrative information

## Building Details

Address: Highgate Newton Community Centre, London,

## Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.4"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.4

BRUKL compliance check version: v5.6.a.1

## Owner Details

Name:

Telephone number:

Address: , ,

## Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO<sub>2</sub> emission rate for the building must not exceed the target

|                                                                                                    |                     |
|----------------------------------------------------------------------------------------------------|---------------------|
| CO <sub>2</sub> emission rate from the notional building, kgCO <sub>2</sub> /m <sup>2</sup> .annum | 15.9                |
| Target CO <sub>2</sub> emission rate (TER), kgCO <sub>2</sub> /m <sup>2</sup> .annum               | 15.9                |
| Building CO <sub>2</sub> emission rate (BER), kgCO <sub>2</sub> /m <sup>2</sup> .annum             | 12                  |
| Are emissions from the building less than or equal to the target?                                  | BER =< TER          |
| Are as built details the same as used in the BER calculations?                                     | Separate submission |

## Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

## Building fabric

| Element                                  | U <sub>a</sub> -Limit | U <sub>a</sub> -Calc | U <sub>i</sub> -Calc | Surface where the maximum value occurs* |
|------------------------------------------|-----------------------|----------------------|----------------------|-----------------------------------------|
| Wall**                                   | 0.35                  | 0.22                 | 0.22                 | External Wall                           |
| Floor                                    | 0.25                  | 0.14                 | 0.18                 | Ground Floor Hall                       |
| Roof                                     | 0.25                  | 0.16                 | 0.18                 | Roof Hall                               |
| Windows***, roof windows, and rooflights | 2.2                   | 1.65                 | 1.9                  | 1F CW part 1                            |
| Personnel doors                          | 2.2                   | 1.72                 | 1.74                 | D12                                     |
| Vehicle access & similar large doors     | 1.5                   | -                    | -                    | No vehicle doors in project             |
| High usage entrance doors                | 3.5                   | -                    | -                    | No high usage entrance doors in project |

U<sub>a</sub>-Limit = Limiting area-weighted average U-values [W/(m<sup>2</sup>K)]U<sub>a</sub>-Calc = Calculated area-weighted average U-values [W/(m<sup>2</sup>K)]U<sub>i</sub>-Calc = Calculated maximum individual element U-values [W/(m<sup>2</sup>K)]

\* There might be more than one surface where the maximum U-value occurs.

\*\* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

\*\*\* Display windows and similar glazing are excluded from the U-value check.

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

| Air Permeability                             | Worst acceptable standard | This building |
|----------------------------------------------|---------------------------|---------------|
| m <sup>3</sup> /(h.m <sup>2</sup> ) at 50 Pa | 10                        | 3.1           |

## Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

|                                                                                              |             |
|----------------------------------------------------------------------------------------------|-------------|
| Whole building lighting automatic monitoring & targeting with alarms for out-of-range values | NO          |
| Whole building electric power factor achieved by power factor correction                     | 0.9 to 0.95 |

### 1- Gym (B.0.10 Gym)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| This system                                                                                                                                                                         | 4.7                | 5.44               | -                  | 1.22          | 0.83          |
| Standard value                                                                                                                                                                      | N/A                | 2.6                | N/A                | 1.6^          | 0.5           |
| Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system                                                                                           |                    |                    |                    |               | YES           |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

### 2- NV + UFH

|                                                                                           | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| This system                                                                               | 1.43               | -                  | -                  | -             | -             |
| Standard value                                                                            | N/A                | N/A                | N/A                | N/A           | N/A           |
| Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system |                    |                    |                    |               | YES           |

### 3- NV + Rads

|                                                                                           | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| This system                                                                               | 1.43               | -                  | -                  | -             | -             |
| Standard value                                                                            | N/A                | N/A                | N/A                | N/A           | N/A           |
| Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system |                    |                    |                    |               | YES           |

### 4- Recording Studio (B.3.06 Recording Studio)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| This system                                                                                                                                                                         | 4.7                | -                  | -                  | 1.4           | 0.5           |
| Standard value                                                                                                                                                                      | 2.5*               | N/A                | N/A                | 1.6^          | 0.5           |
| Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system                                                                                           |                    |                    |                    |               | YES           |
| * Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.                   |                    |                    |                    |               |               |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

### 5- B.0.01 Office - UFH + Supply only (B.0.01 Office)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| This system                                                                                                                                                                         | 1.43               | -                  | -                  | 0.51          | -             |
| Standard value                                                                                                                                                                      | N/A                | N/A                | N/A                | 1.1^          | N/A           |
| Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system                                                                                           |                    |                    |                    |               | YES           |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

### 6- Kitchen (B.0.07 Kitchen)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| This system                                                                                                                                                                         | 1.43               | -                  | -                  | 0.78          | -             |
| Standard value                                                                                                                                                                      | N/A                | N/A                | N/A                | 1.1^          | N/A           |
| Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system                                                                                           |                    |                    |                    |               | YES           |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |



7- Extract Only Local (B.0.06 Laundrette)

|                                                                                                      | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                   | 0                  | -                  | -                  | -             | -             |
| <b>Standard value</b>                                                                                | N/A                | N/A                | N/A                | N/A           | N/A           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b> |                    |                    |                    |               | YES           |

8- Extract Only Central (6 Zones)

|                                                                                                      | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                   | 1.43               | -                  | -                  | -             | -             |
| <b>Standard value</b>                                                                                | N/A                | N/A                | N/A                | N/A           | N/A           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b> |                    |                    |                    |               | YES           |

9- Hall (2 Zones)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                                                                                                  | 1.43               | -                  | -                  | 1.8           | 0.73          |
| <b>Standard value</b>                                                                                                                                                               | N/A                | N/A                | N/A                | 1.5^          | 0.5           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b>                                                                                |                    |                    |                    |               | YES           |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

10- B.0.05 Toilets (4 Zones)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                                                                                                  | 1.43               | -                  | -                  | 0.78          | 0.5           |
| <b>Standard value</b>                                                                                                                                                               | N/A                | N/A                | N/A                | 1.1^          | N/A           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b>                                                                                |                    |                    |                    |               | YES           |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

11- B.1.03 Activity room Kit (B.1.03 Activity Room)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                                                                                                  | 1.43               | -                  | -                  | 1.43          | 0.5           |
| <b>Standard value</b>                                                                                                                                                               | N/A                | N/A                | N/A                | 1.1^          | N/A           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b>                                                                                |                    |                    |                    |               | YES           |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

12- B.3.02 Juice bar (B.3.02 Juice Bar)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                                                                                                  | 0                  | -                  | -                  | 1.43          | 0.8           |
| <b>Standard value</b>                                                                                                                                                               | N/A                | N/A                | N/A                | 1.1^          | 0.5           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b>                                                                                |                    |                    |                    |               | YES           |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

13- GF meeting rooms (3 Zones)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                                                                                                  | 1.43               | -                  | -                  | 1.4           | 0.7           |
| <b>Standard value</b>                                                                                                                                                               | N/A                | N/A                | N/A                | 1.1^          | 0.5           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b>                                                                                |                    |                    |                    |               | YES           |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

## 14- B1.04 Kiln room (B.1.04 Activity Room)

|                                                                                                                                                                                     | Heating efficiency | Cooling efficiency | Radiant efficiency | SFP [W/(l/s)] | HR efficiency |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|---------------|
| <b>This system</b>                                                                                                                                                                  | 1.43               | -                  | -                  | 0.97          | 0.7           |
| <b>Standard value</b>                                                                                                                                                               | N/A                | N/A                | N/A                | 1.1^          | 0.5           |
| <b>Automatic monitoring &amp; targeting with alarms for out-of-range values for this HVAC system</b>                                                                                |                    |                    |                    |               | YES           |
| ^ Limiting SFP may be extended by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide. |                    |                    |                    |               |               |

## 1- New HWS Circuit

|                       | Water heating efficiency | Storage loss factor [kWh/litre per day] |
|-----------------------|--------------------------|-----------------------------------------|
| <b>This building</b>  | 1.43                     | 0                                       |
| <b>Standard value</b> | N/A                      | N/A                                     |

## Local mechanical ventilation, exhaust, and terminal units

| ID | System type in Non-domestic Building Services Compliance Guide                                          |
|----|---------------------------------------------------------------------------------------------------------|
| A  | Local supply or extract ventilation units serving a single area                                         |
| B  | Zonal supply system where the fan is remote from the zone                                               |
| C  | Zonal extract system where the fan is remote from the zone                                              |
| D  | Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery |
| E  | Local supply and extract ventilation system serving a single area with heating and heat recovery        |
| F  | Other local ventilation units                                                                           |
| G  | Fan-assisted terminal VAV unit                                                                          |
| H  | Fan coil units                                                                                          |
| I  | Zonal extract system where the fan is remote from the zone with grease filter                           |

| Zone name         | SFP [W/(l/s)]     |     |     |     |     |     |     |     |     |   | HR efficiency |          |
|-------------------|-------------------|-----|-----|-----|-----|-----|-----|-----|-----|---|---------------|----------|
|                   | ID of system type | A   | B   | C   | D   | E   | F   | G   | H   | I | Zone          | Standard |
|                   | Standard value    | 0.3 | 1.1 | 0.5 | 1.9 | 1.6 | 0.5 | 1.1 | 0.5 | 1 |               |          |
| B.0.06 Laundrette |                   | 0.4 | -   | -   | -   | -   | -   | -   | -   | - | -             | N/A      |
| B.1.06 WC         |                   | -   | -   | 0.5 | -   | -   | -   | -   | -   | - | -             | N/A      |
| B.1.05 Dis WC     |                   | -   | -   | 0.3 | -   | -   | -   | -   | -   | - | -             | N/A      |
| B.2.06 Dis WC     |                   | -   | -   | 0.5 | -   | -   | -   | -   | -   | - | -             | N/A      |
| B.2.07 WC         |                   | -   | -   | 0.5 | -   | -   | -   | -   | -   | - | -             | N/A      |
| B.3.09 WC         |                   | -   | -   | 0.5 | -   | -   | -   | -   | -   | - | -             | N/A      |
| B.3.08 Dis WC     |                   | -   | -   | 0.5 | -   | -   | -   | -   | -   | - | -             | N/A      |

## General lighting and display lighting

| Zone name                     | Luminous efficacy [lm/W] |      |              | General lighting [W] |
|-------------------------------|--------------------------|------|--------------|----------------------|
|                               | Luminaire                | Lamp | Display lamp |                      |
|                               | Standard value           | 60   | 60           | 22                   |
| Hall A                        | -                        | -    | -            | 448                  |
| B.0.01 Office                 | -                        | -    | -            | 94                   |
| B.0.02 Cafe Seating           | -                        | 100  | -            | 79                   |
| B.0.03 Seating                | -                        | 100  | -            | 108                  |
| B.0.05 Toilets - Lobby        | -                        | 100  | -            | 29                   |
| B.0.05 Toilets - Dis WC       | -                        | 100  | -            | 27                   |
| B.0.05 Toilets - WCs          | -                        | 100  | -            | 61                   |
| B.0.05 Toilets - Serperate WC | -                        | 100  | -            | 15                   |
| B.0.06 Laundrette             | -                        | -    | -            | 22                   |



| General lighting and display lighting |                | Luminous efficacy [lm/W] |      |              | General lighting [W] |
|---------------------------------------|----------------|--------------------------|------|--------------|----------------------|
| Zone name                             |                | Luminaire                | Lamp | Display lamp |                      |
|                                       | Standard value | 60                       | 60   | 22           |                      |
| B.0.07 Kitchen                        |                | -                        | 100  | -            | 105                  |
| B.0.08 Servery                        |                | -                        | 100  | -            | 165                  |
| B.0.0X Stairs 1                       |                | -                        | 100  | -            | 62                   |
| B.0.0X Stairs 2                       |                | -                        | 100  | -            | 112                  |
| B.0.0X Second entrance                |                | -                        | -    | -            | 72                   |
| B.0.0X Entrance Circ A                |                | -                        | -    | -            | 502                  |
| B.0.09 Main Hall Store                |                | 100                      | -    | -            | 35                   |
| B.0.10 Gym                            |                | -                        | -    | -            | 305                  |
| B.0.10 Gym WC                         |                | -                        | 100  | -            | 21                   |
| B.1.01 Office                         |                | -                        | -    | -            | 169                  |
| B.1.02 Office                         |                | -                        | -    | -            | 176                  |
| B.1.03 Activity Room                  |                | -                        | -    | -            | 368                  |
| B.1.04 Activity Room                  |                | -                        | -    | -            | 316                  |
| B.1.0X Stair 1                        |                | -                        | 100  | -            | 190                  |
| B.1.0X Stair 2                        |                | -                        | 100  | -            | 127                  |
| B.1.07 Circulation                    |                | -                        | 100  | -            | 50                   |
| B.1.06 WC                             |                | -                        | 100  | -            | 23                   |
| B.1.05 Dis WC                         |                | -                        | 100  | -            | 28                   |
| B.1.08 Store                          |                | -                        | -    | -            | 15                   |
| B.2.01 Activity Room                  |                | -                        | -    | -            | 42                   |
| B.2.02 Activity Room                  |                | -                        | -    | -            | 41                   |
| B.2.03 Activity Room                  |                | -                        | -    | -            | 74                   |
| B.2.04 Activity Room                  |                | -                        | -    | -            | 63                   |
| B.2.05 Office                         |                | -                        | -    | -            | 196                  |
| B.2.08 Circulation                    |                | -                        | 100  | -            | 43                   |
| B.2.0X Stairs 1                       |                | -                        | 100  | -            | 187                  |
| B.2.0X Stairs 2                       |                | -                        | 100  | -            | 127                  |
| B.2.06 Dis WC                         |                | -                        | 100  | -            | 28                   |
| B.2.07 WC                             |                | -                        | 100  | -            | 23                   |
| B.2.09 Store                          |                | -                        | -    | -            | 15                   |
| B.3.01 Activity Space                 |                | -                        | -    | -            | 326                  |
| B.3.02 Juice Bar                      |                | -                        | -    | -            | 91                   |
| B.3.03 Office                         |                | -                        | -    | -            | 250                  |
| B.3.04 1 to 1                         |                | -                        | -    | -            | 89                   |
| B.3.05 Large 1 to 1                   |                | -                        | -    | -            | 134                  |
| B.3.06 Recording Studio               |                | -                        | -    | -            | 90                   |
| B.3.07 Open Plan Classroom            |                | -                        | -    | -            | 170                  |
| B.3.0X Stairs 1                       |                | -                        | 100  | -            | 188                  |
| B.3.0X Stairs 2                       |                | -                        | 100  | -            | 127                  |
| B.3.09 WC                             |                | -                        | 100  | -            | 23                   |
| B.3.08 Dis WC                         |                | -                        | 100  | -            | 28                   |
| B.3.12 Circulation                    |                | -                        | 100  | -            | 68                   |
| B.3.02 Juice Bar - Seating area       |                | -                        | -    | -            | 65                   |

| General lighting and display lighting |                | Luminous efficacy [lm/W] |      |              | General lighting [W] |
|---------------------------------------|----------------|--------------------------|------|--------------|----------------------|
| Zone name                             |                | Luminaire                | Lamp | Display lamp |                      |
|                                       | Standard value | 60                       | 60   | 22           |                      |
| B.0.0X Entrance Circ B                |                | -                        | -    | -            | 135                  |
| Hall B                                |                | -                        | -    | -            | 1136                 |
| B.0.18 Cleaners                       |                | -                        | -    | -            | 49                   |
| B.0.21 Activity room 1                |                | 100                      | -    | -            | 101                  |
| B.0.22 Activity room 2                |                | 100                      | -    | -            | 105                  |
| B.0.23 Activity room 3                |                | 100                      | -    | -            | 90                   |
| B.3.13 Store                          |                | 100                      | -    | -            | 5                    |
| LG_Plantroom                          |                | 100                      | -    | -            | 308                  |
| LG_Corridor                           |                | -                        | 100  | -            | 64                   |

### Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

| Zone                            | Solar gain limit exceeded? (%) | Internal blinds used? |
|---------------------------------|--------------------------------|-----------------------|
| Hall A                          | YES (+1%)                      | NO                    |
| B.0.01 Office                   | NO (-99%)                      | NO                    |
| B.0.02 Cafe Seating             | NO (-38%)                      | NO                    |
| B.0.10 Gym                      | NO (-23%)                      | NO                    |
| B.1.01 Office                   | NO (-68%)                      | NO                    |
| B.1.02 Office                   | NO (-76%)                      | NO                    |
| B.1.03 Activity Room            | NO (-73%)                      | NO                    |
| B.1.04 Activity Room            | NO (-89%)                      | NO                    |
| B.2.01 Activity Room            | NO (-82%)                      | NO                    |
| B.2.02 Activity Room            | NO (-86%)                      | NO                    |
| B.2.03 Activity Room            | NO (-79%)                      | NO                    |
| B.2.04 Activity Room            | NO (-85%)                      | NO                    |
| B.2.05 Office                   | NO (-67%)                      | NO                    |
| B.3.01 Activity Space           | NO (-78%)                      | NO                    |
| B.3.03 Office                   | NO (-85%)                      | NO                    |
| B.3.04 1 to 1                   | NO (-73%)                      | NO                    |
| B.3.05 Large 1 to 1             | NO (-79%)                      | NO                    |
| B.3.06 Recording Studio         | N/A                            | N/A                   |
| B.3.07 Open Plan Classroom      | NO (-77%)                      | NO                    |
| B.3.02 Juice Bar - Seating area | NO (-95%)                      | NO                    |
| Hall B                          | NO (-76%)                      | NO                    |
| B.0.21 Activity room 1          | NO (-48%)                      | NO                    |
| B.0.22 Activity room 2          | NO (-51%)                      | NO                    |
| B.0.23 Activity room 3          | NO (-39%)                      | NO                    |

### Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

## **Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place**

Separate submission

### **EPBD (Recast): Consideration of alternative energy systems**

|                                                                                               |           |
|-----------------------------------------------------------------------------------------------|-----------|
| <b>Were alternative energy systems considered and analysed as part of the design process?</b> | <b>NO</b> |
| Is evidence of such assessment available as a separate submission?                            | NO        |
| Are any such measures included in the proposed design?                                        | YES       |

# Technical Data Sheet (Actual vs. Notional Building)

## Building Global Parameters

|                                                       | Actual | Notional |
|-------------------------------------------------------|--------|----------|
| Area [m <sup>2</sup> ]                                | 1688   | 1688     |
| External area [m <sup>2</sup> ]                       | 3018   | 3018     |
| Weather                                               | LON    | LON      |
| Infiltration [m <sup>3</sup> /hm <sup>2</sup> @ 50Pa] | 3      | 4        |
| Average conductance [W/K]                             | 952    | 1182     |
| Average U-value [W/m <sup>2</sup> K]                  | 0.32   | 0.39     |
| Alpha value* [%]                                      | 21.53  | 21.53    |

\* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

## Building Use

| % Area | Building Type                                                      |
|--------|--------------------------------------------------------------------|
|        | A1/A2 Retail/Financial and Professional services                   |
|        | A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways             |
|        | B1 Offices and Workshop businesses                                 |
|        | B2 to B7 General Industrial and Special Industrial Groups          |
|        | B8 Storage or Distribution                                         |
|        | C1 Hotels                                                          |
|        | C2 Residential Institutions: Hospitals and Care Homes              |
|        | C2 Residential Institutions: Residential schools                   |
|        | C2 Residential Institutions: Universities and colleges             |
|        | C2A Secure Residential Institutions                                |
|        | Residential spaces                                                 |
| 100    | <b>D1 Non-residential Institutions: Community/Day Centre</b>       |
|        | D1 Non-residential Institutions: Libraries, Museums, and Galleries |
|        | D1 Non-residential Institutions: Education                         |
|        | D1 Non-residential Institutions: Primary Health Care Building      |
|        | D1 Non-residential Institutions: Crown and County Courts           |
|        | D2 General Assembly and Leisure, Night Clubs, and Theatres         |
|        | Others: Passenger terminals                                        |
|        | Others: Emergency services                                         |
|        | Others: Miscellaneous 24hr activities                              |
|        | Others: Car Parks 24 hrs                                           |
|        | Others: Stand alone utility block                                  |

## Energy Consumption by End Use [kWh/m<sup>2</sup>]

|                | Actual       | Notional     |
|----------------|--------------|--------------|
| Heating        | 6.07         | 9.21         |
| Cooling        | 0.03         | 0.01         |
| Auxiliary      | 1.83         | 2.05         |
| Lighting       | 11.69        | 14.11        |
| Hot water      | 17.64        | 18.25        |
| Equipment*     | 28.18        | 28.18        |
| <b>TOTAL**</b> | <b>37.26</b> | <b>43.62</b> |

\* Energy used by equipment does not count towards the total for consumption or calculating emissions.

\*\* Total is net of any electrical energy displaced by CHP generators, if applicable.

## Energy Production by Technology [kWh/m<sup>2</sup>]

|                       | Actual | Notional |
|-----------------------|--------|----------|
| Photovoltaic systems  | 2.65   | 0        |
| Wind turbines         | 0      | 0        |
| CHP generators        | 0      | 0        |
| Solar thermal systems | 0      | 0        |

## Energy & CO<sub>2</sub> Emissions Summary

|                                               | Actual | Notional |
|-----------------------------------------------|--------|----------|
| Heating + cooling demand [MJ/m <sup>2</sup> ] | 32     | 41.87    |
| Primary energy* [kWh/m <sup>2</sup> ]         | 77.79  | 92.85    |
| Total emissions [kg/m <sup>2</sup> ]          | 12     | 15.9     |

\* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.



