# ENERGY & SUSTAINABILITY STATEMENT

*(To Accompany Planning Application)*

*Site*

**29-30 HIGH HOLBORN**
**LONDON WC1V 6AZ**

*Proposal*

**PROPOSED REVISIONS TO CHANGE THE MIX AND PROVIDE AN ENLARGED FLAT AT ROOF LEVEL**

*Client*

**WESTCOMBE MANAGEMENT**

11th JANUARY 2021
Ref. E1052-ESS-00

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## 1.0 INTRODUCTION

a) Doherty Energy Limited have been instructed by Westcombe Management to prepare an Energy and Sustainability Statement to support the submission of the planning application for the development at 29-30 High Holborn, London WC1V 6AZ. This report must be read in conjunction with the application forms, certificates, detailed plans and other supporting documents submitted to the Local Authority as part of the application.

b) The Application is for the redevelopment of the site to change the mix and provide an enlarged flat at roof level. The development will create a total of four studio flats and a two bedroom flat.

c) The objectives of this Energy and Sustainability Statement are to outline the possible measures that can be incorporated into the development during detailed design, to make an appraisal of the carbon dioxide emissions of the proposed development, assess the potential fabric and building services efficiencies to reduce the carbon dioxide emission and to suggest the most appropriate means by which the development can contribute towards the aspiration of policy relating to reducing carbon dioxide emissions and energy consumption. It also investigates the water usage of the development with a view to reducing the water consumption of the dwellings.

d) The Assessment shall be carried out following the principles set out in the "Energy Hierarchy". These principles can be summarised as follows:

- Be Lean –use less energy
- Be Clean – supply energy efficiently
- Be Green – use renewable energy

e) At this stage in the design of the development, the detailed Building Regulations construction information has not been prepared and therefore following detailed construction design, the energy calculations will be revisited to ensure the energy requirements and carbon dioxide emissions are up to date.

f) In order to demonstrate the carbon dioxide emissions, it is proposed to use the Standard Assessment Procedure (SAP) for the calculations to obtain initial baseline carbon dioxide emissions figures for the dwelling.

g) Further calculations will be used to demonstrate the potential carbon dioxide emission savings from the initial calculations by enhancements to the building fabric, plant and controls – BE LEAN. The suitability of supplying energy, both heat and power, through the use of a combined heat and power system shall be assessed – BE CLEAN. Finally, the carbon dioxide emission saving by the use of renewable energy shall be assessed through the outputs from the SAP calculation – BE GREEN.

## 2.0 POLICY CONTEXT

a) The London Borough of Camden require all developments to ensure compliance with the applicable energy and sustainability standards stipulated in the London Plan, London Borough of Camden Local Plan and associated documented issued by the Mayor of London.

b) The London Plan, March 2016, Policy 5.2 expects development proposals to 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

c) The Policy also states that the Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Residential buildings:

| Year | Improvement on 2010 building Regulations 2010 |
|---|---|
| 2010-2013 | 25 per cent (Code for Sustainable Homes Level 4) |
| 2013-2016 | 40 per cent |
| 2016-2031 | Zero Carbon |

Non-domestic buildings:

| Year | Improvement on 2010 building Regulations 2010 |
|---|---|
| 2010-2013 | 25 per cent |
| 2013-2016 | 40 per cent |
| 2016-2019 | As per Building Regulations |
| 2019-2031 | Zero Carbon |

d) The Energy Statement follows the principles set out in the Energy Hierarchy and is broken down to provide the following details:

  i) Estimated site-wide regulated carbon dioxide emissions and reductions (broken down for the domestic and non-domestic elements of the development), expressed in tonnes per annum, after each stage of the energy hierarchy
  ii) A clear commitment to regulated carbon dioxide emissions savings compared to a Part L 2013 of the Building Regulations compliant development through energy demand reduction measures alone
  iii) Clear evidence that the risk of overheating has been mitigated through passive design
  iv) Evidence of investigation into existing or planned district heating networks that the development could be connected to, including relevant correspondence with local heat network operators
  v) Commitment to a site heat network served by a single energy centre linking all apartments and non-domestic building uses, if appropriate for the development
  vi) Where applicable, investigations of the feasibility of installing CHP in the proposed development (if connection can't be made to an area wide network) before considering renewables
  vii) An initial feasibility test for renewable energy technologies and, where appropriate, commitment to further reduce carbon dioxide emissions through the use of onsite renewable energy generation

h) As can be seen above, the London Plan policy 5.2 sets a zero carbon target for residential developments over the Building Regulations 2010.

i) However, as the Building Regulations were revised in 2013, the Greater London Authority issued their "Sustainable Design and Construction SPG" in April 2014, which clarifies the current target. This document states:

*"To avoid complexity and extra costs for developers, the Mayor will adopt a flat carbon dioxide improvement target beyond Part L 2013 of 35% to both residential and non-residential development."*

e) Under The London Plan Policy 5.5, the Mayor expects 25 per cent of the heat and power used in London to be generated through the use if localised decentralised energy system by 2025. The London Heat Map has been used to assess the district heat systems, both current and proposed, with the view to connecting the building to them.

j) Policy 5.7 seeks to increase the proportion of energy generated from renewable energy sources and expects that projects that developments will provide on-site renewable energy generation in order to meet the requirements of Policy 5.2.

k) The aim of the Energy Statement is to meet the carbon dioxide reduction targets on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, as per the requirements of The London Plan, any shortfall may be provided off-site or through a "cash in lieu" contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

l) London and the South East is classified as 'seriously' water stressed, meaning that more water is taken from the environment than the environment can sustain in the long term. London is relatively resilient to drought and it takes two consecutive drier than normal winters to create water supply issues.

m) In 2006 and 2012, London experienced significant droughts, and in 2012 only avoided serious water restrictions by the wettest summer in a century.

n) Proposed developments should minimise vulnerability of people and property and be fully adapted and resilient to the future impacts of climate change. Conserving water resources by maximising the flood storage role of rivers, aquifers, ponds, natural floodplains and other surface water features;

promoting the benefits of SuDS for groundwater recharge; and achieving high standards of water efficiency.

o) The Local Plan requires all new dwellings will be expected to meet the requirement of 110 litres per person per day (including 5 litres for external use).

## 3.0 SUSTAINABLE DESIGN AND CONSTRUCTION ASSESSMENT

a) The building fabric, the building services and the management of the building broadly determines its energy usage. The detailed design of a building is an iterative process, often requiring the involvement of different professional disciplines to establish the fundamental objectives of the design. An overall design philosophy in this respect has been established at an early stage.

b) As a result of central Government objectives, followed through at local level the general design philosophy for this site has a strong emphasis on sustainable design. This is not only in terms of the location and suitability of the site but also in relation to the way in which the building is constructed and will be used by its future occupants.

c) The first step in developing an integrated design is to establish the function of the buildings envelope and how it interacts with the usage patterns of the building and the technology used to condition the individual spaces.

d) Good fabric design can minimize the need for services. Where appropriate, designs should avoid simply excluding the environment, but should respond to factors like weather and occupancy and make good use of natural light, ventilation, solar gains and shading, where they are beneficial.

e) This section of the report will look at the ways in which energy is used within the proposed building and how the design can encourage efficient levels of energy consumption.

### 3.1 Management

a) Although improvements can be made to the fabric and services of a building, often the biggest impact on the day-to-day energy consumption is influenced by the way in which the building is managed. It is common to find well-designed buildings operating badly due to poor management. Conversely, poorly designed buildings can be optimised to their maximum efficiency through good management practices.

b) It is recommended that due consideration is given to the management strategy of the building. It is understood that the dwelling will be within private ownership. However, there is still an opportunity to provide for the most efficient management system and to encourage the future occupants to manage their homes efficiently.

c) This may include the use of movement sensor switched lighting systems, the installation of energy efficient electrical appliances, efficient lighting and fittings that do not permit the use of non-efficient lamps, tightly controlled heating and ventilation specific to the location within the dwelling, installation of efficient hot water systems and the provision of recycling facilities.

d) The EU energy efficiency labelling scheme rates products from A (the most efficient) to G (the least efficient). For refrigeration, the scale now extends to A++. The occupants of the dwelling shall be provided with information on the EU Energy Efficiency Labelling Scheme so that they are informed of the benefits of the scheme.

## 3.2 Ventilation

a) Natural ventilation is the most energy efficient form of ventilating any space. The proposed use and traditional architectural design of this building enables it to make best use of natural ventilation via openable windows.

b) Horizontal pivoted windows produce the most effective ventilation because of their inherent characteristic to develop large openings, where air will tend to enter at the lower level and exit via the top. They are easily adjustable to provide control and reduce the amount of energy required to run and maintain artificial ventilation systems. Normal casement windows can provide a degree of natural ventilation and with the layout of the dwelling; it is possible to obtain good cross ventilation.

c) Given the historical records for the British Isles, the weather permits a possible energy saving with the use of windows to provide cooling and ventilation. When the outside temperature ranges between 14 °C through to

24 °C, people are able to moderate the heat build-up in the space with the use of an openable window systems.

d) In addition to allowing direct and flexible control of heat through the use of openable windows they, also provide for the natural provision of fresh air to the occupants eliminating the need for artificially produced fresh air supply.

e) At other times of the year, mechanical ventilation with heat recovery can conserve energy in each dwelling by recovering heat from the warm moist extracted air and transferring it to the incoming fresh air. This works both ways so if the outside temperature is higher than inside the exchanger helps to maintain a comfortable internal environment. The mechanical ventilation with heat recovery system ensures high air quality whilst maintaining a balance between extraction and supply.

## 3.3 Heating System

a) The method of heating for the dwellings is not yet decided, however, it proposed method of heating for the dwelling will use of a highly efficient heat source, with weather compensation. It shall be appropriately designed to provide suitable conditions for the occupants and to offset the heat losses through the fabric of the dwelling.

b) The heating systems will be provided with thermostat, programmer and thermostatic radiator valves to control the heating in the spaces.

c) Weather compensation will be used to help control the heating system. It uses an outdoor temperature sensor to adjust the system controls to compensate for changes in outdoor temperature automatically. As the weather gets colder the system works harder and produces more heat to the space. However, the weather warms up the system reduces the temperature of the heating system thereby reducing the energy consumption and carbon dioxide emissions.

d) If a central heating system was used, the heat would be have to be available for any occupant all the time, which would require a large buffer storage vessel and distribution around the building all the time. With the local heating systems, there are no storage or distribution losses.

e) Due to the high level of insulation standards required under the current building regulations and the associated heat gains of the building, the level of artificially produced heat required to the internal spaces is envisaged to be low.

## 3.4 Lighting (Natural / Artificial)

a) The proposed design makes best use of natural daylight to reduce the amount of electrical energy used to provide the minimum luminance for the required conditions. It is envisaged that all the habitable rooms within the dwelling are to be provided with natural light via windows. The number of windows proposed and the use of dimming controls on the lighting scheme where appropriate may assist in achieving the maximum reduction of electrical consumption.

b) The dwellings are orientated so that the large windows do not face south or are shaded, thus avoiding excessive solar gains during the summer.

c) When selecting luminaries, consideration should be given to their inherent local power consumption and luminance levels. This together with the use of energy saving lamps will reduce the consumption of energy through lighting to a minimum. It is suggested that a development of this kind could reduce the energy usage further by installing luminaries that only allow the use of energy saving lamps.

d) Any lighting in the external areas shall be fitted with automatic control systems, like passive infrared sensors, time switches or “dawn to dusk” day light sensors. These luminaires shall be fitted with low energy lamps.

## 3.5 Hot Water Systems

a) The hot water demand for the dwellings shall be generated using the efficient heating source and if necessary, a very well insulated hot water storage cylinder is to be provided.

b) The hot water system shall be designed to appropriate standards required by the current building regulations. This will ensure the minimum amount of heat loss from hot water pipe work by applying a high standard of thermal insulation and ensuring the correct circulation throughout the system.

c) Waste Water Heat Recovery Systems can be attached to the showers and are a proven and cost effective way to achieve energy savings and carbon emission reductions. They are either fitted around the waste pipe from a shower or bath, or in the shower tray itself, and recover heat from the drain water as it leaves the shower or bath. This recovered heat is used to preheat the cold water feed to the boiler and therefore reduces the amount of energy used by the boiler.

d) It is possible, with the ever-increasing demand on the limited supply of the natural resource of water, to suitably restrict the flow of water outlets. Flow restrictors can be installed on outlets where a reduced flow is acceptable, for example on showers and basins. This system allows for a uniform maximum flow to be provided regardless of natural water pressures throughout the dwelling.

**3.6 Cold Water Systems**

a) Cold water consumption can be kept to a minimum by the installation of a numbers of facilities.

b) Modern water efficient dual flush WC cisterns should be fitted as standard and as with the hot water system flow restrictors can be fitted to provide a uniform maximum flow rate throughout the dwelling.

c) Simple water butts can be provided in appropriate locations, allowing for the collection of rain water for the direct use on external landscaped areas. Water butts are the cheapest and easiest way of reducing the use of drinking water for this purpose. There are many products on the market ranging in price and size and some local authorities offer their own option at a subsidised price to the consumer.

d) It is not possible to estimate the total water saving from the installation and use of such a device as this is very much dependant on the landscaping design for the dwelling, the annual rain fall and the required usage of this water within the domestic setting. However, an average storage device can produce up to 5000 litres of usable rainwater per year.

### 3.7 Sustainable methods of construction

a) Sustainable methods of construction can range from the simplest of solutions, such as construction in locations with access to sustainable modes of transport to the more complex solutions including passive solar design and rainwater harvesting.

b) The following paragraphs will briefly discuss some of the additional options available for incorporation into the scheme at this early stage or later during the detailed design process.

### 3.8 Passive Solar Design

a) Passive solar gain can be experienced in both a positive and negative manner. South facing facades can often benefit from solar passive gain during the winter months but this is counteracted by the increased requirement for cooling during the summer.

b) In a scheme like that proposed, it is important to recognise where solar passive gains will be experienced and to design the scheme to enhance the effect during the winter and protect from it during the summer.

### 3.9 Building Envelope

a) All facades of the dwellings shall be designed to ensure that the minimum standards required by the Approved Document L of the Building Regulations are exceeded and that care shall be exercised to ensure flexibility and good shading systems are installed where necessary.

b) Any insulation that is used in this development shall have global warming potential of less than 5. This shall include not only the thermal insulation, but any acoustic insulation.