## HVAC Systems Performance

| System Type                                                                                                   | Heat dem<br>MJ/m2 | Cool dem<br>MJ/m2 | Heat con<br>kWh/m2 | Cool con<br>kWh/m2 | Aux con<br>kWh/m2 | Heat<br>SSEEF | Cool<br>SSEER | Heat gen<br>SEFF | Cool gen<br>SEER |
|---------------------------------------------------------------------------------------------------------------|-------------------|-------------------|--------------------|--------------------|-------------------|---------------|---------------|------------------|------------------|
| [ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity                      |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                                        | 5.7               | 19.5              | 0.3                | 1                  | 1.6               | 4.7           | 5.44          | 4.7              | 5.44             |
| Notional                                                                                                      | 12.7              | 4.1               | 1.5                | 0.3                | 1.2               | 2.43          | 3.6           | ----             | ----             |
| [ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity       |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                                        | 32.9              | 0                 | 6.7                | 0                  | 1                 | 1.36          | 0             | 1.43             | 0                |
| Notional                                                                                                      | 67.6              | 0                 | 15.9               | 0                  | 1.1               | 1.18          | 0             | ----             | ----             |
| [ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity           |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                                        | 51.9              | 0                 | 10.6               | 0                  | 1.1               | 1.36          | 0             | 1.43             | 0                |
| Notional                                                                                                      | 48.7              | 0                 | 11.5               | 0                  | 1.1               | 1.18          | 0             | ----             | ----             |
| [ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                                        | 1                 | 0                 | 0.1                | 0                  | 3.2               | 4.7           | 0             | 4.7              | 0                |
| Notional                                                                                                      | 8.4               | 0                 | 1                  | 0                  | 2.1               | 2.43          | 0             | ----             | ----             |
| [ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity       |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                                        | 49.8              | 0                 | 10.2               | 0                  | 2.8               | 1.36          | 0             | 1.43             | 0                |
| Notional                                                                                                      | 25.9              | 0                 | 6.1                | 0                  | 6.3               | 1.18          | 0             | ----             | ----             |
| [ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity           |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                                        | 0.6               | 0                 | 0.1                | 0                  | 4.7               | 1.36          | 0             | 1.43             | 0                |
| Notional                                                                                                      | 0                 | 0                 | 0                  | 0                  | 6.5               | 0             | 0             | ----             | ----             |
| [ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity       |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                                        | 0                 | 0                 | 0                  | 0                  | 18.9              | 0             | 0             | 0                | 0                |
| Notional                                                                                                      | 0                 | 0                 | 0                  | 0                  | 18.1              | 0             | 0             | ----             | ----             |
| [ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity           |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                                        | 22.8              | 0                 | 4.7                | 0                  | 9.1               | 1.36          | 0             | 1.43             | 0                |
| Notional                                                                                                      | 23.9              | 0                 | 5.6                | 0                  | 11.3              | 1.18          | 0             | ----             | ----             |
| [ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity           |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                                        | 26                | 0                 | 5.3                | 0                  | 3.2               | 1.36          | 0             | 1.43             | 0                |
| Notional                                                                                                      | 63.2              | 0                 | 14.3               | 0                  | 3.6               | 1.22          | 0             | ----             | ----             |
| [ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity       |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                                        | 19.2              | 0                 | 3.9                | 0                  | 4.9               | 1.36          | 0             | 1.43             | 0                |
| Notional                                                                                                      | 7.1               | 0                 | 1.7                | 0                  | 9.5               | 1.18          | 0             | ----             | ----             |
| [ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity           |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                                        | 0.3               | 0                 | 0.1                | 0                  | 4.3               | 1.36          | 0             | 1.43             | 0                |
| Notional                                                                                                      | 0.6               | 0                 | 0.2                | 0                  | 3.9               | 1.18          | 0             | ----             | ----             |
| [ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity           |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                                        | 0                 | 0                 | 0                  | 0                  | 8.2               | 0             | 0             | 0                | 0                |
| Notional                                                                                                      | 0                 | 0                 | 0                  | 0                  | 6.5               | 0             | 0             | ----             | ----             |
| [ST] Central heating using water: floor heating, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity       |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                                        | 46.5              | 0                 | 9.5                | 0                  | 5.9               | 1.36          | 0             | 1.43             | 0                |
| Notional                                                                                                      | 24.6              | 0                 | 5.8                | 0                  | 7.4               | 1.18          | 0             | ----             | ----             |
| [ST] Central heating using water: radiators, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity           |                   |                   |                    |                    |                   |               |               |                  |                  |
| Actual                                                                                                        | 0.4               | 0                 | 0.1                | 0                  | 3.3               | 1.36          | 0             | 1.43             | 0                |
| Notional                                                                                                      | 1.5               | 0                 | 0.4                | 0                  | 4.6               | 1.18          | 0             | ----             | ----             |

## Key to terms

|                                |                                                                                                       |
|--------------------------------|-------------------------------------------------------------------------------------------------------|
| Heat dem [MJ/m <sup>2</sup> ]  | = Heating energy demand                                                                               |
| Cool dem [MJ/m <sup>2</sup> ]  | = Cooling energy demand                                                                               |
| Heat con [kWh/m <sup>2</sup> ] | = Heating energy consumption                                                                          |
| Cool con [kWh/m <sup>2</sup> ] | = Cooling energy consumption                                                                          |
| Aux con [kWh/m <sup>2</sup> ]  | = Auxiliary energy consumption                                                                        |
| Heat SSEFF                     | = Heating system seasonal efficiency (for notional building, value depends on activity glazing class) |
| Cool SSEER                     | = Cooling system seasonal energy efficiency ratio                                                     |
| Heat gen SSEFF                 | = Heating generator seasonal efficiency                                                               |
| Cool gen SSEER                 | = Cooling generator seasonal energy efficiency ratio                                                  |
| ST                             | = System type                                                                                         |
| HS                             | = Heat source                                                                                         |
| HFT                            | = Heating fuel type                                                                                   |
| CFT                            | = Cooling fuel type                                                                                   |

# Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

## Building fabric

| Element                                                                                                                                    | U <sub>i-Typ</sub> | U <sub>i-Min</sub> | Surface where the minimum value occurs* |
|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|-----------------------------------------|
| Wall                                                                                                                                       | 0.23               | 0.22               | External Wall                           |
| Floor                                                                                                                                      | 0.2                | 0.11               | Ground Floor                            |
| Roof                                                                                                                                       | 0.15               | 0.14               | Roof                                    |
| Windows, roof windows, and rooflights                                                                                                      | 1.5                | 1.5                | Curtain wall                            |
| Personnel doors                                                                                                                            | 1.5                | 1.59               | Gym Door                                |
| Vehicle access & similar large doors                                                                                                       | 1.5                | -                  | No vehicle doors in project             |
| High usage entrance doors                                                                                                                  | 1.5                | -                  | No high usage entrance doors in project |
| U <sub>i-Typ</sub> = Typical individual element U-values [W/(m²K)]      U <sub>i-Min</sub> = Minimum individual element U-values [W/(m²K)] |                    |                    |                                         |
| * There might be more than one surface where the minimum U-value occurs.                                                                   |                    |                    |                                         |

| Air Permeability   | Typical value | This building |
|--------------------|---------------|---------------|
| m³/(h.m²) at 50 Pa | 5             | 3.1           |

## APPENDIX D - TM52 & TM59 RESULTS



Document

**Overheating risk and  
TM52 Assessment**

Project

**Highgate Newton  
Residential and  
Community Centre**

Client

**London Borough of  
Camden**

Date

**February 2020**



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## REVISION HISTORY

| Suitability | Revision | Version Date | Summary of Changes    | Changes marked |
|-------------|----------|--------------|-----------------------|----------------|
| S2          | P1       | 14.02.19     | Issue for information |                |
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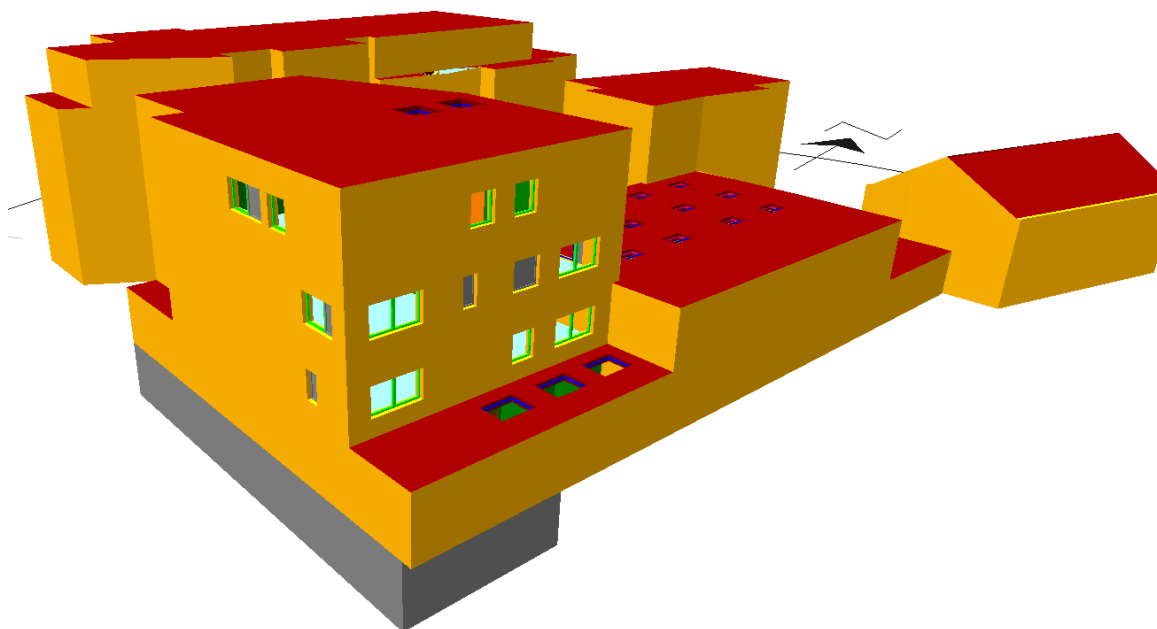
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## 1.0 INTRODUCTION



### 1.1 TM52 Methodology

The CIBSE TM52 assessment follows the methodology and recommendations of BS EN 15251 (BSI, 2007) to determine whether an existing occupied building can be classed as overheating or a proposed building is in danger of becoming overheated.

The following three criteria, taken together, provide a robust yet balanced assessment of the risk of overheating of buildings in the UK and Europe. A room or building that fails any two of the three criteria is classed as overheating.

#### **Criterion 1: Hours of exceedance (He)**

Sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1 K or more during the occupied hours of a typical non-heating season (1 May to 30 September).

#### **Criterion 2: Daily weighted exceedance (We)**

This criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperature rise and its duration. This criterion sets a daily limit for acceptability.

### **Criterion 3: Upper limit temperature (Tupp)**

Sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable

It is recommended that TM52 is read in conjunction with this report for calculation methodology and further clarification.

A TM52 analysis must be performed using the CIBSE Design Summer Year weather data; the **London** DSY weather file was used in this assessment. The period of assessment is from 1st May to 30th September.

## **1.2 Software**

A dynamic thermal model of the building has been created using Tas software, which has been used to assess the dynamic response of the building. The simulation uses hourly time steps and can cover the whole year.

EDSL TAS is AM11 compliant.

## 2.0 RESULTS

### 2.1 TM52 Results

| Zone Name                       | Occupied Summer Hours | Max. Exceedable Hours | Criterion 1: #Hours Exceeding Comfort Range | Criterion 2: Peak Daily Weighted Exceedance | Criterion 3: #Hours Exceeding Absolute Limit | Result |
|---------------------------------|-----------------------|-----------------------|---------------------------------------------|---------------------------------------------|----------------------------------------------|--------|
| B.0.01 Office                   | 1280                  | 38                    | 0                                           | 0.0                                         | 0                                            | Pass   |
| B.0.02 Cafe Seating             | 1530                  | 45                    | 6                                           | 4.0                                         | 0                                            | Pass   |
| B.0.21 Activity room 1          | 1530                  | 45                    | 35                                          | 20.0                                        | 0                                            | Pass   |
| B.0.22 Activity room 2          | 1530                  | 45                    | 37                                          | 20.0                                        | 0                                            | Pass   |
| B.0.23 Activity room 3          | 1530                  | 45                    | 23                                          | 15.0                                        | 0                                            | Pass   |
| B.1.01 Office                   | 1280                  | 38                    | 13                                          | 6.0                                         | 0                                            | Pass   |
| B.1.02 Office                   | 1280                  | 38                    | 13                                          | 6.0                                         | 0                                            | Pass   |
| B.1.03 Activity Room            | 1530                  | 45                    | 5                                           | 3.0                                         | 0                                            | Pass   |
| B.1.04 Activity Room            | 1530                  | 45                    | 11                                          | 5.0                                         | 0                                            | Pass   |
| B.2.01 Activity Room            | 1530                  | 45                    | 8                                           | 4.0                                         | 0                                            | Pass   |
| B.2.02 Activity Room            | 1530                  | 45                    | 23                                          | 8.0                                         | 0                                            | Pass   |
| B.2.03 Activity Room            | 1530                  | 45                    | 22                                          | 19.0                                        | 0                                            | Pass   |
| B.2.04 Activity Room            | 1530                  | 45                    | 27                                          | 19.0                                        | 0                                            | Pass   |
| B.2.05 Office                   | 1280                  | 38                    | 17                                          | 7.0                                         | 0                                            | Pass   |
| B.3.01 Activity Space           | 1530                  | 45                    | 15                                          | 10.0                                        | 0                                            | Pass   |
| B.3.02 Juice Bar                | 1530                  | 45                    | 19                                          | 13.0                                        | 0                                            | Pass   |
| B.3.03 Office                   | 1280                  | 38                    | 4                                           | 4.0                                         | 0                                            | Pass   |
| B.3.04 1 to 1                   | 1530                  | 45                    | 21                                          | 7.0                                         | 0                                            | Pass   |
| B.3.05 Large 1 to 1             | 1530                  | 45                    | 17                                          | 6.0                                         | 0                                            | Pass   |
| B.3.07 Open Plan Classroom      | 1530                  | 45                    | 20                                          | 11.0                                        | 0                                            | Pass   |
| B.3.02 Juice Bar - Seating area | 1530                  | 45                    | 21                                          | 13.0                                        | 0                                            | Pass   |

Please see results in Appendix 3.

## 3.0 INPUT DATA & ASSUMPTIONS

### 3.1 Constructions

Constructions have been modelled within the data provided by the client and are as follows:

External Wall, U Value = 0.22 W/m<sup>2</sup>K:

| Layer | M-Code                       | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description                   |
|-------|------------------------------|------------|----------------------|------------------------------|------------------------|-------------------------------|
| Inner | am1plast\1                   | 25.0       | 0.079                | 400                          | 837                    | LIGHTWEIGHT PLASTER 1 *4      |
| 2     | am1ins\2                     | 140.0      | 0.045                | 25                           | 1000                   | GLASS FIBRE 2 *3              |
| 3     | Cement bonded particle board | 18.0       | 0.230                | 1100                         | 1000                   |                               |
| 4     | am1ins\2                     | 40.0       | 0.045                | 25                           | 1000                   | GLASS FIBRE 2 *3              |
| 5     | am1cav\5                     | 50.0       | 0.000                | 0                            | 0                      | 50MM AIR (Horizontal flow OP) |
| 6     | am1brick\1                   | 105.0      | 0.700                | 1700                         | 800                    | BRICKWORK *4                  |

Ground Floor, U Value = 0.11 W/m<sup>2</sup>K

| Layer | M-Code                   | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description                   |
|-------|--------------------------|------------|----------------------|------------------------------|------------------------|-------------------------------|
| Inner | am1fin\3                 | 3.0        | 0.060                | 186                          | 1360                   | CARPET *2                     |
| 2     | Flooring screed          | 50.0       | 0.410                | 1200                         | 1000                   | Flooring screed. 50mm is a ty |
| 3     | PUR, 75 mm, 3in          | 210.0      | 0.025                | 30                           | 1800                   | Polyurethane, 3 Inch          |
| 4     | Concrete roof/floor slab | 300.0      | 1.350                | 2000                         | 1000                   | Cast concrete                 |
| 5     | Stone chippings          | 25.0       | 2.000                | 2000                         | 1000                   |                               |
| 6     | Notional/Reference Soil  | 1000.0     | 1.500                | 1250                         | 2500                   |                               |

*\*Not included in U value calculation*

Roof Building B, U Value = 0.14 W/m<sup>2</sup>K

| Layer | M-Code        | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description |
|-------|---------------|------------|----------------------|------------------------------|------------------------|-------------|
| Inner | Concrete Deck | 300.0      | 2.000                | 2400                         | 1000                   |             |
| 2     | Screed        | 50.0       | 1.150                | 1800                         | 1000                   |             |
| 3     | Insulation 1  | 160.0      | 0.025                | 40                           | 1450                   |             |
| 4     | membrane      | 1.0        | 1.000                | 1100                         | 1000                   |             |

Internal Floor, U Value = 0.875 W/m<sup>2</sup>K

| Layer | M-Code              | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description |
|-------|---------------------|------------|----------------------|------------------------------|------------------------|-------------|
| Inner | Reinforced concrete | 300.0      | 2.300                | 2300                         | 1000                   |             |
| 2     | Air, 50mm ceiling   | 50.0       | 0.010                | 0                            | 0                      | Upward flow |
| 3     | Insulation 1        | 15.0       | 0.025                | 40                           | 1450                   |             |
| 4     | am1fin\3            | 3.0        | 0.060                | 186                          | 1360                   | CARPET *2   |

Internal Wall, U Value = 1.78 W/m<sup>2</sup>K

| Layer | M-Code         | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description     |
|-------|----------------|------------|----------------------|------------------------------|------------------------|-----------------|
| Inner | Plasterboard   | 12.5       | 0.210                | 700                          | 1000                   |                 |
| 2     | Air, 50mm wall | 50.0       | 0.010                | 0                            | 0                      | Horizontal flow |
| 3     | Plasterboard   | 12.5       | 0.210                | 700                          | 1000                   |                 |

Metal Doors & Louvres, U Value = 1.49 W/m<sup>2</sup>K

| Layer | M-Code       | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description |
|-------|--------------|------------|----------------------|------------------------------|------------------------|-------------|
| Inner | Steel        | 0.6        | 60.000               | 7800                         | 450                    |             |
| 2     | Insulation 5 | 20.0       | 0.040                | 20                           | 1030                   |             |
| 3     | Steel        | 0.6        | 60.000               | 7800                         | 450                    |             |

### Glazing:

All glazing has the following specifications:

| Glazing without blind, U = 1.4 Wm <sup>2</sup> K |             |                      |                    |                    |                               |                                 |                 |       |
|--------------------------------------------------|-------------|----------------------|--------------------|--------------------|-------------------------------|---------------------------------|-----------------|-------|
| Light                                            |             | Solar Energy (EN410) |                    |                    |                               | Pilkington Shading Coefficients |                 |       |
| Transmittance                                    | Reflectance | Direct Transmittance | Direct Reflectance | Direct Absorptance | Total Transmittance (G-Value) | Short Wavelength                | Long Wavelength | Total |
| 0.49                                             | 0.12        | 0.19                 | 0.13               | 0.67               | 0.32                          | 0.22                            | 0.15            | 0.37  |

All frames are aluminium with U value of 2.2 W/m<sup>2</sup>K



---

### 3.2 Internal Conditions

Internal gains have been provided by the client and can be found in the appendices.

Occupancy gains of 57W sensible gain per person and 43W latent gain per person have been used as specified by the client.

The GF Café seating area has been modelled with 30 occupants from 12pm-1pm and 20 occupants at all other times between 8am-6pm.

All spaces have been modelled as occupied from 8am-6pm. The space 2.05 Office has no occupancy, equipment or lighting gains modelled from 12:00 - 14:00 to allow for a lunch break.

The community centre has been modelled as open on weekdays and weekends throughout the whole year.

No heating has been included in the summertime assessment.

### 3.3 Natural Ventilation

Openable side lit windows have been modelled as openable to 45° from 8am-6pm, windows begin to open when the adjacent space reaches 18°C and are fully open when it reaches 19°C.

The rooflights above the GF activity room have all been modelled as openable up to a maximum openable area of 50%.

The Stairwell rooflights have been modelled as openable to a maximum openable area of 2.28m<sup>2</sup> as specified by the client.

A number of spaces have louvres serving them, these have been modelled with a coefficient of discharge of 0.3 and openable areas as specified by the client. These are openable at all times, begin to open when the adjacent space reaches 18°C and are fully open when it reaches 19°C.

Night ventilation has been included, side lit windows are openable to 10% outside of occupied hours and rooflights to 20%, the temperature control for the night ventilation has been modelled the same as for occupied hours (18-19°C). Louvres have been modelled as openable at all times of the year.

There are a number of internal transfer grilles between perimeter spaces and the central spaces, the locations of these can be seen drawn on the floor plans shown in the appendices. Each grille has an openable area of 0.375m<sup>2</sup> and a coefficient of discharge of 0.3.