### 3.10 Enhanced Construction Details

a) The dwellings envelope shall be designed using the Enhanced Construction Details to limit recurring thermal bridging. This exceeds the requirement of the Building Regulations and helps lower the carbon emissions of the dwelling by reducing the heat losses by cold bridging.

### 3.11 Surface Water Drainage

a) Surface water drainage at the site will follow the Sustainable Drainage Systems (SuDS) management train.

b) The surface water will drain into the existing watercourse on site, with the permeable surfacing acting as an attenuation device for slowing and holding the surface water run-off.

### 3.12 Rainwater Harvesting

a) The harvesting and recycling of rainwater can considerably reduce mains water consumption for toilets and other uses that do not need a sanitized water supply.

b) However, the plant space requirement for treatment and storage is often difficult to incorporate into a scheme. It also requires additional public health and water system risers to be installed to serve the facilities able to utilise such a water supply. If this system were to be considered then early design allowances would be required.

c) An alternative option would be to install a water butt system as discussed above, that allows the collection of rainwater from the roof to be used in the amenity space provided.

## 3.13 Sustainable Material Choices

a) A high percentage of carbon dioxide emissions are generated by unsustainable modes of transport. This is not only made up of the use of the private car but is substantially increased by the use of road as the popular way of transporting materials and goods needed during the construction purposes.

b) Many opportunities are now available to Architects wishing to make more sustainable choices when specifying building materials. The consideration can include where the materials come from, its' travel distance, mode of transport, and the nature in which the material resource is manufactured and managed.

c) Throughout the design process consideration will be given to not only the quality of materials to be specified, but also to the quantities. Additional consideration will be given to building material selection that maximises the life expectancy of the building by selecting materials build-ups from the Green Guide to Specification published by the Building Research Establishment (BRE).

d) The proposed development will be constructed of materials with a low environmental impact, achieving a Green Guide rating of between A+ and D for all five elements of construction, as follows:

- Roof.
- External walls.
- Internal walls.
- Upper and ground floors.
- Windows.

e) Consideration will also be given to the use of materials and products manufactured in the UK and Europe. Once a contractor is appointed, the opportunities for the use of local suppliers for their supply chain will also be explored.

f) All timber, including that used in the construction processes, will be required to be legally sourced. The definition of legally sourced timber follows the UK Government's definition of legally sourced timber, according to the CPET 2nd Edition report on UK Government timber procurement policy.

## 3.14 Recycling Facilities

a) In order to encourage the homeowners to recycle household waste, the dwelling can be provided with recycling bins, both within the dwelling and in the external waste storage area.

b) The recycling bins could be in the form of three internal in a dedicated non obstructive location in the kitchen. The bins shall be in a variety of sizes and a total capacity of 30 litres and no individual bins shall have a capacity of less than 7 litres.

c) External bins shall be provided for the Local Authority collection scheme. These shall be located in a dedicated location.

# 4.0 ENERGY ASSESSMENT

## 4.1 Introduction

a) This section of the Energy and Sustainability Statement shall make an appraisal of the carbon dioxide emissions of the proposed development, assess the implications of fabric and building services enhancements, the various methods of generating and using renewable energy at source, and to suggest the most appropriate means by which the development can contribute towards the aspiration of policy relating to reducing energy consumption and renewable energy provision.

b) In order to assess the impact of the improved building envelope and the fixed building services, the initial Standard Assessment Procedure 2012 (SAP) Assessments have been carried out on the proposed dwellings as if they were constructed simply to comply with the requirements of the current Building Regulations. Further SAP calculations have been undertaken to demonstrate an improvement in the carbon emissions by incorporating better fabric constructions, better windows and doors, improved ventilation systems and efficient building services.

c) The energy assessment shall follow the principles set out in the London Plan, March 2016, Policy 5.2, which expects development proposals to 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

## 4.2 Baseline Carbon Dioxide Emissions

a) In order to assess the carbon dioxide emissions of the development, the delivered energy demand needs to be estimated. At this stage in the design of the dwellings, the detailed construction drawings have not been prepared and therefore detailed carbon emission calculations cannot be undertaken to produce the carbon dioxide emissions.

b) However, the dwellings carbon dioxide emission estimates can be based on initial stage SAP calculations.

c) Based on the current design and using construction information, the proposed dwelling complies with the current Building Regulations.

d) The building services information is based on standard building services to meet the requirements of the building regulations.

e) Table 1 below summarises the results from the SAP Worksheets that can be found in Appendix A.

| Dwelling | Floor Area (m2) | Heating (kg/yr) | Water Heating (kg/yr) | Pumps & Fans (kg/yr) | Electricity for Lighting (kg/yr) | Total Emissions (kg/yr) | Dwelling CO2 Emission Rate |
|---|---|---|---|---|---|---|---|
| 1 | 40.6 | 305.2 | 447.2 | 43.6 | 101.3 | 897.4 | 22.1 |
| 2 | 40.6 | 358.0 | 445.4 | 43.6 | 101.3 | 948.3 | 23.4 |
| 3 | 40.6 | 358.0 | 445.4 | 43.6 | 101.3 | 948.3 | 23.4 |
| 4 | 40.6 | 358.0 | 445.4 | 43.6 | 101.3 | 948.3 | 23.4 |
| 5 | 81.2 | 734.4 | 515.5 | 38.9 | 182.8 | 1,471.6 | 18.12 |

| Dwelling | TER (kg/m$^2$/yr) | Area (m$^2$) | Emissions (kg/yr) |
|---|---|---|---|
| 1 | 32.3 | 40.6 | 1,311.4 |
| 2 | 34.24 | 40.6 | 1,390.1 |
| 3 | 34.24 | 40.6 | 1,390.1 |
| 4 | 34.24 | 40.6 | 1,390.1 |
| 5 | 26.59 | 81.2 | 2,159.1 |

| Baseline Carbon Dioxide Emissions (kg/yr) | 7,641 |
|---|---|
| | |

**Table 1 – Baseline Carbon Dioxide Emissions**

## 4.3 Improved Baseline Carbon Dioxide Emissions

a) Following the principles set out in the Mayor's "Energy Hierarchy" which is implemented through the London Plan and the Local Policy, the proposed design has been improved to use less energy and lower the carbon dioxide emissions - BE LEAN.

b) This has been achieved by improving the thermal performance of the various constructions, like the walls, roof, floors, windows, doors etc and incorporating mechanical ventilation heat recovery and improving the air tightness of the dwellings.

c) The floor U Values can be improved by incorporating insulation under the screed, or by using insulation blocks instead of concrete blocks between the beams. For the purposes of these calculations, the U Values of the current floor constructions have been calculated as 0.12 $W/m^2K$.

d) The wall U Values can be improved by improving the thermal performance of the insulation, either by increased thickness or lower thermal conductivity. For the purposes of these calculations, the U Values of the current wall constructions have been calculated as 0.19 $W/m^2K$.

e) The party wall is fully filled with sealed edges, so the U Value is 0.0$W/m^2K$.

f) The roof areas offer excellent opportunity to enhance the insulation levels and for the purposes of these calculations, the U Value of 0.09 $W/m^2K$ have been used.