The GF entrance doors have been modelled as openable with the same controls logic as the side lit windows however these can be full opened.

### 3.4 Mechanical Ventilation

Mechanical ventilation has been included in the GF 0.01 Office and GF 0.02 Café seating area spaces at rates of 6ach and 3ach respectively. This has been modelled as fully on during all occupied hours.

All Mechanically ventilated air provided is at outside air conditions in the thermal model.

### 3.5 Shading

No feature shading has been accounted for other than the adjacent buildings.

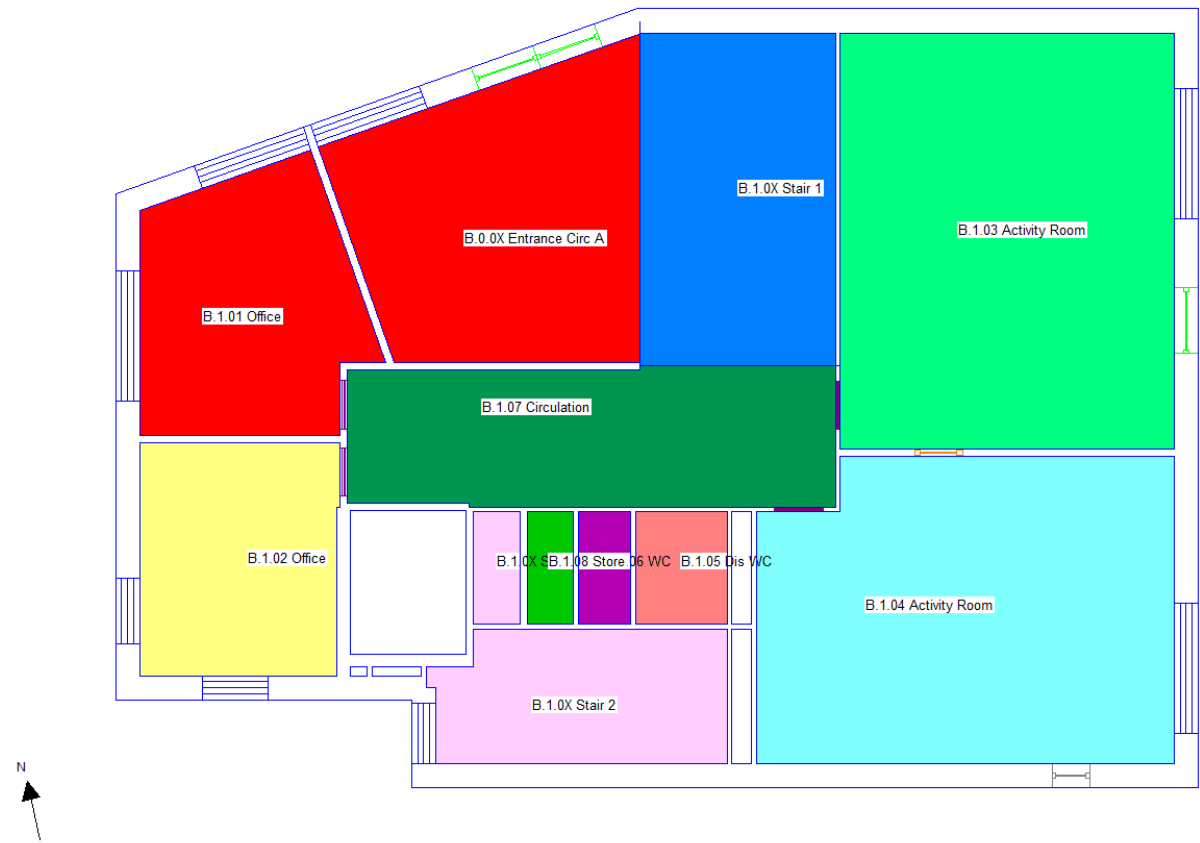
## **APPENDIX 1**

Plans From the TAS model

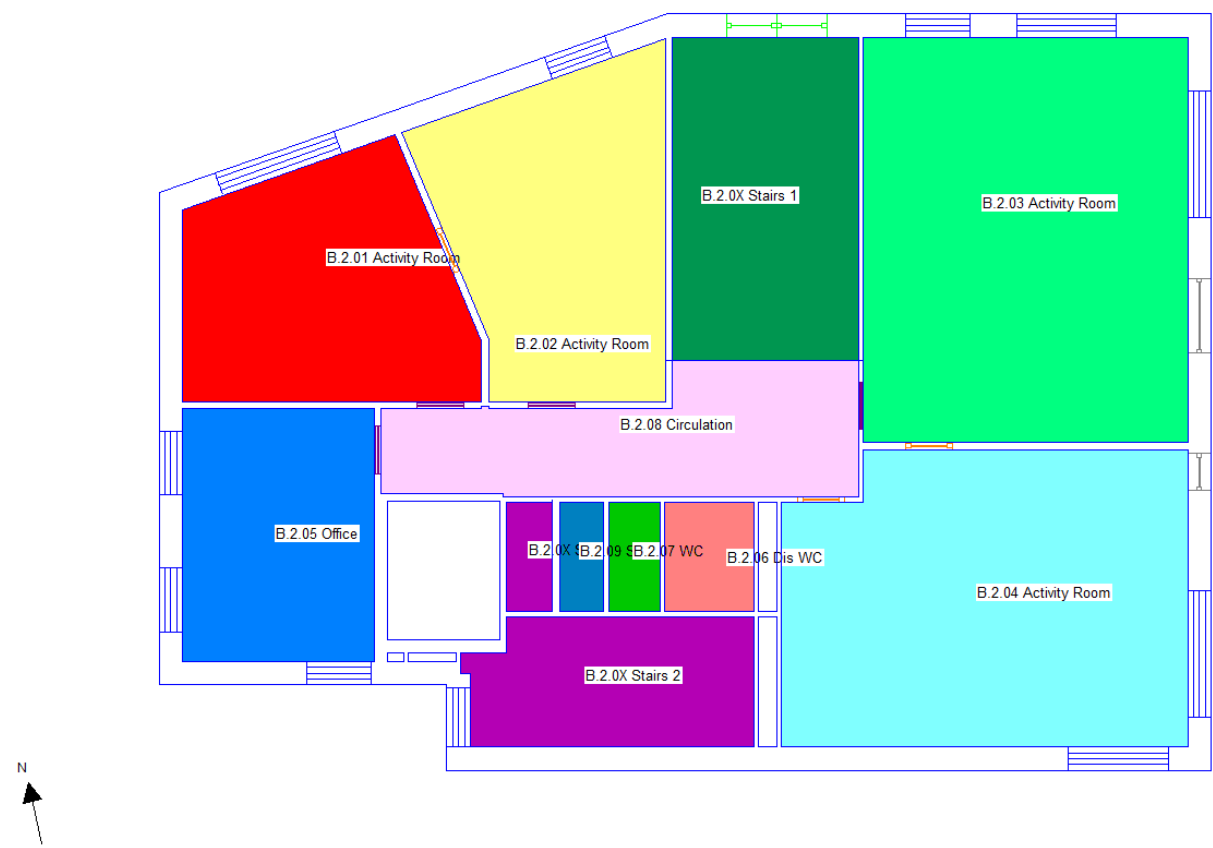
The floor plan of the Broomfield Community Centre is divided into several functional areas:

- Entrance and Circulation:** Includes B.0.0X Entrance Circ A (red), B.0.0X Entrance Circ B (blue), and B.0.0X Stairs 1 (pink) and B.0.0X Stairs 2 (orange).
- Activity and Seating:** Features B.0.02 Cafe Seating (yellow), B.0.03 Seating (green), B.0.04 Outdoor Seating (light green), B.0.21 Activity room 1 (dark green), B.0.22 Activity room 2 (purple), and B.0.23 Activity room 3 (light orange).
- Service and Support:** Includes B.0.01 Office (red), B.0.08 Servery (purple), B.0.06 Laundry (light orange), and B.0.05 Toilets - Dis WC (light blue).
- Sanitary Facilities:** Consists of B.0.05 Toilets - Lobby (blue) and B.0.05 Toilets - WCs (dark green).

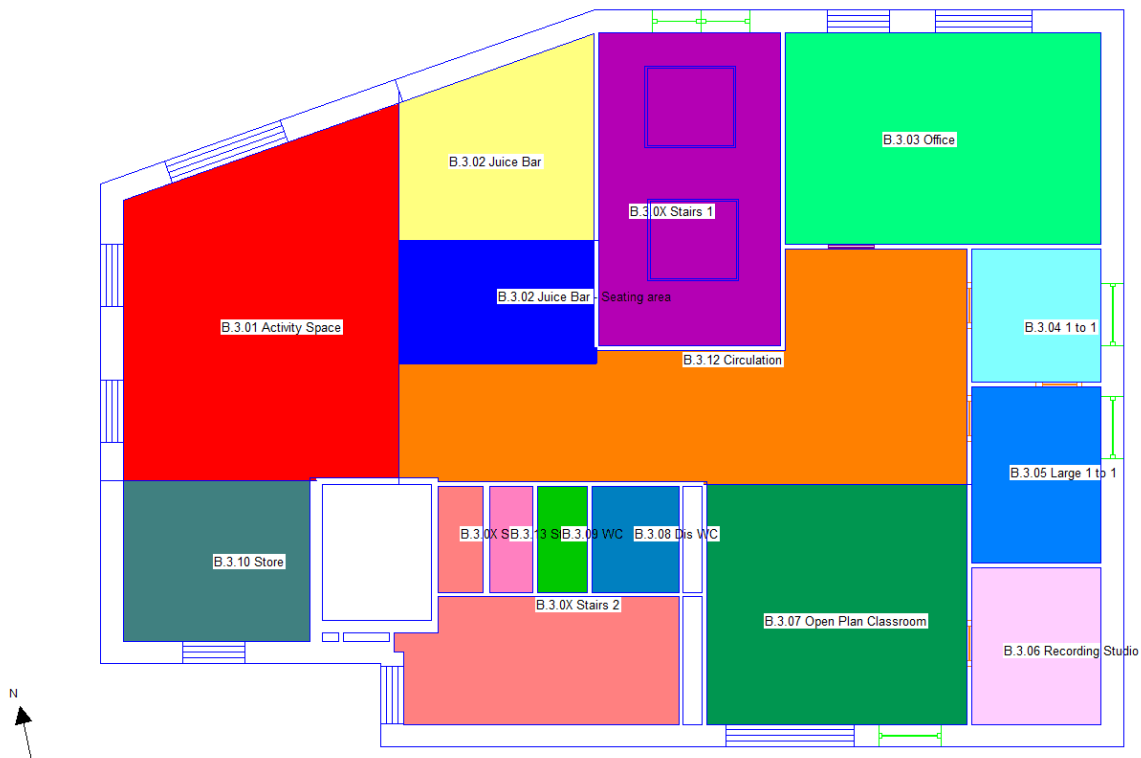
First Floor



Second Floor



## Third Floor



## APPENDIX 2

### INTERNAL CONDITIONS



| Zone name                       | Floor area (m2) | Volume (m3) | Infiltration (ACH) | Lighting Gain<br>(W/m2) | Number of<br>Occupants | Occupancy<br>Sensible Gain per<br>person (W) | Occupancy Sensible<br>W | Occupancy Latent<br>Gain per person<br>(W) | Occupancy Latent<br>W/m2 | Equipment Sensible (W) | Occupancy<br>Schedule |
|---------------------------------|-----------------|-------------|--------------------|-------------------------|------------------------|----------------------------------------------|-------------------------|--------------------------------------------|--------------------------|------------------------|-----------------------|
| B.0.01 Office                   | 8.62            | 26.08       | 0.1                | 8                       | 1                      | 57                                           | 57                      | 43                                         | 43                       | 130                    | 8am-6pm               |
| B.0.02 Cafe Seating             | 32.94           | 99.65       | 0.1                | 8                       | 10                     | 57                                           | 570                     | 43                                         | 430                      | 220                    | 8am-6pm               |
| B.0.03 Seating                  | 71.84           | 217.31      | 0.1                | 8                       | 4                      | 57                                           | 228                     | 43                                         | 172                      | 220                    | 8am-6pm               |
| B.0.21 Activity room 1          | 12.46           | 37.68       | 0.1                | 8                       | 3                      | 57                                           | 171                     | 43                                         | 129                      | 120                    | 8am-6pm               |
| B.0.22 Activity room 2          | 13.23           | 40.03       | 0.1                | 8                       | 3                      | 57                                           | 171                     | 43                                         | 129                      | 108                    | 8am-6pm               |
| B.0.23 Activity room 3          | 10.51           | 31.79       | 0.1                | 8                       | 3                      | 57                                           | 171                     | 43                                         | 129                      | 108                    | 8am-6pm               |
| B.0.0X Stairs 1                 | 28.47           | 97.51       | 0.1                | 8                       |                        |                                              |                         |                                            |                          |                        | 8am-6pm               |
| B.0.0X Stairs 2                 | 18.34           | 111.23      | 0.1                | 8                       |                        |                                              |                         |                                            |                          |                        | 8am-6pm               |
| B.0.0X Second entrance          | 12.17           | 36.81       | 0.1                | 8                       |                        |                                              |                         |                                            |                          |                        | 8am-6pm               |
| B.0.0X Entrance Circ A          | 70.02           | 214.21      | 0.1                | 8                       |                        |                                              |                         |                                            |                          |                        | 8am-6pm               |
| B.1.01 Office                   | 23.37           | 72.32       | 0.1                | 8                       | 3                      | 57                                           | 171                     | 43                                         |                          | 90                     | 8am-6pm               |
| B.1.02 Office                   | 20.02           | 61.96       | 0.1                | 8                       | 4                      | 57                                           | 228                     | 43                                         | 172                      | 120                    | 8am-6pm               |
| B.1.03 Activity Room            | 60.16           | 186.20      | 0.1                | 8                       | 13                     | 57                                           | 741                     | 43                                         | 559                      | 200                    | 8am-6pm               |
| B.1.04 Activity Room            | 53.57           | 165.80      | 0.1                | 8                       | 13                     | 57                                           | 741                     | 43                                         | 559                      | 200                    | 8am-6pm               |
|                                 |                 |             |                    |                         |                        |                                              |                         |                                            |                          | 29                     | 6pm-8am               |
| B.1.0X Stair 1                  | 28.12           | 99.14       | 0.1                | 8                       |                        |                                              |                         |                                            |                          |                        | 8am-6pm               |
| B.1.0X Stair 2                  | 18.80           | 65.27       | 0.1                | 8                       |                        |                                              |                         |                                            |                          |                        | 8am-6pm               |
| B.1.07 Circulation              | 28.89           | 89.41       | 0.1                | 8                       |                        |                                              |                         |                                            |                          |                        | 8am-6pm               |
| B.2.01 Activity Room            | 28.88           | 89.37       | 0.1                | 8                       | 3                      | 57                                           | 171                     | 43                                         | 129                      | 120                    | 8am-6pm               |
| B.2.02 Activity Room            | 31.60           | 97.79       | 0.1                | 8                       | 6                      | 57                                           | 342                     | 43                                         | 258                      | 200                    | 8am-6pm               |
| B.2.03 Activity Room            | 60.30           | 186.63      | 0.1                | 8                       | 30                     | 57                                           | 1710                    | 43                                         | 1290                     | 200                    | 8am-6pm               |
| B.2.04 Activity Room            | 53.44           | 165.38      | 0.1                | 8                       | 28                     | 57                                           | 1596                    | 43                                         | 1204                     | 200                    | 8am-6pm               |
| B.2.05 Office                   | 22.24           | 68.84       | 0.1                | 8                       | 4                      | 57                                           | 228                     | 43                                         | 172                      | 200                    | 8am-6pm               |
| B.2.08 Circulation              | 23.34           | 72.24       | 0.1                | 8                       |                        |                                              |                         |                                            |                          |                        | 8am-6pm               |
| B.2.0X Stairs 1                 | 27.60           | 97.30       | 0.1                | 8                       |                        |                                              |                         |                                            |                          |                        | 8am-6pm               |
| B.2.0X Stairs 2                 | 18.80           | 65.27       | 0.1                | 8                       |                        |                                              |                         |                                            |                          |                        | 8am-6pm               |
| B.3.01 Activity Space           | 43.73           | 136.66      | 0.1                | 8                       | 7                      | 57                                           | 399                     | 43                                         | 301                      | 120                    | 8am-6pm               |
| B.3.02 Juice Bar                | 16.20           | 50.62       | 0.1                | 8                       | 4                      | 57                                           | 228                     | 43                                         | 172                      | 200                    | 8am-6pm               |
| B.3.03 Office                   | 32.37           | 101.17      | 0.1                | 8                       | 4                      | 57                                           | 228                     | 43                                         | 172                      | 120                    | 8am-6pm               |
| B.3.04 1 to 1                   | 8.34            | 26.05       | 0.1                | 8                       | 2                      | 57                                           | 114                     | 43                                         | 86                       | 60                     | 8am-6pm               |
| B.3.05 Large 1 to 1             | 11.01           | 34.41       | 0.1                | 8                       | 2                      | 57                                           | 114                     | 43                                         | 86                       | 120                    | 8am-6pm               |
| B.3.07 Open Plan Classroom      | 30.34           | 94.81       | 0.1                | 8                       | 10                     | 57                                           | 570                     | 43                                         | 430                      | 200                    | 8am-6pm               |
| B.3.0X Stairs 1                 | 27.58           | 87.01       | 0.1                | 8                       |                        |                                              |                         |                                            |                          |                        | 8am-6pm               |
| B.3.0X Stairs 2                 | 18.78           | 59.19       | 0.1                | 8                       |                        |                                              |                         |                                            |                          |                        | 8am-6pm               |
| B.3.12 Circulation              | 43.93           | 137.28      | 0.1                | 8                       |                        |                                              |                         |                                            |                          |                        | 8am-6pm               |
| B.3.02 Juice Bar - Seating area | 11.66           | 36.45       | 0.1                | 8                       | 10                     | 57                                           | 570                     | 43                                         | 430                      | 120                    | 8am-6pm               |

Assume average of 20 with 30 peak  
between 12 to 1300hrs

Assume 1 laptop/person (36W)

Assume 1 laptop/person (36W)

Assume 1 laptop/person (36W)

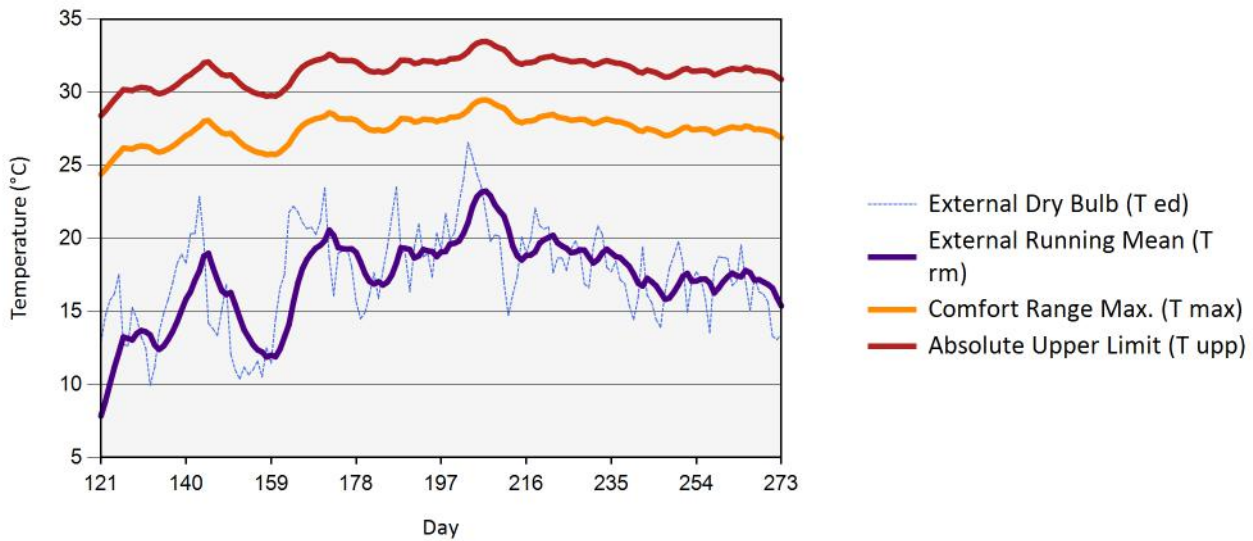
the client has confirmed the kiln  
will be used throughout the night  
for 3 days a week

## APPENDIX 3

### TM52 ANALYSIS RESULTS

# Adaptive Overheating Report (CIBSE TM52)

## Adaptive Summer Temperatures for London DSY



The adaptive overheating assessment tests rooms against three criteria. If a room fails any two of the three criteria then it is said to overheat.

1. The first criterion sets a limit for the number of hours that the operative temperature exceeds the comfort temperature by 1°C or more during the occupied hours over the summer period (1st May to 30th September).
2. The second criterion deals with the severity of the overheating within any one day. This sets a daily limit for acceptability.
3. The third criterion sets an absolute maximum daily temperature for the room.