g) The thermal performance of the windows can be improved by adding coatings to the panes or adding an inert gas to the cavities. For the purposes of these calculations, a U Value for the windows of 1.2 $W/m^2K$ has been used, which uses double glazed planitherm glass, argon gas and warm edge spacer bars.

h) A composite front door can be used instead of a timber door. Modern composite doors have good thermal, fire, acoustic and security properties. These types of door can have U Values as low as 0.55 $W/m^2K$.

i) The air leakage rate for the dwelling can be improved. The maximum allowed under the current Building Regulations Approved Document L1A:2013 is 10 $m^3/hr/m^2$ at 50 Pascal's. With carful detailing, this can be easily improved to 3 $m^3/hr/m^2$ at 50 Pascal's.

j) The use of Accredited Construction Details in the development means that the thermal bridging coefficient can be greatly improved thus a lower γ Value can be used.

k) With regard to the heating, at this time it is proposed to use highly efficient air source heat pumps, with thermostats and programmers. This provides excellent control for the dwelling occupants.

l) More efficient controls can be installed to control the heating, which can include weather compensation and the use of time and temperature zone control could improve the efficiency of the heating system.

m) Instead of simply installing 75% of the light fittings as low energy efficient light fittings, as required by the current Building Regulations, 100% of the light fitting could be low energy fittings.

n) The use of natural lighting has been considered and although its use is not measured in the SAP calculations, it can help lower the energy use and therefore carbon dioxide emissions. This is carefully assessed against any unwanted solar overheating. Whilst a degree of solar gain can be beneficial for the occupants and helps lower the carbon dioxide emissions, it must be controlled to minimise the risk of solar overheating. The calculations show that there is only a slight to medium risk of overheating.

o) Mechanical ventilation heat recovery systems work by removing the warm moist air from kitchens and bathrooms and passing it through a heat exchanger to recover waste heat. This waste heat can then be used to warm the fresh air that is brought into the living areas of the dwellings, therefore reducing the heating load.

p) The development shall be designed to ensure that the Dwelling Emission Rates are better than the Target Emission Rates and the Fabric Energy Efficiency is better than the Target Fabric Energy Efficiency. These are the requirements from Criterion 1 of the current Building Regulations Approved Document L (2013).

q) By incorporating items like those stated above, the SAP calculations have been updated to demonstrate the effect of these improvements and the results are listed in Table 2 below.

r) Full details of the SAP calculations can be found in the Full SAP Calculations Printout in Appendix A.

| Dwelling | Floor Area ($m^2$) | Heating (kg/yr) | Water Heating (kg/yr) | Pumps & Fans (kg/yr) | Electricity for Lighting (kg/yr) | Total Emissions (kg/yr) | Dwelling Target $CO_2$ Emission Rate |
|---|---|---|---|---|---|---|---|
| 1 | 40.6 | 203.6 | 389.6 | 66.4 | 100.5 | 760.2 | 18.72 |
| 2 | 40.6 | 255.0 | 389.6 | 65.2 | 100.5 | 810.4 | 19.96 |
| 3 | 40.6 | 255.0 | 389.6 | 65.2 | 100.5 | 810.4 | 19.96 |
| 4 | 40.6 | 255.0 | 389.6 | 65.2 | 100.5 | 810.4 | 19.96 |
| 5 | 81.2 | 586.4 | 500.1 | 51.1 | 181.3 | 1,318.9 | 16.24 |

| Dwelling | DER ($kg/m^2/yr$) | Area ($m^2$) | Emissions (kg/yr) |
|---|---|---|---|
| 1 | 18.72 | 40.61 | 760.2 |
| 2 | 19.96 | 40.6 | 810.4 |
| 3 | 19.96 | 40.6 | 810.4 |
| 4 | 19.96 | 40.6 | 810.4 |
| 5 | 16.24 | 81.2 | 1,318.7 |
| **Total Carbon Dioxide Emissions (kg/yr)** | | | **4,510** |
| **Percentage Improvement over current Building Regulations** | | | **41.0 %** |

**Table 2 – Actual Carbon Dioxide Emissions**

s) As demonstrated in Table 2 above, it can be seen that the improvements in the thermal performance and fixed building services, a reduction of 41.0% can be achieved in the carbon dioxide emissions of the development.

## 4.4 Supplying Energy Efficiently – BE CLEAN

a) Following the principles set out in the Energy Hierarchy, the next step is to reduce the carbon dioxide emissions by supplying energy efficiently - BE CLEAN.

## 4.5 District Heat Network

a) The London Heat Map is an online tool that can help identify opportunities for the use of decentralised energy networks and systems for use in projects.

b) Using the Heat Map, there appears to be no district heating systems available or even proposed in the area within the next five years, so it would not be feasible to install plant for future connection to such a network at this time.

c) In line with the Greater London Authority's "Sustainable Design and Construction SPG" in published in April 2014, it is considered that no potential heat networks available in the foreseeable future.

## 4.6 Combined Heat and Power

a) Combined Heat and Power typically generates electricity on site as a by-product of generating heat. It uses fuel efficient energy technology that, unlike traditional forms of power generation, uses the by-product of the heat generation required for the development. Normally during power generation, the heat is discharged or wasted to atmosphere.

b) A typical CHP plant can increase the overall efficiency of the fuel use to more than 75%, compared to the traditional power supplies of 40%, which uses inefficient power stations and takes into account transmission and distribution losses.

c) The use of this development is residential and it will be built to exceed the current Building Regulations. The aim of these regulations is to minimise the base heating load and electrical loads. The site base heating and electrical loads is key to the sizing and operation of any CHP system.

d) Due to the high levels of insulation and energy efficiency measures that will be incorporated into this development, there is no year round heat load for the CHP plant and therefore, a CHP system would be considered not viable on this development. As such, if a CHP system were to be incorporated, it would not operate efficiently and therefore NOT BE CLEAN.

## 4.7 Renewable Technologies Considered – BE GREEN

a) Taking into account the requirements of planning policy set out by London Borough of Camden and the London Plan, the developments annual carbon dioxide emission reduction target of 35%, based on the Building Regulations 2013, from energy efficiencies and renewable technology has been calculated as 7,641 kg$CO_2$/year.

b) The final step in the Energy Hierarchy is to reduce the carbon dioxide emissions by the use of renewable technologies - BE GREEN.

c) A review of the potential renewable technologies has been undertaken to identify any potential low or zero carbon technologies which could be incorporated at a later date. The following renewable energy resources have been assessed for availability and appropriateness in relation to the site location, building occupancy and design.

- Combined Heat and Power
- Biomass Heating
- Biomass CHP
- Heat Pumps
- Solar Photovoltaics
- Domestic Solar Hot Water Systems
- Wind Power

d) A preliminary assessment has been carried out for each renewable energy technology and for those appearing viable a further detailed appraisal has been undertaken.

e) The preliminary study considered the site location and the type of building in the development and surroundings and produced a shortlist of renewable energy technologies that will be the subject of a further feasibility study.

f) Table 3 below provides a summary of the assessment.

## 4.8 Renewables Toolkit Assessment

| Energy System | Description | Comment |
|---|---|---|
| Combined Heat and Power (CHP) | Combined Heat and Power systems use the waste heat from an engine to provide heating and hot water, while the engine drives an electricity generator.<br><br>These systems uses gas or oil as the main fuel and therefore can not truly be considered as renewable technology however, it is recognised that they have a significant reduced impact on the environment compared to conventional fossil fueled systems. | As CHP systems produce roughly twice as much heat as they generate electricity, they are usually sized according to the base load heat demand of a building, to minimise heat that is wasted during part-load operations. Therefore, to be viable economically they require a large and constant demand for heat, which make their use in new energy efficient housing, with high insulation, not really suitable.<br><br>The efficiency of small scale CHP is relatively low and is unlikely to result in $CO_2$ emission savings. Economic viability relies on 4000 hours running time, which is unlikely to be achieved in this scheme. |
| **Combined Heat and Power** | | **Feasible – NO** |
| | | |
| Biomass Heating | Solid, liquid or gaseous fuels derived from plant material can provide boiler heat for space and water heating.<br><br>Biomass can be burnt directly to provide heat in buildings. Wood from forests, urban tree pruning, farmed coppices or farm and factory waste, is the most common fuel and is used commercially in the form of wood chips or pellets, although traditional logs are also used. Other forms of Biomass can be used, e.g. bio-diesel. | Wood pellet or wood chip fired or dual bio-diesel/gas-fired boilers could be considered. As this development consists of a new building, it offers the opportunity to accommodate such a system.<br><br>The flues would have to be discharged to atmosphere above roof level and concerns raised by Environmental Health regarding the pollutants and particles, which would have to be addressed. Care need to be taken with the design of the flue to ensure particle discharge is not a concern to residents.<br><br>The fuel storage silo/tank would have to be located external to the building, which is not available on this site.<br><br>A suitable local fuel supplier is required to supply the site. |
| **Biomass Heating** | | **Feasible – NO** |
| | | |

| Energy System | Description | Comment |
| --- | --- | --- |
| Biomass CHP | CHP as above, but with biomass as the fuel. | Whilst the Biomass CHP system may overcome the issue of the reduction in carbon dioxide emissions via true renewable sources, however, the lack of a year round base load is still a problem and therefore Biomass CHP is not feasible for this development. |
| **Biomass CHP** | | **Feasible - NO** |
| | | |
| Ground/Air Source Heat Pumps (GSHP / ASHP) - heating | The ground collector can be installed, either as a loop of pipe, in the piles or using a borehole and a compressor offer efficient heating of a space in winter, as the temperature of the ground (below approx 2m) remains almost constant all year.<br>For air source, the external condensing unit can be located adjacent to the dwelling in a discreet location. | Ground and air source heat pumps are most efficient when supplying heat continuously and in areas where a mains gas supply is not available. In dwellings, GSHP and ASHP are capable of supplying the majority of the total space heating and pre heat for the hot water demand.<br>This site does not appear to have external areas of sufficient size for the installation of ground loops for the collection of heat.<br><br>It is considered that the use of ASHP to offset the heat losses of the dwellings could also be feasible. |
| **Ground/Air Source Heat Pumps** | | **Feasible – YES** |
| | | |
| Solar Photovoltaics (PV) | Building Integrated Photovoltaics (BIPV) or Roof mounted collectors provide noiseless, low maintenance, carbon free electricity. | There appears to be areas of roof that could be utilitised to install PV panels onto the scheme. These could be integrated into the roof finishes or mounted on frames on the roof and orientated towards the south for optimal performance.<br>Careful consideration must be given to the chosen roof finish to ensure compatibility. |
| **Solar PhotoVoltaics** | | **Feasible – YES** |
| | | |
| Solar Thermal Hot Water | Solar collectors for low temperature hot water systems require direct isolation, so the chosen location, orientation and tilt are critical. | This solution could be utilised to generate hot water using the energy from the sun.<br>There are areas of roof that could be used for the installation of solar thermal collectors and careful consideration must be given to the chosen roof finish to ensure compatibility. |
| **Solar Thermal Hot Water** | | **Feasible - YES** |
| | | |
| **Energy** | **Description** | **Comment** |

| System | | |
|---|---|---|
| Wind Power | Most small (1-25kW) wind turbines can be mounted on buildings, but larger machines require foundations at ground level and suitable site location | It could be viable to install some form of wind turbines on this site, however due to surrounding buildings and the visual impact it is not considered to be the most sensitive system of providing energy via renewable resources in this location. |
| **Wind Power** | | **Feasible – NO** |
| | | |

**Table 3 – Renewable Technology Feasibility Assessment**

a) From the above it has been established that there are three potential ways of providing energy via renewable sources appropriate for inclusion in this scheme, these being the use of heat pumps, solar photovoltaics or domestic solar hot water or a combination of these.

b) CHP and Micro CHP are considered not feasible as the economic viability relies on at least 4,000 hours runtime which is unlikely to be achieved in this development.

c) Biomass systems have been considered unfeasible for this site due to particle discharge in a built up area, fuel handling and storage on a site with limited open space, required plant areas and the on going maintenance of the system.

d) Ground source heat pumps have been considered not feasible for this development as there is insufficient ground area for the installation of ground loops.

e) Wind has been considered not viable for this site as there are a lot of the buildings and trees in the surrounding area which are likely to cause disruption to air flows.

## 4.9 Solar Photovoltaics

a) Photovoltaics (PV) is a technology that allows the production of electricity directly from sunlight. The term originates from “Photo” referring to light and “voltaic” referring to voltage. This type of technology has been developed for incorporation within building design to produce electricity for either direct consumption or re-sale to the National Grid.

b) PV panels come in modular panels which can be fitted on the top of roofs or incorporated in the finishes like slates or shingles to form integral part of the roof covering. PV cells can be incorporated into glass for atria walls and roofs or used in the cladding or rain screen on a building wall.

c) When planning to install PV panels, it is important to consider the inherent cost of installation in comparison to possible alternatives. The aesthetic impact of the PV panels also requires careful consideration.

d) Roof mounted PV panels should ideally face south-east to south-west at an elevation of about 30-40°. However, in the UK even if installed flat on a roof, they receive 90% of the energy of an optimum system.

e) PV installations are expressed in terms of the electrical output of the system, i.e. kilowatt peak (kWp). The Department of Trade and Industry estimate that an installation of 1kWp, could produce approximately 700-850 kWh/yr, which would require an area of between 8-20m$^2$, depending on the efficiencies and type of PV panel used.

f) It is also estimated that a gas heated, well insulated typical dwelling would use approximately 1,500kWh/year electricity for the lights and appliances, therefore the 1kWp system could save approximately 45% of a single dwellings electrical energy requirements.

g) Although often not unattractive, and possible to integrate into the building or roof cladding, PV systems are still considered likely to have visual implications, therefore careful sighting of the panels is required.

h) As this installation will be contained on the roof of the proposed dwellings, it involves no additional land use. With regard to noise and vibration, a PV system is completely silent in operation.

i) Care must be taken with the design and installation of PV systems as they need to meet standards for electrical safety.

j) Space has been identified on the roof areas of the dwellings that can be used for the installation of photovoltaic systems.

k) However, initial calculations have demonstrated that there is insufficient area available to make a significant contributions towards the target of zero carbon, whilst maintenance some amenity space for the dwellings occupants.

a) Therefore, at this stage, the use of photovoltaics will not be considered further. The use of photovoltaic systems may be considered at a later date.