## Project Details

**Building Designer File (.tbd):** highgate newtown cc L2\_kiln 29W.tbd

**Simulation Results File (.tsd):** highgate newtown cc L2\_kiln 29W v2.tsd

**Date:** 05 February 2020

**Building Category:** Category II

**Report Criteria:** TM52

## Results

| Zone Name              | Occupied Summer Hours | Max. Exceedable Hours | Criterion 1: #Hours Exceeding Comfort Range | Criterion 2: Peak Daily Weighted Exceedance | Criterion 3: #Hours Exceeding Absolute Limit | Result |
|------------------------|-----------------------|-----------------------|---------------------------------------------|---------------------------------------------|----------------------------------------------|--------|
| B.0.01 Office          | 1280                  | 38                    | 0                                           | 0.0                                         | 0                                            | Pass   |
| B.0.02 Cafe Seating    | 1530                  | 45                    | 6                                           | 4.0                                         | 0                                            | Pass   |
| B.0.21 Activity room 1 | 1530                  | 45                    | 35                                          | 20.0                                        | 0                                            | Pass   |
| B.0.22 Activity room 2 | 1530                  | 45                    | 37                                          | 20.0                                        | 0                                            | Pass   |
| B.0.23 Activity room 3 | 1530                  | 45                    | 23                                          | 15.0                                        | 0                                            | Pass   |
| B.1.01 Office          | 1280                  | 38                    | 13                                          | 6.0                                         | 0                                            | Pass   |
| B.1.02 Office          | 1280                  | 38                    | 13                                          | 6.0                                         | 0                                            | Pass   |
| B.1.03 Activity Room   | 1530                  | 45                    | 5                                           | 3.0                                         | 0                                            | Pass   |
| B.1.04 Activity Room   | 1530                  | 45                    | 11                                          | 5.0                                         | 0                                            | Pass   |
| B.2.01 Activity Room   | 1530                  | 45                    | 8                                           | 4.0                                         | 0                                            | Pass   |

# Adaptive Overheating Report (CIBSE TM52)

## Results

| Zone Name                       | Occupied Summer Hours | Max. Exceedable Hours | Criterion 1: #Hours Exceeding Comfort Range | Criterion 2: Peak Daily Weighted Exceedance | Criterion 3: #Hours Exceeding Absolute Limit | Result |
|---------------------------------|-----------------------|-----------------------|---------------------------------------------|---------------------------------------------|----------------------------------------------|--------|
| B.2.02 Activity Room            | 1530                  | 45                    | 23                                          | 8.0                                         | 0                                            | Pass   |
| B.2.03 Activity Room            | 1530                  | 45                    | 22                                          | 19.0                                        | 0                                            | Pass   |
| B.2.04 Activity Room            | 1530                  | 45                    | 27                                          | 19.0                                        | 0                                            | Pass   |
| B.2.05 Office                   | 1280                  | 38                    | 17                                          | 7.0                                         | 0                                            | Pass   |
| B.3.01 Activity Space           | 1530                  | 45                    | 15                                          | 10.0                                        | 0                                            | Pass   |
| B.3.02 Juice Bar                | 1530                  | 45                    | 19                                          | 13.0                                        | 0                                            | Pass   |
| B.3.03 Office                   | 1280                  | 38                    | 4                                           | 4.0                                         | 0                                            | Pass   |
| B.3.04 1 to 1                   | 1530                  | 45                    | 21                                          | 7.0                                         | 0                                            | Pass   |
| B.3.05 Large 1 to 1             | 1530                  | 45                    | 17                                          | 6.0                                         | 0                                            | Pass   |
| B.3.07 Open Plan Classroom      | 1530                  | 45                    | 20                                          | 11.0                                        | 0                                            | Pass   |
| B.3.02 Juice Bar - Seating area | 1530                  | 45                    | 21                                          | 13.0                                        | 0                                            | Pass   |

Document

**A Study of Residential  
Overheating Risk  
(TM59)**

Project

**Highgate Newtown  
Residential and  
Community Centre  
Redevelopment**

Client

**London Borough of  
Camden**

Date

**January 2019**

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| Rolfe Jackson | Director |
|               |          |

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## 1.0 TM59 METHODOLOGY

TM59 aims to provide a standardised approach to predicting overheating risk for residential building designs using dynamic thermal analysis. The aim is to produce a test that encourages good design that is comfortable within sensible limits, without being so stringent that it over-promotes the use of mechanical cooling.

The assessment should follow the following steps:

1. A suitable sample of units within a development should be selected
2. All sample units should be zoned into the separate rooms including kitchens, living rooms, bedrooms, bathrooms and halls
3. Building constructions should be modelled as proposed, accurately reflecting thermal properties such as thermal mass, insulation and solar transmittance for glazing
4. Standard profiles should be applied for occupancy, lighting and equipment gains
5. Guidance on the treatment of communal corridors from section 3.8 of the TM59 guide should be followed
6. Pipework and equipment, e.g. heat interface unit gains from community heating systems, should follow the guidance given in section 3.9 of the TM59 guide
7. Openable windows should be included in the model and follow the guidance given in section 3.3 of the TM59 guide
8. Any internal or external shading provision should be included in the model and follow the guidance included in section 3.7 of the TM59 guide
9. Additional mechanical ventilation including mechanical ventilation with heat recovery (MVHR) or extract systems should be included in the model and follow the guidance given in section 3.5 of the TM59 guide
10. Air speed assumptions should be based on the guidance given in section 3.6 of the TM59 guide
11. The weather file used for the methodology should be the DSY1 (Design Summer Year) file most appropriate for the site location for the 2020s, high emissions, 50% percentile scenario; see section 3.2 of the TM59 guide
12. The assessment should be undertaken using hourly dynamic simulation modelling, which includes all the relevant features of the building. For homes which are predominantly naturally ventilated: compliance is based on passing *both* of the following two criteria, the first of which is taken from CIBSE TM52 Criterion 1:
  - a) *For living rooms, kitchens and bedrooms*: the number of hours during which  $\Delta T$  is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3% of occupied hours. (CIBSE TM52 Criterion 1: *Hours of exceedance*).
  - b) *For bedrooms only*: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10pm to 7am shall not exceed 26 °C for more than 1% of annual hours. (*Note*: 1% of the annual hours between 22:00 and 07:00 for bedrooms is 32 hours, so 33 or more hours above 26 °C will be recorded as a fail).

Criteria 2 and 3 of CIBSE TM52 may fail to be met, but both a) and b) above *must* be passed for all relevant rooms.



**For homes predominantly mechanically ventilated:** the CIBSE fixed temperature test must be followed, i.e. all occupied rooms should not exceed an operative temperature of 26 °C for more than 3% of the annual occupied annual hours (CIBSE Guide A (2015a)).

The following three criteria, taken together, provide a robust yet balanced assessment of the risk of overheating of buildings in the UK and Europe. A room or building that fails any two of the three criteria is classed as overheating.

TM52 Criterion definitions:

Criterion 1: Hours of exceedance (H<sub>e</sub>)

Sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1 K or more during the occupied hours of a typical non-heating season (1 May to 30 September).

Criterion 2: Daily weighted exceedance (W<sub>e</sub>)

Deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperature rise and its duration. This criterion sets a daily limit for acceptability.

Criterion 3: Upper limit temperature (T<sub>upp</sub>)

Sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable

It is recommended that TM52 and TM59 guides are read in conjunction with this report for calculation methodology and further clarification. A dynamic thermal model of the building has been created using Tas software, which has been used to assess the dynamic response of the building. The simulation uses hourly time steps and covers the whole year, with the period of assessment from 1st May to 30th September.

## 2.0 INPUT DATA AND ASSUMPTIONS

### 2.1 Overview

This report assesses the two flat blocks (blocks A&D) and the house block (block C).

Assessments have been carried out using the London 2020s, high emissions, 50<sup>th</sup> percentile DSY1 scenario as outlined in the TM59. We have also included results for the London 2020s, high emissions, 50<sup>th</sup> percentile DSY2 & DSY3 weather files.

The London 2050s, high emissions, 50<sup>th</sup> percentile DSY1 future weather file has not yet been run.

The majority of bedrooms are double bedrooms and this is denoted in the zone reference as “dbed”, the single bedrooms are labelled as “sbed”.

The zone labels have been set as follows: ‘room usage.number of bedrooms [Block(Flat number) floor]’. For example the space liv/kit.2 [A6 2F] is a living and kitchen space in a 2 bedroom flat on the 2F of block A, this is also the 6<sup>th</sup> flat in the zoning system.

For the location of zones please see floor plans the appendices.

### 2.2 Constructions

Construction Information & U values have been provided by the client and are as follows:

External Wall Block A, U Value = 0.15 W/m<sup>2</sup>K

| Layer | M-Code               | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description                    |
|-------|----------------------|------------|----------------------|------------------------------|------------------------|--------------------------------|
| Inner | am1plast\1           | 26.0       | 0.079                | 400                          | 837                    | LIGHTWEIGHT PLASTER 1 *4       |
| 2     | am1ins\2             | 100.0      | 0.035                | 25                           | 1000                   | GLASS FIBRE 2 *3               |
| 3     | Cement particleboard | 13.0       | 0.230                | 1200                         | 1500                   | Cement particle board          |
| 4     | am1ins\2             | 100.0      | 0.035                | 25                           | 1000                   | GLASS FIBRE 2 *3               |
| 5     | am1cav\5             | 50.0       | 0.000                | 0                            | 0                      | 50MM AIR (HORIZONTAL FLOW - OP |
| 6     | am1brick\1           | 102.0      | 0.700                | 1700                         | 800                    | BRICKWORK *4                   |

External Wall Block C, U Value = 0.15 W/m<sup>2</sup>K

| Layer | M-Code     | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description                    |
|-------|------------|------------|----------------------|------------------------------|------------------------|--------------------------------|
| Inner | am1plast\1 | 26.0       | 0.079                | 400                          | 837                    | LIGHTWEIGHT PLASTER 1 *4       |
| 2     | am1cav\5   | 50.0       | 0.000                | 0                            | 0                      | 50MM AIR (HORIZONTAL FLOW - OP |
| 3     | am1ins\2   | 115.0      | 0.022                | 25                           | 1000                   | GLASS FIBRE 2 *3               |
| 4     | am1brick\1 | 300.0      | 0.700                | 1700                         | 800                    | BRICKWORK *4                   |

External Wall Block D, U Value = 0.15 W/m<sup>2</sup>K

| Layer | M-Code     | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description                    |
|-------|------------|------------|----------------------|------------------------------|------------------------|--------------------------------|
| Inner | am1plast\1 | 26.0       | 0.079                | 400                          | 837                    | LIGHTWEIGHT PLASTER 1 *4       |
| 2     | am1block\1 | 140.0      | 0.317                | 1040                         | 1050                   | FOAMED SLAG CONC. PARTITION BL |
| 3     | am1ins\2   | 115.0      | 0.022                | 25                           | 1000                   | GLASS FIBRE 2 *3               |
| 4     | am1cav\5   | 50.0       | 0.000                | 0                            | 0                      | 50MM AIR (HORIZONTAL FLOW - OP |
| 5     | am1brick\1 | 102.0      | 0.700                | 1700                         | 800                    | BRICKWORK *4                   |

Ground Floor Block A = 0.11 W/m<sup>2</sup>K

| Layer | M-Code                   | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description |
|-------|--------------------------|------------|----------------------|------------------------------|------------------------|-------------|
| Inner | am1fin\3                 | 3.0        | 0.060                | 186                          | 1360                   | CARPET *2   |
| 2     | Screed                   | 50.0       | 1.150                | 1800                         | 1000                   |             |
| 3     | Insulation 5             | 175.0      | 0.021                | 20                           | 1030                   |             |
| 4     | Reinforced concrete      | 250.0      | 2.300                | 2300                         | 1000                   |             |
| 5     | Notional/Reference Soil* | 1000.0     | 1.500                | 1250                         | 2500                   |             |

\*Notional/Reference Soil Not included in U value Calc.

Ground Floor Block C = 0.13 W/m<sup>2</sup>K

| Layer | M-Code                   | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description |
|-------|--------------------------|------------|----------------------|------------------------------|------------------------|-------------|
| Inner | am1fin\3                 | 3.0        | 0.060                | 186                          | 1360                   | CARPET *2   |
| 2     | Screed                   | 50.0       | 1.150                | 1800                         | 1000                   |             |
| 3     | Insulation 5             | 155.0      | 0.021                | 20                           | 1030                   |             |
| 4     | Reinforced concrete      | 200.0      | 2.300                | 2300                         | 1000                   |             |
| 5     | Notional/Reference Soil* | 1000.0     | 1.500                | 1250                         | 2500                   |             |

\*Notional/Reference Soil Not included in U value Calc.

Ground Floor Block D = 0.11 W/m<sup>2</sup>K

| Layer | M-Code       | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description                    |
|-------|--------------|------------|----------------------|------------------------------|------------------------|--------------------------------|
| Inner | am1fin\3     | 3.0        | 0.060                | 186                          | 1360                   | CARPET *2                      |
| 2     | Screed       | 50.0       | 1.150                | 1800                         | 1000                   |                                |
| 3     | Insulation 5 | 180.0      | 0.023                | 20                           | 1030                   |                                |
| 4     | am1block\1   | 140.0      | 0.317                | 1040                         | 1050                   | FOAMED SLAG CONC. PARTITION BL |

|   |                          |        |       |      |      |  |
|---|--------------------------|--------|-------|------|------|--|
| 5 | Notional/Reference Soil* | 1000.0 | 1.500 | 1250 | 2500 |  |
|---|--------------------------|--------|-------|------|------|--|

\*Notional/Reference Soil Not included in U value Calc.

Flat Concrete Roof, U Value = 0.11 W/m<sup>2</sup>K

| Layer | M-Code        | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description                    |
|-------|---------------|------------|----------------------|------------------------------|------------------------|--------------------------------|
| Inner | Plasterboard  | 12.5       | 0.210                | 700                          | 1000                   |                                |
| 2     | am1cav\15     | 100.0      | 0.000                | 0                            | 0                      | 100MM AIR (UPWARD FLOW - OPAQU |
| 3     | Concrete Deck | 250.0      | 2.000                | 2400                         | 1000                   |                                |
| 4     | Insulation 1  | 168.0      | 0.021                | 40                           | 1450                   |                                |
| 5     | membrane      | 10.0       | 1.000                | 1100                         | 1000                   |                                |
| 6     | am1soil\1     | 200.0      | 0.700                | 1280                         | 1840                   | CLAY 1 (DARK) *2               |

Pitched House Roof, U Value = 0.11 W/m<sup>2</sup>K

| Layer | M-Code       | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description                    |
|-------|--------------|------------|----------------------|------------------------------|------------------------|--------------------------------|
| Inner | Plasterboard | 12.5       | 0.210                | 700                          | 1000                   |                                |
| 2     | am1cav\16    | 200.0      | 0.000                | 0                            | 0                      | 200MM AIR (UPWARD FLOW - OPAQU |
| 3     | am1ins\1     | 175.0      | 0.021                | 12                           | 833                    | GLASS FIBRE 1 *3               |
| 4     | am1asph\9    | 3.0        | 0.410                | 960                          | 1000                   | ROOFING FELT 1 *2              |
| 5     | am1tile\10   | 5.0        | 2.000                | 2700                         | 753                    | SLATE, GREY *4                 |

Internal Floor Blocks A & C, U Value = 0.53 W/m<sup>2</sup>K

| Layer | M-Code              | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description                    |
|-------|---------------------|------------|----------------------|------------------------------|------------------------|--------------------------------|
| Inner | Plasterboard        | 12.5       | 0.210                | 700                          | 1000                   |                                |
| 2     | am1cav\15           | 100.0      | 0.000                | 0                            | 0                      | 100MM AIR (UPWARD FLOW - OPAQU |
| 3     | Reinforced concrete | 250.0      | 2.300                | 2300                         | 1000                   |                                |
| 4     | Insulation 1        | 25.0       | 0.021                | 40                           | 1450                   |                                |
| 5     | Screed              | 50.0       | 1.150                | 1800                         | 1000                   |                                |
| 6     | am1fin\3            | 4.0        | 0.060                | 186                          | 1360                   | CARPET *2                      |

Internal Floor Block D, U Value = 0.11 W/m<sup>2</sup>K

| Layer | M-Code              | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description                    |
|-------|---------------------|------------|----------------------|------------------------------|------------------------|--------------------------------|
| Inner | Plasterboard        | 12.5       | 0.210                | 700                          | 1000                   |                                |
| 2     | am1cav\15           | 100.0      | 0.000                | 0                            | 0                      | 100MM AIR (UPWARD FLOW - OPAQU |
| 3     | Reinforced concrete | 250.0      | 2.300                | 2300                         | 1000                   |                                |
| 4     | Insulation 1        | 170.0      | 0.021                | 40                           | 1450                   |                                |
| 5     | Screed              | 50.0       | 1.150                | 1800                         | 1000                   |                                |
| 6     | am1fin\3            | 4.0        | 0.060                | 186                          | 1360                   | CARPET *2                      |

Stud Internal Wall (for internal walls within dwellings) Blocks A & D, U Value = 0.77 W/m<sup>2</sup>K

| Layer | M-Code         | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description      |
|-------|----------------|------------|----------------------|------------------------------|------------------------|------------------|
| Inner | Plasterboard   | 25.0       | 0.210                | 700                          | 1000                   |                  |
| 2     | Air, 50mm wall | 50.0       | 0.010                | 0                            | 0                      | Horizontal flow  |
| 3     | am1ins\1       | 25.0       | 0.040                | 12                           | 833                    | GLASS FIBRE 1 *3 |
| 4     | Plasterboard   | 25.0       | 0.210                | 700                          | 1000                   |                  |

Stud Internal Wall (for internal walls within dwellings) Block C, U Value = 0.31 W/m<sup>2</sup>K

| Layer | M-Code         | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description      |
|-------|----------------|------------|----------------------|------------------------------|------------------------|------------------|
| Inner | Plasterboard   | 25.0       | 0.210                | 700                          | 1000                   |                  |
| 2     | Air, 50mm wall | 50.0       | 0.010                | 0                            | 0                      | Horizontal flow  |
| 3     | am1ins\1       | 100.0      | 0.040                | 12                           | 833                    | GLASS FIBRE 1 *3 |
| 4     | Plasterboard   | 25.0       | 0.210                | 700                          | 1000                   |                  |

Block Internal Wall (for internal walls between 2 dwellings or between dwellings and communal corridors), U Value = 0.29 W/m<sup>2</sup>K

| Layer | M-Code     | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description                    |
|-------|------------|------------|----------------------|------------------------------|------------------------|--------------------------------|
| Inner | am1plast\1 | 26.0       | 0.079                | 400                          | 837                    | LIGHTWEIGHT PLASTER 1 *4       |
| 2     | am1block\1 | 100.0      | 0.317                | 1040                         | 1050                   | FOAMED SLAG CONC. PARTITION BL |
| 3     | am1ins\1   | 75.0       | 0.040                | 12                           | 833                    | GLASS FIBRE 1 *3               |
| 4     | am1block\1 | 100.0      | 0.317                | 1040                         | 1050                   | FOAMED SLAG CONC. PARTITION BL |
| 5     | am1plast\1 | 26.0       | 0.079                | 400                          | 837                    | LIGHTWEIGHT PLASTER 1 *4       |

Opaque Doors U Values = 2.18 W/m<sup>2</sup>K

| Layer | M-Code   | Width (mm) | Conductivity (W/m.K) | Density (kg/m <sup>3</sup> ) | Specific Heat (J/kg.K) | Description |
|-------|----------|------------|----------------------|------------------------------|------------------------|-------------|
| Inner | Hardwood | 52.0       | 0.180                | 2100                         | 1000                   |             |

## Glazing:

All Glazing:

| Glazing, U = 1.4 Wm <sup>2</sup> K |             |                      |                    |                    |                               |                                 |                 |       |
|------------------------------------|-------------|----------------------|--------------------|--------------------|-------------------------------|---------------------------------|-----------------|-------|
| Light                              |             | Solar Energy (EN410) |                    |                    |                               | Pilkington Shading Coefficients |                 |       |
| Transmittance                      | Reflectance | Direct Transmittance | Direct Reflectance | Direct Absorptance | Total Transmittance (G-Value) | Short Wavelength                | Long Wavelength | Total |
| 0.42                               | 0.06        | 0.27                 | 0.09               | 0.64               | 0.37                          | 0.31                            | 0.11            | 0.43  |

No blinds have been modelled at this stage.

All frames have a U value of 2.20 W/m<sup>2</sup>K

## 2.3 Internal Gains

Occupancy and equipment gains have been modelled as outlined in table 1 found at the end of this section of the report below, this table has been taken directly from TM59. Corridors and WCs have been modelled with no occupancy or equipment gains.

In line with TM59, lighting is modelled as on from 6pm to 11pm every day at a value of 2.0 W/m<sup>2</sup> in bedrooms and living rooms/kitchens, WCs and corridors.

Infiltration has been modelled as 0.15ach for all spaces.

No heating has been modelled through the summer period.

Each flat has a heat interface unit in the dwelling corridor, this has been modelled as 39W equipment gains in each flat corridor space, the studio flat has this gain modelled in the living space as it does not have a corridor.

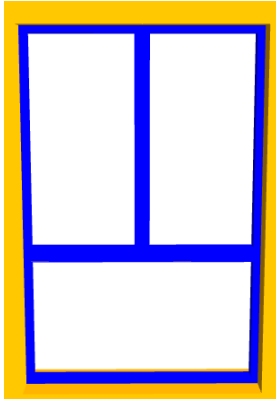
## 2.4 Natural Ventilation

A number of windows have been modelled as openable, they have been modelled with a maximum openable areas depending on the window type (more information on this has been given below) and begin to open when the adjacent space reaches 21°C and are fully open when this spaces reaches 22°C. Windows have been modelled as open when the adjacent space is occupied, this means bedroom windows are always openable and living room/bathroom windows are openable from 9am-10pm. The exception to this is GF bedrooms which have windows modelled as openable from 9am-10pm for security reasons.

Internal doors have been modelled as fully open during waking hours (this has been taken to be 8am-11pm).

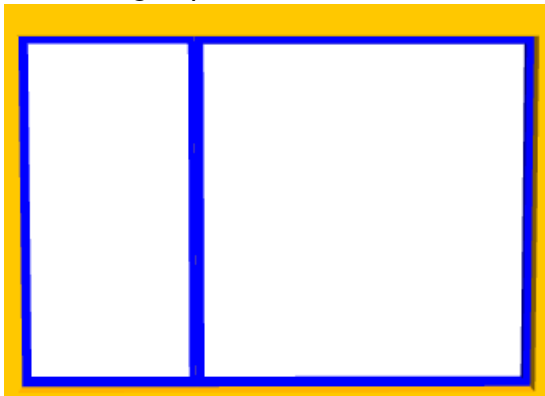
The following windows groups have been modelled as openable in the TM59 assessment:

Flat 3 window group:



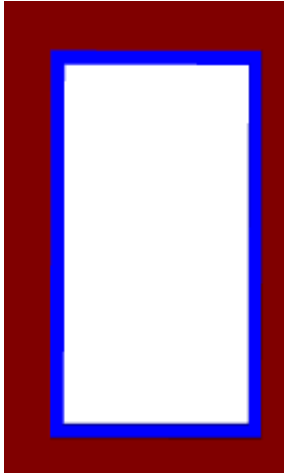
The top 2 windows have been modelled with a maximum openable proportion of 100%, the bottom window has not been modelled as openable.

Flat door group:



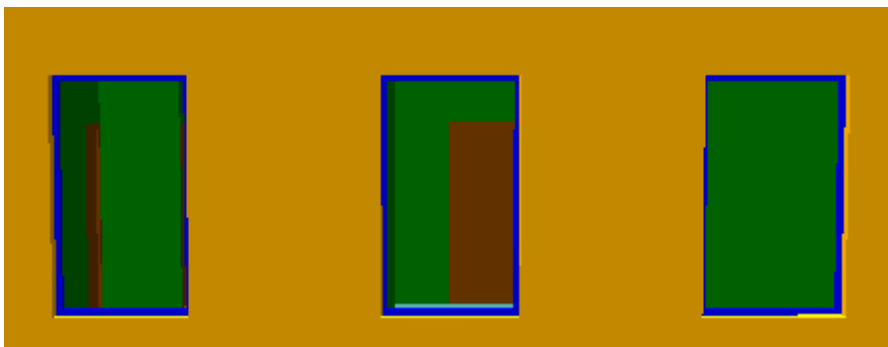
The smaller door has been modelled as fully openable, the larger pane has been not been modelled as openable.

House rooflight window:



The 1F rooflight windows in the house have been modelled with a maximum openable proportion of 100%.

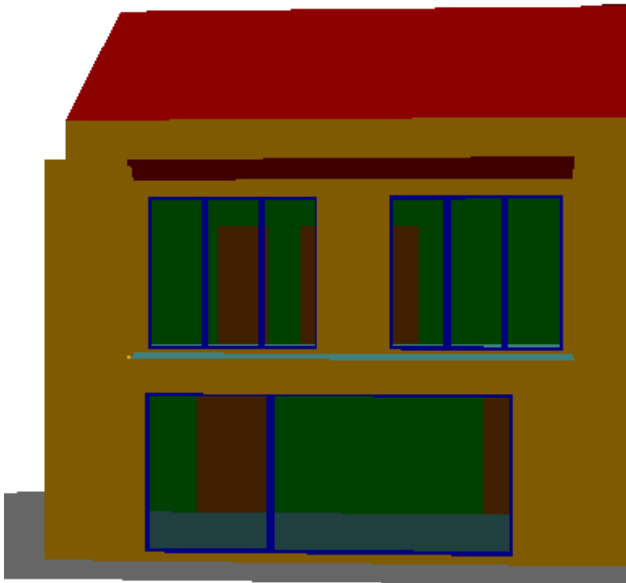
The 1F House bedroom/corridor windows:



These have been modelled with a maximum openable proportion of 100%.



House Doors:



For the GF the smaller pane has been modelled as fully openable, for the 1F one pane has been modelled as fully openable.

## **2.5Mechanical Ventilation**

Living and kitchen and bedroom spaces have 6l/s of air mechanically extracted overnight. Makeup air is assumed to be at outside air conditions. This has been modelled 24/7.

No further mechanical ventilation has been included

## **2.6Comfort Cooling**

No comfort cooling has been modelled.

## **2.7Blinds**

No blinds have been included in the assessment.

## **2.8Shading**

Only the adjacent buildings have been included as shade buildings.

**Table 1 - Dwelling occupancy and equipment gain**

| Unit/ room type                                      | Occupancy                                                                                                                                                                | Equipment load                                                                                                                                                   |
|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Studio                                               | 2 people at 70% gains from 11 pm to 8 am<br>2 people at 100% gains from 8 am to 11 pm                                                                                    | Peak load of 450 W from 6 pm to 8 pm*.<br>200 W from 8 pm to 10 pm<br>110 W from 9 am to 6 pm and 10 pm to 12 pm<br>Base load of 85 W for the rest of the day    |
| 1-bedroom apartment:<br>living room/kitchen          | 1 person from 9 am to 10 pm; room is unoccupied for the rest of the day                                                                                                  | Peak load of 450 W from 6 pm to 8 pm<br>200 W from 8 pm to 10 pm<br>110 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 85 W for the rest of the day |
| 1-bedroom apartment:<br>living room                  | 1 person at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day                                                                                     | Peak load of 150 W from 6 pm to 10 pm<br>60 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 35 W for the rest of the day                             |
| 1-bedroom apartment:<br>kitchen                      | 1 person at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day                                                                                     | Peak load of 300 W from 6 pm to 8 pm<br>Base load of 50 W for the rest of the day                                                                                |
| 2-bedroom apartment:<br>living room/kitchen          | 2 people from 9 am to 10 pm; room is unoccupied for the rest of the day                                                                                                  | Peak load of 450 W from 6 pm to 8 pm<br>200 W from 8 pm to 10 pm<br>110 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 85 W for the rest of the day |
| 2-bedroom apartment:<br>living room                  | 2 people at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day                                                                                     | Peak load of 150 W from 6 pm to 10 pm<br>60 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 35 W for the rest of the day                             |
| 2-bedroom apartment:<br>kitchen                      | 2 people at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day                                                                                     | Peak load of 300 W from 6 pm to 8 pm<br>Base load of 50 W for the rest of the day                                                                                |
| 3-bedroom apartment:<br>living room/kitchen          | 3 people from 9 am to 10 pm; room is unoccupied for the rest of the day                                                                                                  | Peak load of 450 W from 6 pm to 8 pm<br>200W from 8 pm to 10 pm<br>110 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 85 W for the rest of the day  |
| 3-bedroom apartment:<br>living room                  | 3 people at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day                                                                                     | Peak load of 150 W from 6 pm to 10 pm<br>60 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 35 W for the rest of the day                             |
| 3-bedroom apartment:<br>kitchen                      | 3 people at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day                                                                                     | Peak load of 300 W from 6 pm to 8 pm<br>base load of 50 W for the rest of the day                                                                                |
| Double bedroom                                       | 2 people at 70% gains from 11 pm to 8 am<br>2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm<br>1 person at full gains in the bedroom from 9 am to 10 pm | Peak load of 80 W from 8 am to 11 pm<br>Base load of 10 W during the sleeping hours                                                                              |
| Single bedroom (too small to accommodate double bed) | 1 person at 70% gains from 11 pm to 8 am<br>1 person at full gains from 8 am to 11 pm                                                                                    | Peak load of 80 W from 8 am to 11 pm<br>Base load of 10 W during sleeping hours                                                                                  |
| Communal corridors                                   | Assumed to be zero                                                                                                                                                       | Pipework heat loss only; see section 3.1 above                                                                                                                   |

\* All times in GMT

### 3.0 RESULTS

The thermal comfort category used is category II, in accordance with the CIBSE TM59 guidance.

Results for the weather files used can be as outlined found below

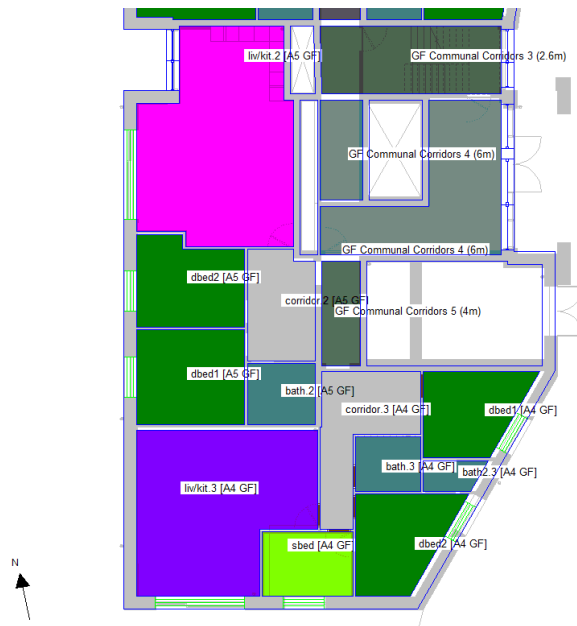
| Result | Weather file (London Heathrow)       |
|--------|--------------------------------------|
| 4.1    | DSY1 2020 high emission 50percentile |
| 4.2    | DSY2 2020 high emission 50percentile |
| 4.3    | DSY3 2020 high emission 50percentile |

A few flats show a risk of overheating during the summer period, mainly in the living room/kitchen space. Those will be further analysed in the next design stage in order to reduce that risk.

## 4.0 APPENDICES

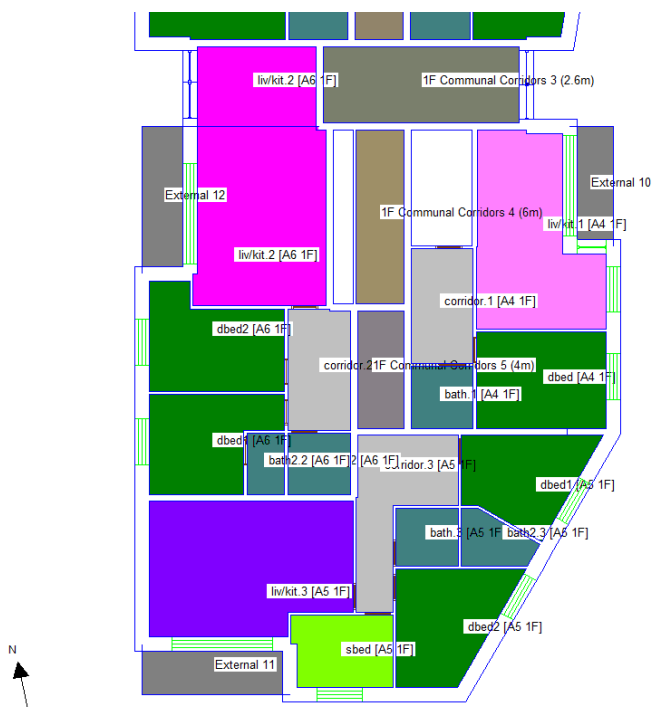
### 4.1 Floor plans from the Tas model

#### Block A GF South

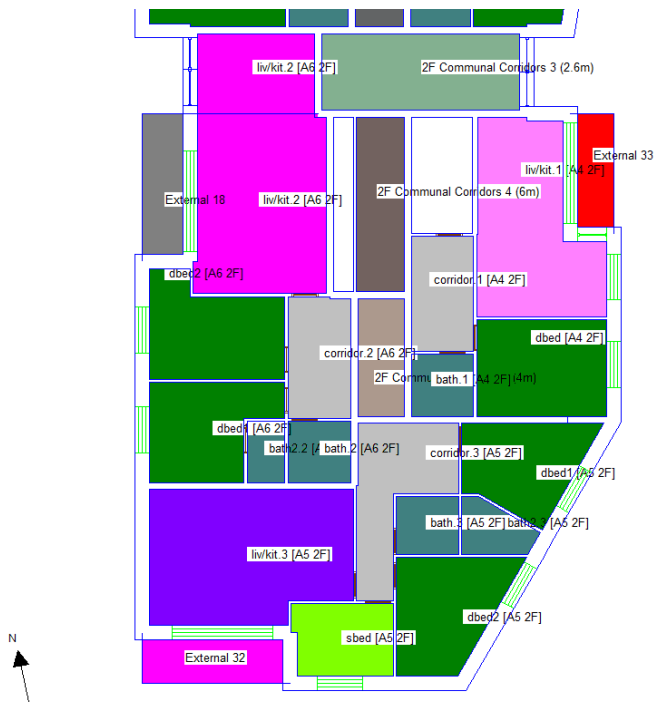


*\*Please note that only the coloured and labelled spaces were included in this assessment.*

#### Block A 1F South



### Block A 2F South



### Block A 3F South

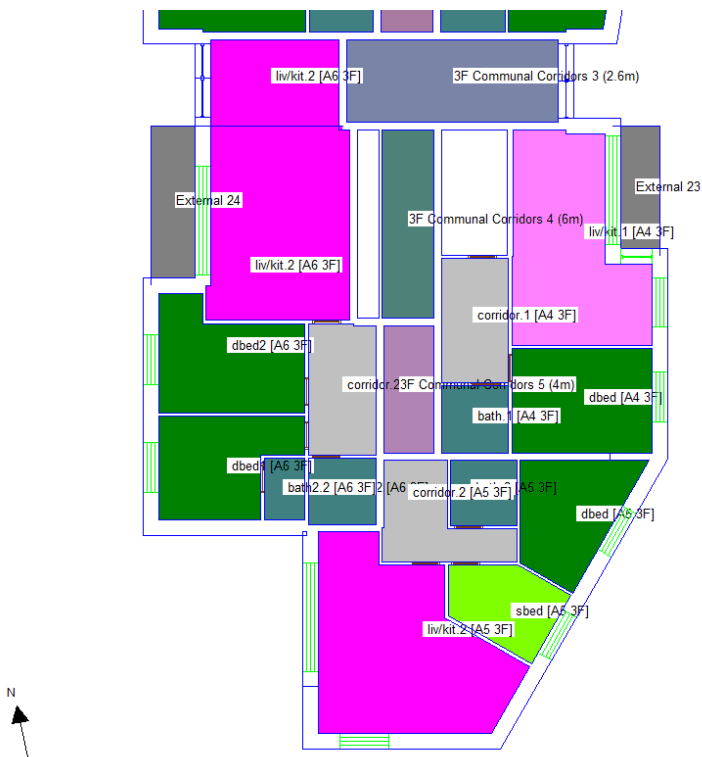
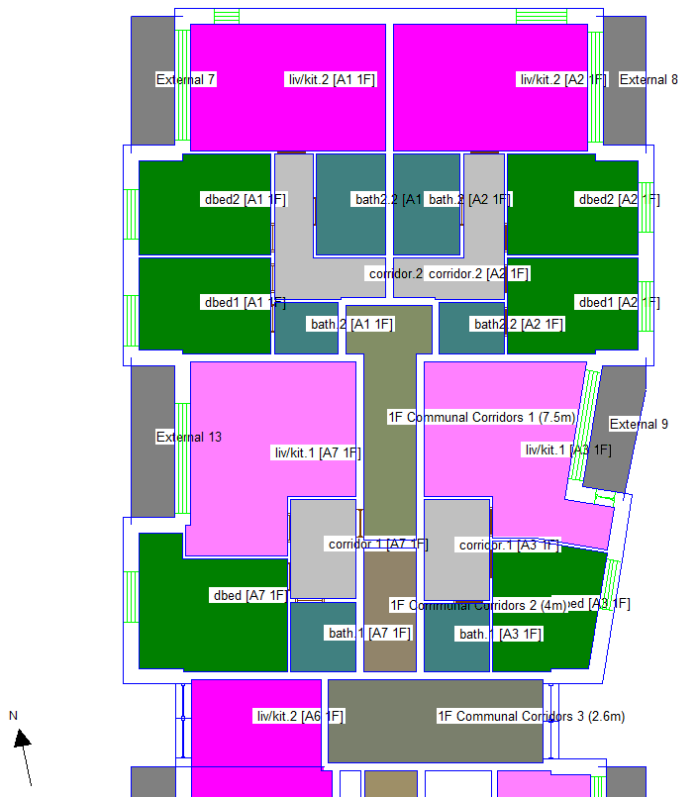




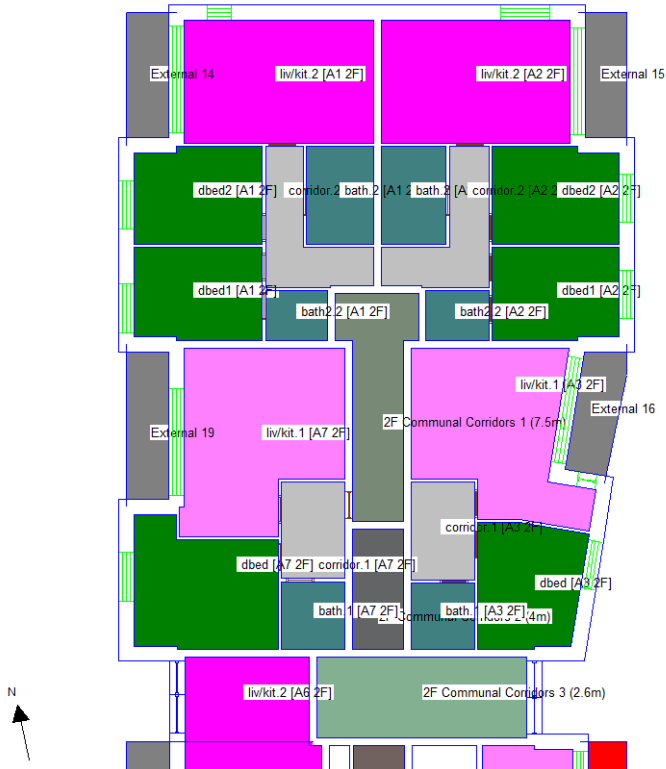
Figure 1: Floor plan of the 1st floor of the building. The plan shows various rooms including living/kit areas (liv/kit), bedrooms (dbed), bathrooms (bath), and corridors (corridor). Rooms are color-coded: pink for living/kit, green for bedrooms, blue for bathrooms, and grey for corridors. The plan is divided into two main sections by a central corridor. The top section includes liv/kit.2 [A1 GF], liv/kit.2 [A2 GF], dbed2 [A1 GF], dbed2 [A2 GF], bath.2 [A1 GF], bath.2 [A2 GF], and liv/kit.1 [A6 GF]. The bottom section includes liv/kit.1 [A3 GF], liv/kit.1 [A6 GF], dbed [A6 GF], bath.1 [A6 GF], bath.1 [A3 GF], and liv/kit.2 [A5 GF]. External areas are labeled External 2 and External 4. The plan also shows GF Communal Corridors 2 (4.1m) and GF Communal Corridors 3 (2.6m).