## 4.10 Domestic Solar Hot Water System

b) This system uses the energy from the sun to heat water, most commonly to provide the hot water demands of the development. The system uses heat collectors, generally mounted on the roof, in which a fluid is heated by the sun. This fluid is used to heat up water that is stored in either a separate cylinder or a twin coil hot water cylinder inside the dwelling. The system works very successfully in the UK, as it can operate in diffused light conditions.

c) As with PV panels, the collectors should be mounted facing in a southerly direction, from south-east through to south-west and at an elevation of 10 to 60°. The panels can be installed on the roof, either on the slope of the roof, on a frame, or they can be integrated into the roof finishes.

d) This system would be best suited on sites where the solar thermal collectors can be located close to the hot water storage vessel within the dwelling and therefore any losses can be minimised.

e) Approximately 2-4m$^2$ of solar thermal collectors could provide the hot water requirements of a typical dwelling. These could be used to feed twin coil hot water cylinders positioned within the dwelling, allowing the water to be heated by the sun when possible whilst retaining the backup of the main heating system when required.

f) This system would be relatively easy to install. However, the visual impact needs to be given consideration.

g) Although often not unattractive, and possible to integrate into the building or roof cladding system domestic solar thermal collectors are still considered likely to have visual implications, therefore careful sighting of the panels is required.

h) As this installation will be contained on the roof of the proposed development, it involves no additional land use.

i) With regard to noise and vibration, a domestic solar hot water system is completely silent in operation.

I) Space has been identified on the roof areas of the dwellings that can be used for the installation of solar hot water systems.

j) However, initial calculations have demonstrated that there is insufficient area available to make a significant contributions towards the target of zero carbon, whilst maintenance some amenity space for the dwellings occupants. In addition, due to the height of the dwelling, the efficiency of the systems would be reduced.

k) Therefore, at this stage, the use of domestic solar hot water will not be considered further. The use of domestic solar hot water may be considered at a later date.

## 4.11 Heat Pumps

a) Heat pumps are used to extract the heat from the ground, air or water and transfer it to a heating distribution system, such as under floor heating or radiators using an electric pump. They are usually efficient enough to provide for all space heating requirements and a pre-heat for the domestic hot water systems.

b) The system would comprise of a heat exchanger either buried in the ground, or mounted on the exterior of the building, or located within a water course, and a heat pump. These would be connected to a traditional heating distribution system, like radiators, underfloor heating, fan coil units etc.

c) The system uses the latent solar energy stored in the ground or water, or the latent temperature of the air around or within the building. The heat pump upgrades the heat energy to provide the heating for the building. The heat pump operates on the same principles as a refrigeration cycle, like a domestic fridge, except the heat is retained and the cold rejected.

d) Ground source heat pumps are generally the most efficient however can be expensive to install as the heat exchanger needs to be buried under the ground. Their efficiency and practicality can also be affected by the ground conditions of the site. Water source heat pumps are only suitable where there is a water source available and when appropriate consents have been obtained to utilize this source. Air source heat pumps are generally more flexible as the heat pump and exchanger unit is usually mounted external to the building or within a garage or storage space.

e) This development is in a built up area and not at ground floor level so there is no scope for the installation of ground loops or heat exchangers, therefore, the use of ground source heat pumps is not feasible.

f) Air source heat pumps could be installed with the outdoor units installed either on the flat roof areas either at first floor level or at level seven.

g) With regard to emissions, noise and vibration, heat pump installations are pollution free and noise levels are generally low. There are no local emissions and, although there will be carbon dioxide emissions associated with their electricity use, these are much less than other forms of electric heating and can be lower than those associated with conventional gas or oil fired boilers.

h) Heat pump installations are unobtrusive. The technology used in air source heating systems has very low visual impact.

i) Many of the safety considerations appropriate to any refrigeration or air conditioning systems apply to the use of heat pumps since the working fluid is often a controlled substance that needs to be handled by trained personnel. However, once the system is commissioned, accidental release of refrigerant is unlikely.

j) In general terms heat pumps of all kinds are expected to operate an average output efficiency of 3:1, this means that for every 1 unit of energy used to run the system it will produce 3 units of energy as a result.

k) As the heat pumps use electricity as the fuel source, the baseline carbon dioxide emission from the SAP Assessments has to be changed to use electricity as the fuel source as well. Full details of the SAP calculations can be found in the Full SAP Worksheets in Appendix A.

l) The carbon dioxide emission figures for the dwellings using the use of an air source heat pump to provide the heating and hot water, have been included with the improvements in the thermal performance from Table 2. These demonstrate an overall improvement of 41.0% over the current Building Regulations.

## 4.12 Annual Carbon Dioxide Emission Reduction

a) Based on the initial SAP calculations for the dwellings, it has been calculated that the baseline carbon dioxide emissions figure for the development is 7,641 kg$CO_2$/year.

b) In accordance with the Planning Policies set out by London Borough of Camden, this report has demonstrated an improvement in carbon dioxide emissions by fabric and energy efficiencies and the inclusion of renewable technologies of 41.0%.

c) A number of options have been considered and the potential carbon dioxide reductions calculated using the SAP calculations and a summary of the results is provided in Table 4 below.

| | Total Carbon Dioxide Emissions (kg$CO_2$/yr) | Reduction in Carbon Dioxide Emissions (%) |
|---|---|---|
| Building Regulations Compliant Development | 7,641 | - |
| Development incorporating Energy Efficiency Measures and ASHPs | 4,510 | 41.0% |
| **Percentage Improvement incorporating Energy Efficiency Measures and renewable technologies** | | **41.0 %** |

**Table 4 – Summary of Reduction in Carbon Dioxide Emissions**

d) It has been demonstrated that it is possible to achieve a 41.0% reduction in carbon dioxide emissions over and above the 2013 Building Regulations by improving the energy efficiency of the development and its building services efficiencies and the incorporation of air source heat pumps systems. This could be further improved during detailed design.

e) CHP and Biomass CHP have been analysed but are considered not feasible for this development as the heating and electrical load profiles would not provide a good clean efficient system for the development.

f) Biomass heating has been analysed but is considered not feasible for this development due to particle discharge in the built up area, space requirements and the cost and the reliability of a biomass fuel source.

g) Wind power is considered not feasible for this development due to the visual impact in the area and the turbulence caused by the surrounding buildings and trees etc.

h) Solar hot water has been considered but due to the height of the building and the minimal reduction in carbon dioxide emissions, it is not being considered further at this stage.

i) The installation of ground source heat pumps would not be feasible for this development.

j) The initial calculations for photovoltaic systems demonstrated that there was not enough roof area for the installation of the panels to achieve a meaningful reduction in carbon dioxide emissions for this development, whilst also providing some amenity space for the building occupants.

k) At this stage of the development, the use of air source heat pumps is considered favorable as it is likely to provide a good reduction in carbon dioxide emissions for the development.

l) Detailed calculations of the total carbon dioxide emissions compared to the estimated carbon dioxide reduction for the development can be undertaken once the detailed design has progressed to construction drawing stage.

m) For the purpose of planning and based on the figures provided by initial SAP calculations, this report has demonstrated that it is feasible, with the improvement of the building fabric, the introduction of energy efficient controls and systems and the incorporation of air source heat pumps, a reduction of 41.0% of the developments carbon dioxide emissions could be achieved. This complies with the requirements of the planning policies set out by the London Borough of Camden.