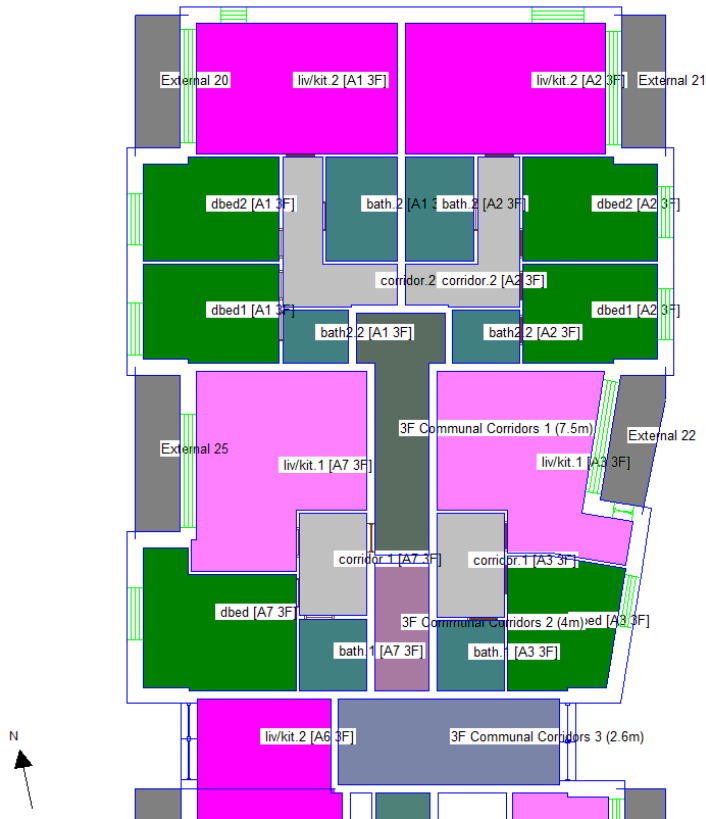
### Block A 1F North



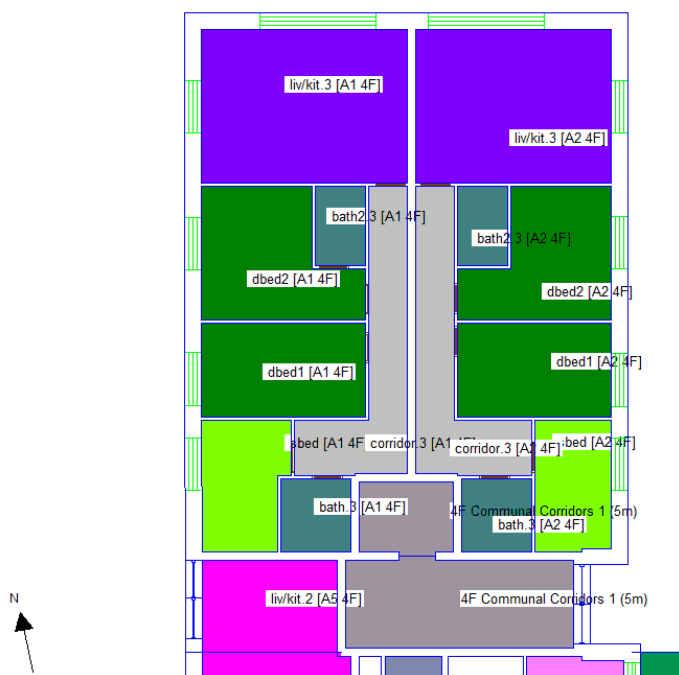
### Block A 2F North



## Block A 3F North

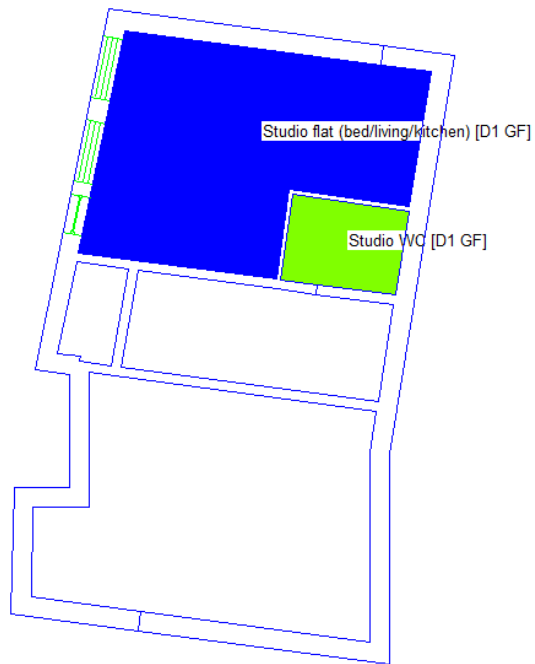


## Block A 4F North

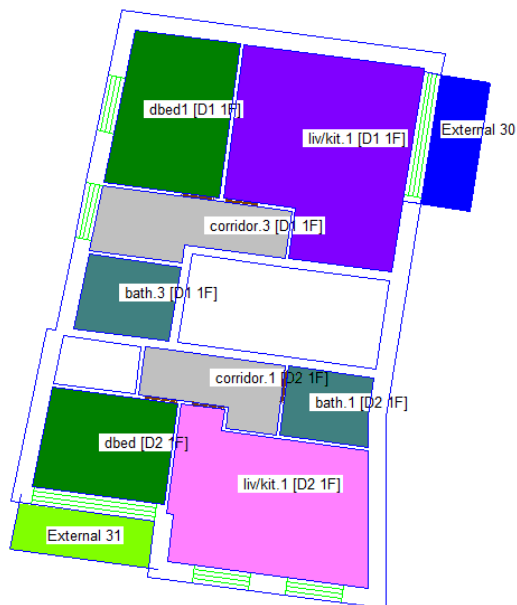




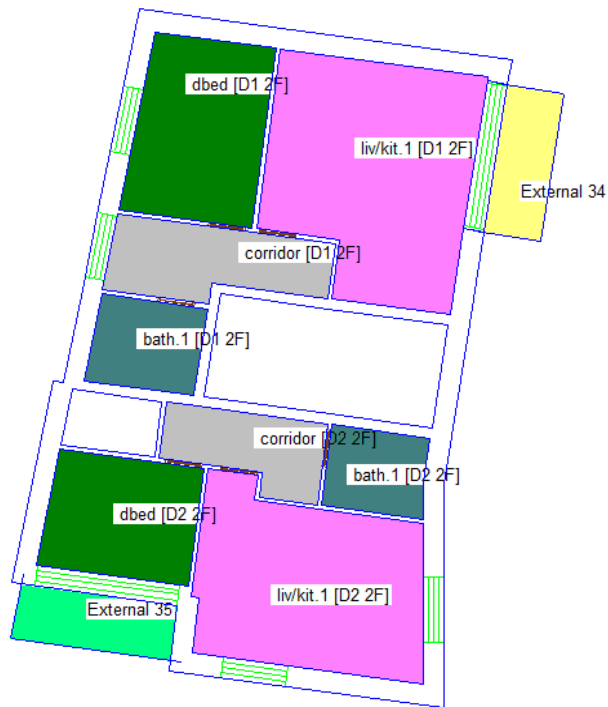
### Block D GF



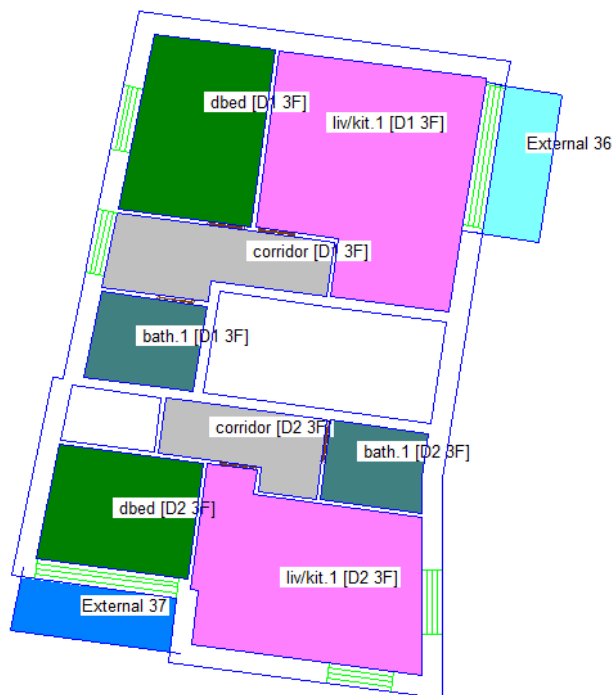
### Block D 1F



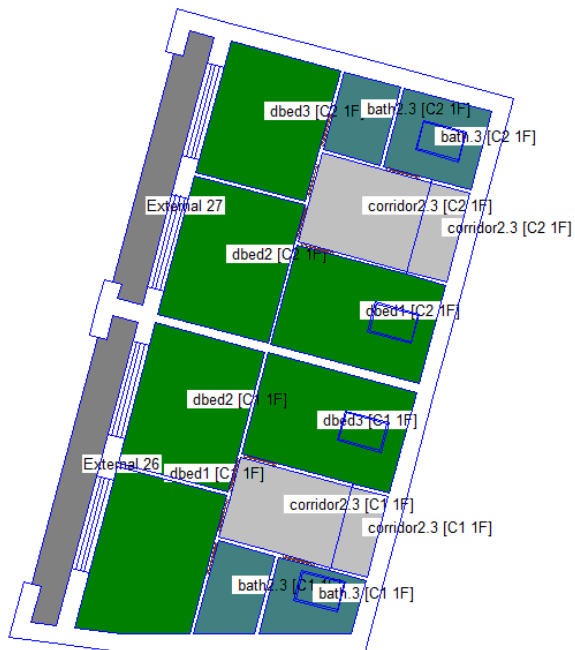
## Block D 2F



## Block D 3F



Block C (House) GF



#### 4.2 “TM59 DSY1 24hr vent 100% FA windows”

# Domestic Overheating (CIBSE TM59)

## Project Details

**Building Designer File (.tbd):** HN\_Resi new\_London\_LHR\_DSY1.tbd

**Simulation Results File (.tsd):** HN\_Resi new\_London\_LHR\_DSY1.tsd

**Date:** 29 January 2019

**Building Category:** Category II

## Natural Ventilation Overheating Results

| Zone Name                      | Room Use | Occupied Summer Hours | Max. Exceedable Hours | Criterion 1: #Hours Exceeding Comfort Range | Annual Night Occupied Hours for Bedroom | Max Exceedable Night Hours | Criterion 2: Number of Night Hours Exceeding 26 °C for Bedrooms. | Result |
|--------------------------------|----------|-----------------------|-----------------------|---------------------------------------------|-----------------------------------------|----------------------------|------------------------------------------------------------------|--------|
| 1F Communal Corridors 1 (7.5m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 1F Communal Corridors 2 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 1F Communal Corridors 3 (2.6m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 1F Communal Corridors 4 (6m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 1F Communal Corridors 5 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 2F Communal Corridors 1 (7.5m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 2F Communal Corridors 2 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 2F Communal Corridors 3 (2.6m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 2F Communal Corridors 4 (6m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 2F Communal Corridors 5 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 3F Communal Corridors 1 (7.5m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 3F Communal Corridors 2 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 3F Communal Corridors 3 (2.6m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 3F Communal Corridors 4 (6m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 3F Communal Corridors 5 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 4F Communal Corridors 1 (5m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |

# Domestic Overheating (CIBSE TM59)

|                                    |       |   |   |   |     |     |     |      |
|------------------------------------|-------|---|---|---|-----|-----|-----|------|
| 4F Communal Corridors<br>2 (10.5m) | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A1 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A1 2F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A1 3F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A1 GF]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A2 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A2 2F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A2 3F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A2 GF]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A5 4F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A6 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A6 2F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A6 3F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [A1 4F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [A2 4F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [A4 GF]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [A5 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [A5 2F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [C1 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [C2 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath3.3 [C1 GF]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath3.3 [C2 GF]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A3 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A3 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A3 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A3 4F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A3 GF]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A4 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A4 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A4 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A4 4F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A6 GF]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A7 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A7 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A7 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [D1 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [D1 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [D2 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [D2 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [D2 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A1 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A1 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A1 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A1 GF]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A2 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |

# Domestic Overheating (CIBSE TM59)

|                     |       |   |   |   |     |     |     |      |
|---------------------|-------|---|---|---|-----|-----|-----|------|
| bath.2 [A2 2F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A2 3F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A2 GF]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A5 3F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A5 4F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A5 GF]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A6 1F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A6 2F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A6 3F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [A1 4F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [A2 4F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [A4 GF]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [A5 1F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [A5 2F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [C1 1F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [C2 1F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [D1 1F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor2.3 [C1 1F] | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor2.3 [C2 1F] | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor [D1 2F]    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor [D1 3F]    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor [D2 2F]    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor [D2 3F]    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A3 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A3 2F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A3 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A3 4F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A3 GF]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A4 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A4 2F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A4 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A4 4F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A6 GF]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A7 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A7 2F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A7 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [D2 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A1 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A1 2F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A1 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A1 GF]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A2 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A2 2F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A2 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A2 GF]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A5 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |

# Domestic Overheating (CIBSE TM59)

|                    |         |      |     |    |      |     |     |      |
|--------------------|---------|------|-----|----|------|-----|-----|------|
| corridor.2 [A5 4F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.2 [A5 GF] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.2 [A6 1F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.2 [A6 2F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.2 [A6 3F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.3 [A1 4F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.3 [A2 4F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.3 [A4 GF] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.3 [A5 1F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.3 [A5 2F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.3 [C1 GF] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.3 [C2 GF] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.3 [D1 1F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| dbed1 [A1 1F]      | Bedroom | 3672 | 110 | 28 | 3285 | 32  | 7   | Pass |
| dbed1 [A1 2F]      | Bedroom | 3672 | 110 | 29 | 3285 | 32  | 7   | Pass |
| dbed1 [A1 3F]      | Bedroom | 3672 | 110 | 29 | 3285 | 32  | 7   | Pass |
| dbed1 [A1 4F]      | Bedroom | 3672 | 110 | 33 | 3285 | 32  | 8   | Pass |
| dbed1 [A1 GF]      | Bedroom | 3672 | 110 | 1  | 3285 | 32  | 5   | Pass |
| dbed1 [A2 1F]      | Bedroom | 3672 | 110 | 17 | 3285 | 32  | 7   | Pass |
| dbed1 [A2 2F]      | Bedroom | 3672 | 110 | 19 | 3285 | 32  | 7   | Pass |
| dbed1 [A2 3F]      | Bedroom | 3672 | 110 | 24 | 3285 | 32  | 8   | Pass |
| dbed1 [A2 4F]      | Bedroom | 3672 | 110 | 26 | 3285 | 32  | 7   | Pass |
| dbed1 [A2 GF]      | Bedroom | 3672 | 110 | 4  | 3285 | 32  | 82  | Fail |
| dbed1 [A4 GF]      | Bedroom | 3672 | 110 | 37 | 3285 | 32  | 85  | Fail |
| dbed1 [A5 1F]      | Bedroom | 3672 | 110 | 22 | 3285 | 32  | 7   | Pass |
| dbed1 [A5 2F]      | Bedroom | 3672 | 110 | 26 | 3285 | 32  | 7   | Pass |
| dbed1 [A5 4F]      | Bedroom | 3672 | 110 | 43 | 3285 | 32  | 12  | Pass |
| dbed1 [A5 GF]      | Bedroom | 3672 | 110 | 62 | 3285 | 32  | 161 | Fail |
| dbed1 [A6 1F]      | Bedroom | 3672 | 110 | 35 | 3285 | 32  | 9   | Pass |
| dbed1 [A6 2F]      | Bedroom | 3672 | 110 | 34 | 3285 | 32  | 9   | Pass |
| dbed1 [A6 3F]      | Bedroom | 3672 | 110 | 42 | 3285 | 32  | 10  | Pass |
| dbed1 [C1 1F]      | Bedroom | 3672 | 110 | 42 | 3285 | 32  | 7   | Pass |
| dbed1 [C2 1F]      | Bedroom | 3672 | 110 | 43 | 3285 | 32  | 12  | Pass |
| dbed1 [D1 1F]      | Bedroom | 3672 | 110 | 20 | 3285 | 32  | 6   | Pass |
| dbed2 [A1 1F]      | Bedroom | 3672 | 110 | 33 | 3285 | 32  | 7   | Pass |
| dbed2 [A1 2F]      | Bedroom | 3672 | 110 | 36 | 3285 | 32  | 8   | Pass |
| dbed2 [A1 3F]      | Bedroom | 3672 | 110 | 36 | 3285 | 32  | 8   | Pass |
| dbed2 [A1 4F]      | Bedroom | 3672 | 110 | 25 | 3285 | 32  | 8   | Pass |
| dbed2 [A1 GF]      | Bedroom | 3672 | 110 | 17 | 3285 | 32  | 5   | Pass |
| dbed2 [A2 1F]      | Bedroom | 3672 | 110 | 22 | 3285 | 32  | 7   | Pass |
| dbed2 [A2 2F]      | Bedroom | 3672 | 110 | 25 | 3285 | 32  | 8   | Pass |
| dbed2 [A2 3F]      | Bedroom | 3672 | 110 | 28 | 3285 | 32  | 8   | Pass |
| dbed2 [A2 4F]      | Bedroom | 3672 | 110 | 23 | 3285 | 32  | 8   | Pass |
| dbed2 [A2 GF]      | Bedroom | 3672 | 110 | 22 | 3285 | 32  | 91  | Fail |
| dbed2 [A4 GF]      | Bedroom | 3672 | 110 | 37 | 3285 | 32  | 82  | Fail |
| dbed2 [A5 1F]      | Bedroom | 3672 | 110 | 26 | 3285 | 32  | 7   | Pass |



# Domestic Overheating (CIBSE TM59)

|                   |                          |      |     |     |      |     |     |      |
|-------------------|--------------------------|------|-----|-----|------|-----|-----|------|
| dbed2 [A5 2F]     | Bedroom                  | 3672 | 110 | 29  | 3285 | 32  | 7   | Pass |
| dbed2 [A5 4F]     | Bedroom                  | 3672 | 110 | 49  | 3285 | 32  | 12  | Pass |
| dbed2 [A5 GF]     | Bedroom                  | 3672 | 110 | 88  | 3285 | 32  | 202 | Fail |
| dbed2 [A6 1F]     | Bedroom                  | 3672 | 110 | 48  | 3285 | 32  | 10  | Pass |
| dbed2 [A6 2F]     | Bedroom                  | 3672 | 110 | 47  | 3285 | 32  | 9   | Pass |
| dbed2 [A6 3F]     | Bedroom                  | 3672 | 110 | 49  | 3285 | 32  | 10  | Pass |
| dbed2 [C1 1F]     | Bedroom                  | 3672 | 110 | 59  | 3285 | 32  | 7   | Pass |
| dbed2 [C2 1F]     | Bedroom                  | 3672 | 110 | 62  | 3285 | 32  | 7   | Pass |
| dbed3 [C1 1F]     | Bedroom                  | 3672 | 110 | 39  | 3285 | 32  | 11  | Pass |
| dbed3 [C2 1F]     | Bedroom                  | 3672 | 110 | 72  | 3285 | 32  | 7   | Pass |
| dbed [A3 1F]      | Bedroom                  | 3672 | 110 | 37  | 3285 | 32  | 10  | Pass |
| dbed [A3 2F]      | Bedroom                  | 3672 | 110 | 38  | 3285 | 32  | 11  | Pass |
| dbed [A3 3F]      | Bedroom                  | 3672 | 110 | 40  | 3285 | 32  | 10  | Pass |
| dbed [A3 4F]      | Bedroom                  | 3672 | 110 | 0   | 3285 | 32  | 6   | Pass |
| dbed [A3 GF]      | Bedroom                  | 3672 | 110 | 85  | 3285 | 32  | 218 | Fail |
| dbed [A4 1F]      | Bedroom                  | 3672 | 110 | 0   | 3285 | 32  | 8   | Pass |
| dbed [A4 2F]      | Bedroom                  | 3672 | 110 | 6   | 3285 | 32  | 9   | Pass |
| dbed [A4 3F]      | Bedroom                  | 3672 | 110 | 6   | 3285 | 32  | 9   | Pass |
| dbed [A4 4F]      | Bedroom                  | 3672 | 110 | 29  | 3285 | 32  | 6   | Pass |
| dbed [A5 3F]      | Bedroom                  | 3672 | 110 | 37  | 3285 | 32  | 7   | Pass |
| dbed [A6 GF]      | Bedroom                  | 3672 | 110 | 1   | 3285 | 32  | 6   | Pass |
| dbed [A7 1F]      | Bedroom                  | 3672 | 110 | 29  | 3285 | 32  | 10  | Pass |
| dbed [A7 2F]      | Bedroom                  | 3672 | 110 | 33  | 3285 | 32  | 11  | Pass |
| dbed [A7 3F]      | Bedroom                  | 3672 | 110 | 30  | 3285 | 32  | 11  | Pass |
| dbed [D1 2F]      | Bedroom                  | 3672 | 110 | 24  | 3285 | 32  | 6   | Pass |
| dbed [D1 3F]      | Bedroom                  | 3672 | 110 | 26  | 3285 | 32  | 6   | Pass |
| dbed [D2 1F]      | Bedroom                  | 3672 | 110 | 73  | 3285 | 32  | 6   | Pass |
| dbed [D2 2F]      | Bedroom                  | 3672 | 110 | 76  | 3285 | 32  | 7   | Pass |
| dbed [D2 3F]      | Bedroom                  | 3672 | 110 | 131 | 3285 | 32  | 8   | Fail |
| kit.3 [C1 GF]     | Living Room /<br>Kitchen | 1989 | 59  | 14  | N/A  | N/A | N/A | Pass |
| kit.3 [C2 GF]     | Living Room /<br>Kitchen | 1989 | 59  | 26  | N/A  | N/A | N/A | Pass |
| liv.3 [C1 GF]     | Living Room /<br>Kitchen | 1989 | 59  | 28  | N/A  | N/A | N/A | Pass |
| liv.3 [C2 GF]     | Living Room /<br>Kitchen | 1989 | 59  | 65  | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A3 1F] | Living Room /<br>Kitchen | 1989 | 59  | 43  | N/A  | N/A | N/A | Pass |
| liv/kit.1 [A3 2F] | Living Room /<br>Kitchen | 1989 | 59  | 58  | N/A  | N/A | N/A | Pass |
| liv/kit.1 [A3 3F] | Living Room /<br>Kitchen | 1989 | 59  | 60  | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A3 4F] | Living Room /<br>Kitchen | 1989 | 59  | 112 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A3 GF] | Living Room /<br>Kitchen | 1989 | 59  | 32  | N/A  | N/A | N/A | Pass |
| liv/kit.1 [A4 1F] | Living Room /<br>Kitchen | 1989 | 59  | 143 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A4 2F] | Living Room /<br>Kitchen | 1989 | 59  | 119 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A4 3F] | Living Room /<br>Kitchen | 1989 | 59  | 117 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A4 4F] | Living Room /<br>Kitchen | 1989 | 59  | 77  | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A6 GF] | Living Room /<br>Kitchen | 1989 | 59  | 57  | N/A  | N/A | N/A | Pass |
| liv/kit.1 [A7 1F] | Living Room /<br>Kitchen | 1989 | 59  | 116 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A7 2F] | Living Room /<br>Kitchen | 1989 | 59  | 136 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A7 3F] | Living Room /<br>Kitchen | 1989 | 59  | 123 | N/A  | N/A | N/A | Fail |

# Domestic Overheating (CIBSE TM59)

|                                          |                       |      |     |     |      |     |     |      |
|------------------------------------------|-----------------------|------|-----|-----|------|-----|-----|------|
| liv/kit.1 [D1 1F]                        | Living Room / Kitchen | 1989 | 59  | 37  | N/A  | N/A | N/A | Pass |
| liv/kit.1 [D1 2F]                        | Living Room / Kitchen | 1989 | 59  | 32  | N/A  | N/A | N/A | Pass |
| liv/kit.1 [D1 3F]                        | Living Room / Kitchen | 1989 | 59  | 32  | N/A  | N/A | N/A | Pass |
| liv/kit.1 [D2 1F]                        | Living Room / Kitchen | 1989 | 59  | 63  | N/A  | N/A | N/A | Fail |
| liv/kit.1 [D2 2F]                        | Living Room / Kitchen | 1989 | 59  | 41  | N/A  | N/A | N/A | Pass |
| liv/kit.1 [D2 3F]                        | Living Room / Kitchen | 1989 | 59  | 47  | N/A  | N/A | N/A | Pass |
| liv/kit.2 [A1 1F]                        | Living Room / Kitchen | 1989 | 59  | 52  | N/A  | N/A | N/A | Pass |
| liv/kit.2 [A1 2F]                        | Living Room / Kitchen | 1989 | 59  | 56  | N/A  | N/A | N/A | Pass |
| liv/kit.2 [A1 3F]                        | Living Room / Kitchen | 1989 | 59  | 52  | N/A  | N/A | N/A | Pass |
| liv/kit.2 [A1 GF]                        | Living Room / Kitchen | 1989 | 59  | 43  | N/A  | N/A | N/A | Pass |
| liv/kit.2 [A2 1F]                        | Living Room / Kitchen | 1989 | 59  | 36  | N/A  | N/A | N/A | Pass |
| liv/kit.2 [A2 2F]                        | Living Room / Kitchen | 1989 | 59  | 52  | N/A  | N/A | N/A | Pass |
| liv/kit.2 [A2 3F]                        | Living Room / Kitchen | 1989 | 59  | 51  | N/A  | N/A | N/A | Pass |
| liv/kit.2 [A2 GF]                        | Living Room / Kitchen | 1989 | 59  | 23  | N/A  | N/A | N/A | Pass |
| liv/kit.2 [A5 3F]                        | Living Room / Kitchen | 1989 | 59  | 60  | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A5 4F]                        | Living Room / Kitchen | 1989 | 59  | 165 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A5 GF]                        | Living Room / Kitchen | 1989 | 59  | 124 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A6 1F]                        | Living Room / Kitchen | 1989 | 59  | 142 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A6 2F]                        | Living Room / Kitchen | 1989 | 59  | 143 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A6 3F]                        | Living Room / Kitchen | 1989 | 59  | 141 | N/A  | N/A | N/A | Fail |
| liv/kit.3 [A1 4F]                        | Living Room / Kitchen | 1989 | 59  | 56  | N/A  | N/A | N/A | Pass |
| liv/kit.3 [A2 4F]                        | Living Room / Kitchen | 1989 | 59  | 54  | N/A  | N/A | N/A | Pass |
| liv/kit.3 [A4 GF]                        | Living Room / Kitchen | 1989 | 59  | 67  | N/A  | N/A | N/A | Fail |
| liv/kit.3 [A5 1F]                        | Living Room / Kitchen | 1989 | 59  | 31  | N/A  | N/A | N/A | Pass |
| liv/kit.3 [A5 2F]                        | Living Room / Kitchen | 1989 | 59  | 31  | N/A  | N/A | N/A | Pass |
| sbed [A1 4F]                             | Bedroom               | 3672 | 110 | 45  | 3285 | 32  | 7   | Pass |
| sbed [A2 4F]                             | Bedroom               | 3672 | 110 | 37  | 3285 | 32  | 6   | Pass |
| sbed [A4 GF]                             | Bedroom               | 3672 | 110 | 65  | 3285 | 32  | 70  | Fail |
| sbed [A5 1F]                             | Bedroom               | 3672 | 110 | 52  | 3285 | 32  | 5   | Pass |
| sbed [A5 2F]                             | Bedroom               | 3672 | 110 | 55  | 3285 | 32  | 7   | Pass |
| sbed [A5 3F]                             | Bedroom               | 3672 | 110 | 53  | 3285 | 32  | 7   | Pass |
| Utility2 [C1 GF]                         | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| Utility2 [C2 GF]                         | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| Utility [C1 GF]                          | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| Utility [C2 GF]                          | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| GF Communal Corridors 2 (4.1m)           | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| GF Communal Corridors 3 (2.6m)           | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| GF Communal Corridors 4 (6m)             | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| GF Communal Corridors 5 (4m)             | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| Studio flat (bed/living/kitchen) [D1 GF] | Bedroom               | 3672 | 110 | 15  | 3285 | 32  | 104 | Fail |

# Domestic Overheating (CIBSE TM59)

|                   |       |   |   |   |     |     |     |      |
|-------------------|-------|---|---|---|-----|-----|-----|------|
| Studio WC [D1 GF] | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
|-------------------|-------|---|---|---|-----|-----|-----|------|

\*Zone name's that have an orange coloured font are bedrooms which do not have 24/7 365 days a year occupancy, as per the

#### 4.3 “TM59 DSY2 24hr vent 100% FA windows”

# Domestic Overheating (CIBSE TM59)

## Project Details

**Building Designer File (.tbd):** HN\_Resi new\_London\_LHR\_DSY2.tbd

**Simulation Results File (.tsd):** HN\_Resi new\_London\_LHR\_DSY2.tsd

**Date:** 29 January 2019

**Building Category:** Category II

## Natural Ventilation Overheating Results

| Zone Name                      | Room Use | Occupied Summer Hours | Max. Exceedable Hours | Criterion 1: #Hours Exceeding Comfort Range | Annual Night Occupied Hours for Bedroom | Max Exceedable Night Hours | Criterion 2: Number of Night Hours Exceeding 26 °C for Bedrooms. | Result |
|--------------------------------|----------|-----------------------|-----------------------|---------------------------------------------|-----------------------------------------|----------------------------|------------------------------------------------------------------|--------|
| 1F Communal Corridors 1 (7.5m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 1F Communal Corridors 2 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 1F Communal Corridors 3 (2.6m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 1F Communal Corridors 4 (6m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 1F Communal Corridors 5 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 2F Communal Corridors 1 (7.5m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 2F Communal Corridors 2 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 2F Communal Corridors 3 (2.6m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 2F Communal Corridors 4 (6m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 2F Communal Corridors 5 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 3F Communal Corridors 1 (7.5m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 3F Communal Corridors 2 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 3F Communal Corridors 3 (2.6m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 3F Communal Corridors 4 (6m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 3F Communal Corridors 5 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 4F Communal Corridors 1 (5m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |

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|                                    |       |   |   |   |     |     |     |      |
|------------------------------------|-------|---|---|---|-----|-----|-----|------|
| 4F Communal Corridors<br>2 (10.5m) | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A1 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A1 2F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A1 3F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A1 GF]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A2 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A2 2F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A2 3F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A2 GF]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A5 4F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A6 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A6 2F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A6 3F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [A1 4F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [A2 4F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [A4 GF]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [A5 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [A5 2F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [C1 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [C2 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath3.3 [C1 GF]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath3.3 [C2 GF]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A3 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A3 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A3 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A3 4F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A3 GF]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A4 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A4 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A4 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A4 4F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A6 GF]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A7 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A7 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A7 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [D1 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [D1 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [D2 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [D2 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [D2 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A1 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A1 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A1 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A1 GF]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A2 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |

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|                     |       |   |   |   |     |     |     |      |
|---------------------|-------|---|---|---|-----|-----|-----|------|
| bath.2 [A2 2F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A2 3F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A2 GF]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A5 3F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A5 4F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A5 GF]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A6 1F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A6 2F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A6 3F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [A1 4F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [A2 4F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [A4 GF]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [A5 1F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [A5 2F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [C1 1F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [C2 1F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [D1 1F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor2.3 [C1 1F] | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor2.3 [C2 1F] | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor [D1 2F]    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor [D1 3F]    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor [D2 2F]    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor [D2 3F]    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A3 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A3 2F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A3 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A3 4F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A3 GF]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A4 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A4 2F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A4 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A4 4F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A6 GF]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A7 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A7 2F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A7 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [D2 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A1 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A1 2F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A1 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A1 GF]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A2 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A2 2F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A2 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A2 GF]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A5 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |

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|                    |         |      |     |    |      |     |     |      |
|--------------------|---------|------|-----|----|------|-----|-----|------|
| corridor.2 [A5 4F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.2 [A5 GF] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.2 [A6 1F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.2 [A6 2F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.2 [A6 3F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.3 [A1 4F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.3 [A2 4F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.3 [A4 GF] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.3 [A5 1F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.3 [A5 2F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.3 [C1 GF] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.3 [C2 GF] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| corridor.3 [D1 1F] | Other   | 0    | 0   | 0  | N/A  | N/A | N/A | Pass |
| dbed1 [A1 1F]      | Bedroom | 3672 | 110 | 29 | 3285 | 32  | 15  | Pass |
| dbed1 [A1 2F]      | Bedroom | 3672 | 110 | 35 | 3285 | 32  | 18  | Pass |
| dbed1 [A1 3F]      | Bedroom | 3672 | 110 | 36 | 3285 | 32  | 18  | Pass |
| dbed1 [A1 4F]      | Bedroom | 3672 | 110 | 37 | 3285 | 32  | 18  | Pass |
| dbed1 [A1 GF]      | Bedroom | 3672 | 110 | 1  | 3285 | 32  | 9   | Pass |
| dbed1 [A2 1F]      | Bedroom | 3672 | 110 | 37 | 3285 | 32  | 15  | Pass |
| dbed1 [A2 2F]      | Bedroom | 3672 | 110 | 43 | 3285 | 32  | 17  | Pass |
| dbed1 [A2 3F]      | Bedroom | 3672 | 110 | 51 | 3285 | 32  | 19  | Pass |
| dbed1 [A2 4F]      | Bedroom | 3672 | 110 | 55 | 3285 | 32  | 17  | Pass |
| dbed1 [A2 GF]      | Bedroom | 3672 | 110 | 26 | 3285 | 32  | 112 | Fail |
| dbed1 [A4 GF]      | Bedroom | 3672 | 110 | 71 | 3285 | 32  | 115 | Fail |
| dbed1 [A5 1F]      | Bedroom | 3672 | 110 | 47 | 3285 | 32  | 14  | Pass |
| dbed1 [A5 2F]      | Bedroom | 3672 | 110 | 48 | 3285 | 32  | 14  | Pass |
| dbed1 [A5 4F]      | Bedroom | 3672 | 110 | 41 | 3285 | 32  | 19  | Pass |
| dbed1 [A5 GF]      | Bedroom | 3672 | 110 | 84 | 3285 | 32  | 143 | Fail |
| dbed1 [A6 1F]      | Bedroom | 3672 | 110 | 38 | 3285 | 32  | 19  | Pass |
| dbed1 [A6 2F]      | Bedroom | 3672 | 110 | 38 | 3285 | 32  | 20  | Pass |
| dbed1 [A6 3F]      | Bedroom | 3672 | 110 | 41 | 3285 | 32  | 20  | Pass |
| dbed1 [C1 1F]      | Bedroom | 3672 | 110 | 56 | 3285 | 32  | 16  | Pass |
| dbed1 [C2 1F]      | Bedroom | 3672 | 110 | 65 | 3285 | 32  | 24  | Pass |
| dbed1 [D1 1F]      | Bedroom | 3672 | 110 | 43 | 3285 | 32  | 16  | Pass |
| dbed2 [A1 1F]      | Bedroom | 3672 | 110 | 38 | 3285 | 32  | 17  | Pass |
| dbed2 [A1 2F]      | Bedroom | 3672 | 110 | 40 | 3285 | 32  | 20  | Pass |
| dbed2 [A1 3F]      | Bedroom | 3672 | 110 | 40 | 3285 | 32  | 20  | Pass |
| dbed2 [A1 4F]      | Bedroom | 3672 | 110 | 27 | 3285 | 32  | 18  | Pass |
| dbed2 [A1 GF]      | Bedroom | 3672 | 110 | 22 | 3285 | 32  | 12  | Pass |
| dbed2 [A2 1F]      | Bedroom | 3672 | 110 | 46 | 3285 | 32  | 18  | Pass |
| dbed2 [A2 2F]      | Bedroom | 3672 | 110 | 50 | 3285 | 32  | 18  | Pass |
| dbed2 [A2 3F]      | Bedroom | 3672 | 110 | 57 | 3285 | 32  | 20  | Pass |
| dbed2 [A2 4F]      | Bedroom | 3672 | 110 | 53 | 3285 | 32  | 17  | Pass |
| dbed2 [A2 GF]      | Bedroom | 3672 | 110 | 53 | 3285 | 32  | 114 | Fail |
| dbed2 [A4 GF]      | Bedroom | 3672 | 110 | 75 | 3285 | 32  | 110 | Fail |
| dbed2 [A5 1F]      | Bedroom | 3672 | 110 | 49 | 3285 | 32  | 16  | Pass |



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|                   |                          |      |     |     |      |     |     |      |
|-------------------|--------------------------|------|-----|-----|------|-----|-----|------|
| dbed2 [A5 2F]     | Bedroom                  | 3672 | 110 | 50  | 3285 | 32  | 16  | Pass |
| dbed2 [A5 4F]     | Bedroom                  | 3672 | 110 | 52  | 3285 | 32  | 20  | Pass |
| dbed2 [A5 GF]     | Bedroom                  | 3672 | 110 | 108 | 3285 | 32  | 164 | Fail |
| dbed2 [A6 1F]     | Bedroom                  | 3672 | 110 | 47  | 3285 | 32  | 19  | Pass |
| dbed2 [A6 2F]     | Bedroom                  | 3672 | 110 | 45  | 3285 | 32  | 20  | Pass |
| dbed2 [A6 3F]     | Bedroom                  | 3672 | 110 | 46  | 3285 | 32  | 20  | Pass |
| dbed2 [C1 1F]     | Bedroom                  | 3672 | 110 | 73  | 3285 | 32  | 16  | Pass |
| dbed2 [C2 1F]     | Bedroom                  | 3672 | 110 | 77  | 3285 | 32  | 19  | Pass |
| dbed3 [C1 1F]     | Bedroom                  | 3672 | 110 | 60  | 3285 | 32  | 22  | Pass |
| dbed3 [C2 1F]     | Bedroom                  | 3672 | 110 | 81  | 3285 | 32  | 19  | Pass |
| dbed [A3 1F]      | Bedroom                  | 3672 | 110 | 66  | 3285 | 32  | 25  | Pass |
| dbed [A3 2F]      | Bedroom                  | 3672 | 110 | 70  | 3285 | 32  | 23  | Pass |
| dbed [A3 3F]      | Bedroom                  | 3672 | 110 | 70  | 3285 | 32  | 23  | Pass |
| dbed [A3 4F]      | Bedroom                  | 3672 | 110 | 14  | 3285 | 32  | 15  | Pass |
| dbed [A3 GF]      | Bedroom                  | 3672 | 110 | 145 | 3285 | 32  | 196 | Fail |
| dbed [A4 1F]      | Bedroom                  | 3672 | 110 | 24  | 3285 | 32  | 18  | Pass |
| dbed [A4 2F]      | Bedroom                  | 3672 | 110 | 27  | 3285 | 32  | 18  | Pass |
| dbed [A4 3F]      | Bedroom                  | 3672 | 110 | 32  | 3285 | 32  | 19  | Pass |
| dbed [A4 4F]      | Bedroom                  | 3672 | 110 | 57  | 3285 | 32  | 16  | Pass |
| dbed [A5 3F]      | Bedroom                  | 3672 | 110 | 68  | 3285 | 32  | 21  | Pass |
| dbed [A6 GF]      | Bedroom                  | 3672 | 110 | 2   | 3285 | 32  | 13  | Pass |
| dbed [A7 1F]      | Bedroom                  | 3672 | 110 | 33  | 3285 | 32  | 19  | Pass |
| dbed [A7 2F]      | Bedroom                  | 3672 | 110 | 38  | 3285 | 32  | 22  | Pass |
| dbed [A7 3F]      | Bedroom                  | 3672 | 110 | 36  | 3285 | 32  | 23  | Pass |
| dbed [D1 2F]      | Bedroom                  | 3672 | 110 | 32  | 3285 | 32  | 16  | Pass |
| dbed [D1 3F]      | Bedroom                  | 3672 | 110 | 32  | 3285 | 32  | 17  | Pass |
| dbed [D2 1F]      | Bedroom                  | 3672 | 110 | 95  | 3285 | 32  | 16  | Pass |
| dbed [D2 2F]      | Bedroom                  | 3672 | 110 | 100 | 3285 | 32  | 17  | Pass |
| dbed [D2 3F]      | Bedroom                  | 3672 | 110 | 131 | 3285 | 32  | 19  | Fail |
| kit.3 [C1 GF]     | Living Room /<br>Kitchen | 1989 | 59  | 38  | N/A  | N/A | N/A | Pass |
| kit.3 [C2 GF]     | Living Room /<br>Kitchen | 1989 | 59  | 55  | N/A  | N/A | N/A | Pass |
| liv.3 [C1 GF]     | Living Room /<br>Kitchen | 1989 | 59  | 43  | N/A  | N/A | N/A | Pass |
| liv.3 [C2 GF]     | Living Room /<br>Kitchen | 1989 | 59  | 74  | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A3 1F] | Living Room /<br>Kitchen | 1989 | 59  | 82  | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A3 2F] | Living Room /<br>Kitchen | 1989 | 59  | 90  | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A3 3F] | Living Room /<br>Kitchen | 1989 | 59  | 92  | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A3 4F] | Living Room /<br>Kitchen | 1989 | 59  | 127 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A3 GF] | Living Room /<br>Kitchen | 1989 | 59  | 60  | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A4 1F] | Living Room /<br>Kitchen | 1989 | 59  | 149 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A4 2F] | Living Room /<br>Kitchen | 1989 | 59  | 137 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A4 3F] | Living Room /<br>Kitchen | 1989 | 59  | 135 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A4 4F] | Living Room /<br>Kitchen | 1989 | 59  | 109 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A6 GF] | Living Room /<br>Kitchen | 1989 | 59  | 57  | N/A  | N/A | N/A | Pass |
| liv/kit.1 [A7 1F] | Living Room /<br>Kitchen | 1989 | 59  | 95  | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A7 2F] | Living Room /<br>Kitchen | 1989 | 59  | 102 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A7 3F] | Living Room /<br>Kitchen | 1989 | 59  | 93  | N/A  | N/A | N/A | Fail |