## 4.13 Energy Hierarchy Carbon Dioxide Emissions Summary

a) The concept of applying the energy hierarchy in relation to Approved Document L of the Building Regulations 2013, the Energy Planning, Greater London Authority Guidance on Preparing Energy Assessments (March 2016) document provides further guidance on how the carbon dioxide emission figures can be presented.

b) The regulated carbon dioxide emissions reduction target for the development would be to achieve zero carbon as assessed under the Approved Document L 2013 of the Building Regulations.

c) These figures are based on the current design information and are subject to change when the detailed construction information is produced.

d) Table 5 provides Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings.

| | | Tonnes $CO_2$/yr |
|---|---|---|
| Baseline: Part L 2013 of the Building Regulations Compliant Development | a | 7.6 |
| After energy demand reduction | b | 4.5 |
| After heat network / CHP | c | 4.5 |
| After renewable energy | d | 4.5 |

**Table 5 – Carbon Dioxide Emissions after each stage of the Energy Hierarchy**

e) Table 6 provides Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings

| | | Tonnes $CO_2$/yr | | % |
|---|---|---|---|---|
| Savings from energy demand reduction | a-b | 3.1 | (a-b)/a*100 | 41.0% |
| Savings from heat network / CHP | b-c | 0.0 | (b-c)/a*100 | 0.0% |
| Savings from renewable energy | c-d | 0.0 | (c-d)/a*100 | 0.0% |
| **Cumulative on site savings** | **a-d=e** | **3.1** | **(a-d)/a*100** | **41.0%** |
| Annual Savings from off-set payment | a-e=f | 4.5 | | |
| Cumulative savings for off-set payment | f*30=g | 135.3 | | |

**Table 6 – Regulated carbon dioxide savings from each stage of the Energy Hierarchy**

f) The calculations contained within this Energy Statement are based on the current design information and are subject to change when the detailed design is undertaken and the construction information is produced.

## 5.0 OVERHEATING

a) It is important to consider the internal comfort conditions for the occupants of the dwelling. At design stage, this can be met through the use of the "cooling hierarchy", as set out in the London Plan. The cooling hierarchy, in Policy 5.9, seeks to reduce any potential overheating and also the need to cool a building through active cooling measures. Air conditioning systems are a very resource intensive form of active cooling, increasing carbon dioxide emissions, and also emitting large amounts of heat into the surrounding area. By incorporating the cooling hierarchy into the design process buildings will be better equipped to manage their cooling needs and to adapt to the changing climate they will experience over their lifetime.

b) The development shall reduce the potential for overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

   a) minimise internal heat generation through energy efficient design
   b) reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
   c) manage the heat within the building through exposed internal thermal mass and high ceilings
   d) passive ventilation
   e) mechanical ventilation
   f) active cooling systems (ensuring they are the lowest carbon options).

c) During the initial design, the initial SAP Assessment was carried out for the dwelling to help assess the energy demand and carbon emissions of the development. The SAP Assessment includes an overheating assessment in line with the requirements of the Building Regulations.

d) Based on this SAP Assessment, the dwelling has a slight risk of solar overheating. This is acceptable under the requirements of the Building Regulations.

e) The internal heat generation has been minimised through energy efficient design. All of the luminaires shall be low energy which will also remove an internal heat generating load.

f) The heat entering the building in summer is reduced through the optimisation of glazing area, the use of shading via building form and other protruding edges, together with the inclusion of very high performance façade materials and improved air tightness. The use of a solar control glazing, which has a coating applied to lower the G Value of the glass, can be applied. This acts in the same way that the low e coating lowers the U Value which helps reduce heat losses through the windows.

g) The dwelling could have a mechanical ventilation system installed, which provides filtered fresh air to the dwelling. This is tempered by the crossover heat exchanger, which recovers waste heat from the extract air from the dwelling. The ventilation systems shall be controlled locally by the occupants.

h) Low energy lamps shall be used in the luminaires to reduce heat gain. These lamps do not emit heat like traditional GLS lamps.

i) It is also possible to include passive ventilation within the cores and staircase by utilising the smoke vents. The smoke vents are linked to thermostats and can be opened if the temperature exceeds an upper limit, thus providing passive and natural ventilation to these areas to remove any potential heat build-up.

j) If required, during the detailed design phase of this project, dynamic thermal modelling, using IES software to produce an SBEM model, in accordance with CIBSE Guide A, TM52 and TM49, can be used to ensure that the finding of the initial overheating assessment are still valid and provide a more detailed assessment and prediction of the overheating risk for the development.

# 6.0 WATER CALCULATIONS

k) The London Borough of Camden recognises that London and the South East is classified as 'seriously' water stressed, meaning that more water is taken from the environment than the environment can sustain in the long term. London is relatively resilient to drought and it takes two consecutive drier than normal winters to create water supply issues.

l) The Local Plan requires all new dwellings will be expected to meet the requirement of 110 litres per person per day (including 5 litres for external use).

m) Low water usage fitting, or flow restrictors can be fitted in the dwelling. Efficient white goods that are not only energy efficient but also water efficient can also be installed.

n) At this stage in the design, the final selection of the water fittings and appliance has not been made, but this calculations shows the design intent for these fittings and appliances.

o) Dual flush toilets can be installed to reduce the water consumption of the dwelling. A full flush capacity of 4.5 litres and a part flush capacity of 3 litres has been selected.

p) Flow restrictors shall be installed to limit the flow rates of the taps to 3 litres / minute. Flow restrictors shall also be installed in the kitchen taps and the showers to restrict their flow to 8 litres / minute. The showers shall be restricted to 8 litres / minute.

q) No bath is being provided.

r) No Appliances have been selected at this time, so the default Best Practise values have been used. The washing machine shall have a water consumption of 8.17 litres / kg of dry load. The dishwasher shall have a water consumption of 1.25 litres / place setting.

s) No water softeners are being installed.

t) Using the Building Regulations Approved Document G Calculator, the water consumption has been calculated as 97.92 litres / person / day for the studios and 97.94 litres / person / day for the two bedroom flat. This includes the 5 litre per day external water allowance.

u) The calculated water consumption for the dwellings complies with the requirements of the Local Plan and the Building Regulations Approved Document G.

v) Details of the calculations can be found in Appendix B.