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|                                          |                       |      |     |     |      |     |     |      |
|------------------------------------------|-----------------------|------|-----|-----|------|-----|-----|------|
| liv/kit.1 [D1 1F]                        | Living Room / Kitchen | 1989 | 59  | 58  | N/A  | N/A | N/A | Pass |
| liv/kit.1 [D1 2F]                        | Living Room / Kitchen | 1989 | 59  | 48  | N/A  | N/A | N/A | Pass |
| liv/kit.1 [D1 3F]                        | Living Room / Kitchen | 1989 | 59  | 47  | N/A  | N/A | N/A | Pass |
| liv/kit.1 [D2 1F]                        | Living Room / Kitchen | 1989 | 59  | 97  | N/A  | N/A | N/A | Fail |
| liv/kit.1 [D2 2F]                        | Living Room / Kitchen | 1989 | 59  | 68  | N/A  | N/A | N/A | Fail |
| liv/kit.1 [D2 3F]                        | Living Room / Kitchen | 1989 | 59  | 79  | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A1 1F]                        | Living Room / Kitchen | 1989 | 59  | 63  | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A1 2F]                        | Living Room / Kitchen | 1989 | 59  | 68  | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A1 3F]                        | Living Room / Kitchen | 1989 | 59  | 59  | N/A  | N/A | N/A | Pass |
| liv/kit.2 [A1 GF]                        | Living Room / Kitchen | 1989 | 59  | 52  | N/A  | N/A | N/A | Pass |
| liv/kit.2 [A2 1F]                        | Living Room / Kitchen | 1989 | 59  | 60  | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A2 2F]                        | Living Room / Kitchen | 1989 | 59  | 77  | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A2 3F]                        | Living Room / Kitchen | 1989 | 59  | 77  | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A2 GF]                        | Living Room / Kitchen | 1989 | 59  | 50  | N/A  | N/A | N/A | Pass |
| liv/kit.2 [A5 3F]                        | Living Room / Kitchen | 1989 | 59  | 77  | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A5 4F]                        | Living Room / Kitchen | 1989 | 59  | 136 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A5 GF]                        | Living Room / Kitchen | 1989 | 59  | 116 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A6 1F]                        | Living Room / Kitchen | 1989 | 59  | 120 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A6 2F]                        | Living Room / Kitchen | 1989 | 59  | 119 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A6 3F]                        | Living Room / Kitchen | 1989 | 59  | 121 | N/A  | N/A | N/A | Fail |
| liv/kit.3 [A1 4F]                        | Living Room / Kitchen | 1989 | 59  | 64  | N/A  | N/A | N/A | Fail |
| liv/kit.3 [A2 4F]                        | Living Room / Kitchen | 1989 | 59  | 75  | N/A  | N/A | N/A | Fail |
| liv/kit.3 [A4 GF]                        | Living Room / Kitchen | 1989 | 59  | 95  | N/A  | N/A | N/A | Fail |
| liv/kit.3 [A5 1F]                        | Living Room / Kitchen | 1989 | 59  | 60  | N/A  | N/A | N/A | Fail |
| liv/kit.3 [A5 2F]                        | Living Room / Kitchen | 1989 | 59  | 55  | N/A  | N/A | N/A | Pass |
| sbed [A1 4F]                             | Bedroom               | 3672 | 110 | 48  | 3285 | 32  | 12  | Pass |
| sbed [A2 4F]                             | Bedroom               | 3672 | 110 | 64  | 3285 | 32  | 14  | Pass |
| sbed [A4 GF]                             | Bedroom               | 3672 | 110 | 100 | 3285 | 32  | 106 | Fail |
| sbed [A5 1F]                             | Bedroom               | 3672 | 110 | 72  | 3285 | 32  | 10  | Pass |
| sbed [A5 2F]                             | Bedroom               | 3672 | 110 | 73  | 3285 | 32  | 10  | Pass |
| sbed [A5 3F]                             | Bedroom               | 3672 | 110 | 77  | 3285 | 32  | 16  | Pass |
| Utility2 [C1 GF]                         | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| Utility2 [C2 GF]                         | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| Utility [C1 GF]                          | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| Utility [C2 GF]                          | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| GF Communal Corridors 2 (4.1m)           | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| GF Communal Corridors 3 (2.6m)           | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| GF Communal Corridors 4 (6m)             | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| GF Communal Corridors 5 (4m)             | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| Studio flat (bed/living/kitchen) [D1 GF] | Bedroom               | 3672 | 110 | 26  | 3285 | 32  | 129 | Fail |

# Domestic Overheating (CIBSE TM59)

|                   |       |   |   |   |     |     |     |      |
|-------------------|-------|---|---|---|-----|-----|-----|------|
| Studio WC [D1 GF] | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
|-------------------|-------|---|---|---|-----|-----|-----|------|

\*Zone name's that have an orange coloured font are bedrooms which do not have 24/7 365 days a year occupancy, as per the

#### 4.4 “TM59 DSY3 24hr vent 100% FA windows”

# Domestic Overheating (CIBSE TM59)

## Project Details

**Building Designer File (.tbd):** HN\_Resi new\_London\_LHR\_DSY3.tbd

**Simulation Results File (.tsd):** HN\_Resi new\_London\_LHR\_DSY3.tsd

**Date:** 29 January 2019

**Building Category:** Category II

## Natural Ventilation Overheating Results

| Zone Name                      | Room Use | Occupied Summer Hours | Max. Exceedable Hours | Criterion 1: #Hours Exceeding Comfort Range | Annual Night Occupied Hours for Bedroom | Max Exceedable Night Hours | Criterion 2: Number of Night Hours Exceeding 26 °C for Bedrooms. | Result |
|--------------------------------|----------|-----------------------|-----------------------|---------------------------------------------|-----------------------------------------|----------------------------|------------------------------------------------------------------|--------|
| 1F Communal Corridors 1 (7.5m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 1F Communal Corridors 2 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 1F Communal Corridors 3 (2.6m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 1F Communal Corridors 4 (6m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 1F Communal Corridors 5 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 2F Communal Corridors 1 (7.5m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 2F Communal Corridors 2 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 2F Communal Corridors 3 (2.6m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 2F Communal Corridors 4 (6m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 2F Communal Corridors 5 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 3F Communal Corridors 1 (7.5m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 3F Communal Corridors 2 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 3F Communal Corridors 3 (2.6m) | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 3F Communal Corridors 4 (6m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 3F Communal Corridors 5 (4m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |
| 4F Communal Corridors 1 (5m)   | Other    | 0                     | 0                     | 0                                           | N/A                                     | N/A                        | N/A                                                              | Pass   |

# Domestic Overheating (CIBSE TM59)

|                                    |       |   |   |   |     |     |     |      |
|------------------------------------|-------|---|---|---|-----|-----|-----|------|
| 4F Communal Corridors<br>2 (10.5m) | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A1 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A1 2F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A1 3F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A1 GF]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A2 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A2 2F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A2 3F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A2 GF]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A5 4F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A6 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A6 2F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.2 [A6 3F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [A1 4F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [A2 4F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [A4 GF]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [A5 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [A5 2F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [C1 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath2.3 [C2 1F]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath3.3 [C1 GF]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath3.3 [C2 GF]                    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A3 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A3 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A3 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A3 4F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A3 GF]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A4 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A4 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A4 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A4 4F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A6 GF]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A7 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A7 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [A7 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [D1 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [D1 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [D2 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [D2 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.1 [D2 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A1 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A1 2F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A1 3F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A1 GF]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A2 1F]                     | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |

# Domestic Overheating (CIBSE TM59)

|                     |       |   |   |   |     |     |     |      |
|---------------------|-------|---|---|---|-----|-----|-----|------|
| bath.2 [A2 2F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A2 3F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A2 GF]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A5 3F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A5 4F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A5 GF]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A6 1F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A6 2F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.2 [A6 3F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [A1 4F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [A2 4F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [A4 GF]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [A5 1F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [A5 2F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [C1 1F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [C2 1F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| bath.3 [D1 1F]      | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor2.3 [C1 1F] | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor2.3 [C2 1F] | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor [D1 2F]    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor [D1 3F]    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor [D2 2F]    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor [D2 3F]    | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A3 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A3 2F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A3 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A3 4F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A3 GF]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A4 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A4 2F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A4 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A4 4F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A6 GF]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A7 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A7 2F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [A7 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.1 [D2 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A1 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A1 2F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A1 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A1 GF]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A2 1F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A2 2F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A2 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A2 GF]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
| corridor.2 [A5 3F]  | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |

# Domestic Overheating (CIBSE TM59)

|                    |         |      |     |     |      |     |     |      |
|--------------------|---------|------|-----|-----|------|-----|-----|------|
| corridor.2 [A5 4F] | Other   | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| corridor.2 [A5 GF] | Other   | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| corridor.2 [A6 1F] | Other   | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| corridor.2 [A6 2F] | Other   | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| corridor.2 [A6 3F] | Other   | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| corridor.3 [A1 4F] | Other   | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| corridor.3 [A2 4F] | Other   | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| corridor.3 [A4 GF] | Other   | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| corridor.3 [A5 1F] | Other   | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| corridor.3 [A5 2F] | Other   | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| corridor.3 [C1 GF] | Other   | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| corridor.3 [C2 GF] | Other   | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| corridor.3 [D1 1F] | Other   | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| dbed1 [A1 1F]      | Bedroom | 3672 | 110 | 80  | 3285 | 32  | 34  | Fail |
| dbed1 [A1 2F]      | Bedroom | 3672 | 110 | 85  | 3285 | 32  | 35  | Fail |
| dbed1 [A1 3F]      | Bedroom | 3672 | 110 | 86  | 3285 | 32  | 36  | Fail |
| dbed1 [A1 4F]      | Bedroom | 3672 | 110 | 92  | 3285 | 32  | 36  | Fail |
| dbed1 [A1 GF]      | Bedroom | 3672 | 110 | 21  | 3285 | 32  | 23  | Pass |
| dbed1 [A2 1F]      | Bedroom | 3672 | 110 | 55  | 3285 | 32  | 33  | Fail |
| dbed1 [A2 2F]      | Bedroom | 3672 | 110 | 66  | 3285 | 32  | 33  | Fail |
| dbed1 [A2 3F]      | Bedroom | 3672 | 110 | 78  | 3285 | 32  | 38  | Fail |
| dbed1 [A2 4F]      | Bedroom | 3672 | 110 | 92  | 3285 | 32  | 28  | Pass |
| dbed1 [A2 GF]      | Bedroom | 3672 | 110 | 74  | 3285 | 32  | 172 | Fail |
| dbed1 [A4 GF]      | Bedroom | 3672 | 110 | 115 | 3285 | 32  | 171 | Fail |
| dbed1 [A5 1F]      | Bedroom | 3672 | 110 | 79  | 3285 | 32  | 25  | Pass |
| dbed1 [A5 2F]      | Bedroom | 3672 | 110 | 83  | 3285 | 32  | 28  | Pass |
| dbed1 [A5 4F]      | Bedroom | 3672 | 110 | 115 | 3285 | 32  | 41  | Fail |
| dbed1 [A5 GF]      | Bedroom | 3672 | 110 | 186 | 3285 | 32  | 234 | Fail |
| dbed1 [A6 1F]      | Bedroom | 3672 | 110 | 101 | 3285 | 32  | 36  | Fail |
| dbed1 [A6 2F]      | Bedroom | 3672 | 110 | 90  | 3285 | 32  | 36  | Fail |
| dbed1 [A6 3F]      | Bedroom | 3672 | 110 | 104 | 3285 | 32  | 36  | Fail |
| dbed1 [C1 1F]      | Bedroom | 3672 | 110 | 92  | 3285 | 32  | 27  | Pass |
| dbed1 [C2 1F]      | Bedroom | 3672 | 110 | 104 | 3285 | 32  | 38  | Fail |
| dbed1 [D1 1F]      | Bedroom | 3672 | 110 | 79  | 3285 | 32  | 32  | Pass |
| dbed2 [A1 1F]      | Bedroom | 3672 | 110 | 94  | 3285 | 32  | 34  | Fail |
| dbed2 [A1 2F]      | Bedroom | 3672 | 110 | 95  | 3285 | 32  | 35  | Fail |
| dbed2 [A1 3F]      | Bedroom | 3672 | 110 | 101 | 3285 | 32  | 35  | Fail |
| dbed2 [A1 4F]      | Bedroom | 3672 | 110 | 71  | 3285 | 32  | 38  | Fail |
| dbed2 [A1 GF]      | Bedroom | 3672 | 110 | 50  | 3285 | 32  | 25  | Pass |
| dbed2 [A2 1F]      | Bedroom | 3672 | 110 | 72  | 3285 | 32  | 34  | Fail |
| dbed2 [A2 2F]      | Bedroom | 3672 | 110 | 92  | 3285 | 32  | 33  | Fail |
| dbed2 [A2 3F]      | Bedroom | 3672 | 110 | 97  | 3285 | 32  | 38  | Fail |
| dbed2 [A2 4F]      | Bedroom | 3672 | 110 | 85  | 3285 | 32  | 28  | Pass |
| dbed2 [A2 GF]      | Bedroom | 3672 | 110 | 114 | 3285 | 32  | 174 | Fail |
| dbed2 [A4 GF]      | Bedroom | 3672 | 110 | 124 | 3285 | 32  | 162 | Fail |
| dbed2 [A5 1F]      | Bedroom | 3672 | 110 | 85  | 3285 | 32  | 27  | Pass |



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|                   |                          |      |     |     |      |     |     |      |
|-------------------|--------------------------|------|-----|-----|------|-----|-----|------|
| dbed2 [A5 2F]     | Bedroom                  | 3672 | 110 | 89  | 3285 | 32  | 27  | Pass |
| dbed2 [A5 4F]     | Bedroom                  | 3672 | 110 | 128 | 3285 | 32  | 43  | Fail |
| dbed2 [A5 GF]     | Bedroom                  | 3672 | 110 | 228 | 3285 | 32  | 263 | Fail |
| dbed2 [A6 1F]     | Bedroom                  | 3672 | 110 | 116 | 3285 | 32  | 38  | Fail |
| dbed2 [A6 2F]     | Bedroom                  | 3672 | 110 | 109 | 3285 | 32  | 37  | Fail |
| dbed2 [A6 3F]     | Bedroom                  | 3672 | 110 | 114 | 3285 | 32  | 39  | Fail |
| dbed2 [C1 1F]     | Bedroom                  | 3672 | 110 | 114 | 3285 | 32  | 27  | Fail |
| dbed2 [C2 1F]     | Bedroom                  | 3672 | 110 | 117 | 3285 | 32  | 29  | Fail |
| dbed3 [C1 1F]     | Bedroom                  | 3672 | 110 | 96  | 3285 | 32  | 36  | Fail |
| dbed3 [C2 1F]     | Bedroom                  | 3672 | 110 | 135 | 3285 | 32  | 29  | Fail |
| dbed [A3 1F]      | Bedroom                  | 3672 | 110 | 111 | 3285 | 32  | 42  | Fail |
| dbed [A3 2F]      | Bedroom                  | 3672 | 110 | 116 | 3285 | 32  | 43  | Fail |
| dbed [A3 3F]      | Bedroom                  | 3672 | 110 | 121 | 3285 | 32  | 45  | Fail |
| dbed [A3 4F]      | Bedroom                  | 3672 | 110 | 45  | 3285 | 32  | 26  | Pass |
| dbed [A3 GF]      | Bedroom                  | 3672 | 110 | 250 | 3285 | 32  | 282 | Fail |
| dbed [A4 1F]      | Bedroom                  | 3672 | 110 | 51  | 3285 | 32  | 41  | Fail |
| dbed [A4 2F]      | Bedroom                  | 3672 | 110 | 64  | 3285 | 32  | 40  | Fail |
| dbed [A4 3F]      | Bedroom                  | 3672 | 110 | 66  | 3285 | 32  | 42  | Fail |
| dbed [A4 4F]      | Bedroom                  | 3672 | 110 | 81  | 3285 | 32  | 27  | Pass |
| dbed [A5 3F]      | Bedroom                  | 3672 | 110 | 115 | 3285 | 32  | 37  | Fail |
| dbed [A6 GF]      | Bedroom                  | 3672 | 110 | 27  | 3285 | 32  | 34  | Fail |
| dbed [A7 1F]      | Bedroom                  | 3672 | 110 | 103 | 3285 | 32  | 39  | Fail |
| dbed [A7 2F]      | Bedroom                  | 3672 | 110 | 109 | 3285 | 32  | 46  | Fail |
| dbed [A7 3F]      | Bedroom                  | 3672 | 110 | 108 | 3285 | 32  | 42  | Fail |
| dbed [D1 2F]      | Bedroom                  | 3672 | 110 | 67  | 3285 | 32  | 29  | Pass |
| dbed [D1 3F]      | Bedroom                  | 3672 | 110 | 74  | 3285 | 32  | 31  | Pass |
| dbed [D2 1F]      | Bedroom                  | 3672 | 110 | 144 | 3285 | 32  | 27  | Fail |
| dbed [D2 2F]      | Bedroom                  | 3672 | 110 | 137 | 3285 | 32  | 28  | Fail |
| dbed [D2 3F]      | Bedroom                  | 3672 | 110 | 182 | 3285 | 32  | 27  | Fail |
| kit.3 [C1 GF]     | Living Room /<br>Kitchen | 1989 | 59  | 71  | N/A  | N/A | N/A | Fail |
| kit.3 [C2 GF]     | Living Room /<br>Kitchen | 1989 | 59  | 86  | N/A  | N/A | N/A | Fail |
| liv.3 [C1 GF]     | Living Room /<br>Kitchen | 1989 | 59  | 95  | N/A  | N/A | N/A | Fail |
| liv.3 [C2 GF]     | Living Room /<br>Kitchen | 1989 | 59  | 133 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A3 1F] | Living Room /<br>Kitchen | 1989 | 59  | 147 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A3 2F] | Living Room /<br>Kitchen | 1989 | 59  | 171 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A3 3F] | Living Room /<br>Kitchen | 1989 | 59  | 178 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A3 4F] | Living Room /<br>Kitchen | 1989 | 59  | 200 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A3 GF] | Living Room /<br>Kitchen | 1989 | 59  | 121 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A4 1F] | Living Room /<br>Kitchen | 1989 | 59  | 217 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A4 2F] | Living Room /<br>Kitchen | 1989 | 59  | 205 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A4 3F] | Living Room /<br>Kitchen | 1989 | 59  | 205 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A4 4F] | Living Room /<br>Kitchen | 1989 | 59  | 155 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A6 GF] | Living Room /<br>Kitchen | 1989 | 59  | 133 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A7 1F] | Living Room /<br>Kitchen | 1989 | 59  | 209 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A7 2F] | Living Room /<br>Kitchen | 1989 | 59  | 217 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [A7 3F] | Living Room /<br>Kitchen | 1989 | 59  | 205 | N/A  | N/A | N/A | Fail |

# Domestic Overheating (CIBSE TM59)

|                                          |                       |      |     |     |      |     |     |      |
|------------------------------------------|-----------------------|------|-----|-----|------|-----|-----|------|
| liv/kit.1 [D1 1F]                        | Living Room / Kitchen | 1989 | 59  | 114 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [D1 2F]                        | Living Room / Kitchen | 1989 | 59  | 105 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [D1 3F]                        | Living Room / Kitchen | 1989 | 59  | 101 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [D2 1F]                        | Living Room / Kitchen | 1989 | 59  | 157 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [D2 2F]                        | Living Room / Kitchen | 1989 | 59  | 114 | N/A  | N/A | N/A | Fail |
| liv/kit.1 [D2 3F]                        | Living Room / Kitchen | 1989 | 59  | 136 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A1 1F]                        | Living Room / Kitchen | 1989 | 59  | 142 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A1 2F]                        | Living Room / Kitchen | 1989 | 59  | 144 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A1 3F]                        | Living Room / Kitchen | 1989 | 59  | 139 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A1 GF]                        | Living Room / Kitchen | 1989 | 59  | 102 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A2 1F]                        | Living Room / Kitchen | 1989 | 59  | 128 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A2 2F]                        | Living Room / Kitchen | 1989 | 59  | 140 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A2 3F]                        | Living Room / Kitchen | 1989 | 59  | 136 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A2 GF]                        | Living Room / Kitchen | 1989 | 59  | 87  | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A5 3F]                        | Living Room / Kitchen | 1989 | 59  | 139 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A5 4F]                        | Living Room / Kitchen | 1989 | 59  | 256 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A5 GF]                        | Living Room / Kitchen | 1989 | 59  | 201 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A6 1F]                        | Living Room / Kitchen | 1989 | 59  | 223 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A6 2F]                        | Living Room / Kitchen | 1989 | 59  | 222 | N/A  | N/A | N/A | Fail |
| liv/kit.2 [A6 3F]                        | Living Room / Kitchen | 1989 | 59  | 223 | N/A  | N/A | N/A | Fail |
| liv/kit.3 [A1 4F]                        | Living Room / Kitchen | 1989 | 59  | 130 | N/A  | N/A | N/A | Fail |
| liv/kit.3 [A2 4F]                        | Living Room / Kitchen | 1989 | 59  | 131 | N/A  | N/A | N/A | Fail |
| liv/kit.3 [A4 GF]                        | Living Room / Kitchen | 1989 | 59  | 142 | N/A  | N/A | N/A | Fail |
| liv/kit.3 [A5 1F]                        | Living Room / Kitchen | 1989 | 59  | 102 | N/A  | N/A | N/A | Fail |
| liv/kit.3 [A5 2F]                        | Living Room / Kitchen | 1989 | 59  | 100 | N/A  | N/A | N/A | Fail |
| sbed [A1 4F]                             | Bedroom               | 3672 | 110 | 109 | 3285 | 32  | 33  | Fail |
| sbed [A2 4F]                             | Bedroom               | 3672 | 110 | 109 | 3285 | 32  | 25  | Pass |
| sbed [A4 GF]                             | Bedroom               | 3672 | 110 | 160 | 3285 | 32  | 155 | Fail |
| sbed [A5 1F]                             | Bedroom               | 3672 | 110 | 120 | 3285 | 32  | 25  | Fail |
| sbed [A5 2F]                             | Bedroom               | 3672 | 110 | 119 | 3285 | 32  | 24  | Fail |
| sbed [A5 3F]                             | Bedroom               | 3672 | 110 | 123 | 3285 | 32  | 26  | Fail |
| Utility2 [C1 GF]                         | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| Utility2 [C2 GF]                         | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| Utility [C1 GF]                          | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| Utility [C2 GF]                          | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| GF Communal Corridors 2 (4.1m)           | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| GF Communal Corridors 3 (2.6m)           | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| GF Communal Corridors 4 (6m)             | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| GF Communal Corridors 5 (4m)             | Other                 | 0    | 0   | 0   | N/A  | N/A | N/A | Pass |
| Studio flat (bed/living/kitchen) [D1 GF] | Bedroom               | 3672 | 110 | 87  | 3285 | 32  | 203 | Fail |

# Domestic Overheating (CIBSE TM59)

|                   |       |   |   |   |     |     |     |      |
|-------------------|-------|---|---|---|-----|-----|-----|------|
| Studio WC [D1 GF] | Other | 0 | 0 | 0 | N/A | N/A | N/A | Pass |
|-------------------|-------|---|---|---|-----|-----|-----|------|

\*Zone name's that have an orange coloured font are bedrooms which do not have 24/7 365 days a year occupancy, as per the