# 7.0 CONCLUSION

a) The London Borough of Camden and the London Plan 2016 Policy 5.2 requires new residential developments to minimise and exhibit the highest standards of sustainable design and construction. The reduction in carbon dioxide emissions target has been set as zero carbon. The development should achieve a minimum of 35% over the Target Emission Rate, as defined by the Building Regulations 2013.

b) The Application at 29-30 High Holborn, London WC1V 6AZ is for the redevelopment of the site to change the mix and provide an enlarged flat at roof level. The development will create a total of four studio flats and a two bedroom flat

c) It is proposed that in order to meet the requirements of policy this development will adopt a high standard of design with regard to energy efficiency principles. It has been estimated that the proposed development will achieve a reduction in the carbon dioxide emissions through fabric and services efficiencies and a further reduction through the use on-site renewable energy generation. This results in a total of 41.0%. It is envisaged during detailed construction design, these figures can be improved.

d) At planning stage it is not possible to produce the final reports on the energy demand, carbon dioxide emissions, based on the initial construction information. It is envisaged that during detailed design, the reduction in carbon dioxide emissions can be improved.

e) This report has assessed the risk of overheating and the development has been identified as having a slight risk, which can be reduced by incorporating low G value glazing, internal shading by light coloured curtains or cross ventilation by opening the windows fifty percent of the time.

f) The water usage has been assessed and although the actual water fittings have not been selected yet, the calculations show that it is possible for this development to achieve the requirements of the planning policy, thus minimising the impact of the development on the local water resources.

g) This Energy and Sustainability Statement demonstrates that the proposed development complies with the requirements of planning policy with regard to carbon dioxide reduction, incorporation of low and zero carbon technologies and water consumption. It is for these reasons it is considered that this application should be viewed favorably by the London Borough of Camden.

## Appendix A – Full SAP Calculations Printout

# FULL SAP CALCULATION PRINTOUT
## Calculation Type: New Build (As Designed)

Doherty Energy

| | | | |
|---|---|---|---|
| Property Reference | E1052-01 | Issued on Date | 12/01/2021 |
| Assessment Reference | E1052-01-ASHP | Prop Type Ref | |
| Property | Flat 1, Alliance House, 29 High Holborn, London, WC1V 6AZ | | |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 81 B | DER | 18.72 | TER | 32.30 |
| Environmental | 83 B | % DER<TER | 42.04 | | |
| $CO_2$ Emissions (t/year) | 0.98 | DFEE | 31.19 | TFEE | 42.41 |
| General Requirements Compliance | Pass | % DFEE<TFEE | 26.45 | | |

| | | | |
|---|---|---|---|
| Assessor Details | Mr. Jason Doherty, Doherty Energy Limited, Tel: 01480451569, jason@doherty-energy.co.uk | Assessor ID | L143-0001 |
| Client | | | |

## 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 41 $m^2$

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:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 32.30 kg$CO_2$/$m^2$
Dwelling Carbon Dioxide Emission Rate (DER) 18.72 kg$CO_2$/$m^2$OK

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**1b TFEE and DFEE**

Target Fabric Energy Efficiency (TFEE)42.4 kWh/$m^2$/yr
Dwelling Fabric Energy Efficiency (DFEE)31.2 kWh/$m^2$/yrOK

---

**2 Fabric U-values**

| Element | Average | Highest | |
|---|---|---|---|
| External wall | 0.19 (max. 0.30) | 0.19 (max. 0.70) | OK |
| Party wall | 0.00 (max. 0.20) | - | OK |
| Floor | (no floor) | | |
| Roof | (no roof) | | |
| Openings | 1.08 (max. 2.00) | 1.20 (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: | Heat pump with radiators or underfloor - Electric | |
| NIBE F205P | | |
| Secondary heating system: | None | |

---

| 5 Cylinder insulation | | |
|---|---|---|
| Hot water storage | No cylinder | |

---

| 6 Controls | | |
|---|---|---|
| Space heating controls: | Programmer and room thermostat | OK |
| Hot water controls: | No cylinder | |

---

| 7 Low energy lights | | |
|---|---|---|
| Percentage of fixed lights with low-energy fittings:100% | | |
| Minimum | 75% | OK |

---

| 8 Mechanical ventilation | | |
|---|---|---|
| Continuous extract system | | |
| Specific fan power: | 0.65 | |
| Maximum | 0.7 | OK |

---

| 9 Summertime temperature | | |
|---|---|---|
| Overheating risk (Thames Valley): | Medium | OK |
| Based on: | | |
| Overshading: | Average | |
| Windows facing North: | 5.59 $m^2$, No overhang | |
| Windows facing South: | 3.57 $m^2$, No overhang | |
| Air change rate: | 3.00 ach | |
| Blinds/curtains: | Light-coloured curtain or roller blind, closed 100% of daylight hours | |

---

| 10 Key features | |
|---|---|
| Party wall U-value | 0.00 W/$m^2$K |
| Door U-value | 0.55 W/$m^2$K |
| Air permeability | 3.0 $m^3$/$m^2$h |

---

## 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 (m2) | | | Storey height (m) | | | Volume (m3) | |
|---|---|---|---|---|---|---|---|---|---|
| Ground floor | | 40.6000 | (1b) | x | 2.5000 | (2b) | = | 101.5000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 40.6000 | | | | | | | | (4) |
| Dwelling volume | | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | | = | 101.5000 | (5) |

### 2. Ventilation rate

| | main heating | | secondary 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 | | 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) |

Mechanical extract ventilation - centralised

If mechanical ventilation: 0.5000 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.5000 (23b)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | (25) |

### 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Window (Uw = 1.20) | | | 9.1600 | 1.1450 | 10.4885 | | | (27) |
| Door | | | 2.1000 | 0.5500 | 1.1550 | | | (26) |
| External Wall | 30.0000 | 9.1600 | 20.8400 | 0.1900 | 3.9596 | 60.0000 | 1250.4000 | (29a) |
| Sheltered Wall | 17.2500 | 2.1000 | 15.1500 | 0.1800 | 2.7270 | 60.0000 | 909.0000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 47.2500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 18.3301 | | | (33) |
| Party Wall 1 | | | 18.0000 | 0.0000 | 0.0000 | 180.0000 | 3240.0000 | (32) |
| Party Floor 1 | | | 40.6000 | | | 40.0000 | 1624.0000 | (32d) |
| Party Ceilings 1 | | | 40.6000 | | | 40.0000 | 1624.0000 | (32b) |
| Internal Wall 1 | | | 22.5000 | | | 9.0000 | 202.5000 | (32c) |

| | | | |
|---|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 8849.9000 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 217.9778 | (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 2.0560 | (36) |
| Total fabric heat loss | (33) + (36) = | 20.3861 | (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 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | (38) |
| Heat transfer coeff | 37.1336 | 37.1336 | 37.1336 | 37.1336 | 37.1336 | 37.1336 | 37.1336 | 37.1336 | 37.1336 | 37.1336 | 37.1336 | 37.1336 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 37.1336 | (39) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9146 | 0.9146 | 0.9146 | 0.9146 | 0.9146 | 0.9146 | 0.9146 | 0.9146 | 0.9146 | 0.9146 | 0.9146 | 0.9146 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9146 | (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 | 1.4224 | (42) |
| Average daily hot water use (litres/day) | 67.9814 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 74.7795 | 72.0602 | 69.3410 | 66.6217 | 63.9025 | 61.1832 | 61.1832 | 63.9025 | 66.6217 | 69.3410 | 72.0602 | 74.7795 | (44) |
| Energy conte | 110.8958 | 96.9902 | 100.0852 | 87.2567 | 83.7249 | 72.2482 | 66.9486 | 76.8245 | 77.7420 | 90.6008 | 98.8979 | 107.3967 | (45) |

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

Energy content (annual) Total = Sum(45)m = 1069.6114 (45)

Distribution loss (46)m = 0.15 x (45)m

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 16.6344 | 14.5485 | 15.0128 | 13.0885 | 12.5587 | 10.8372 | 10.0423 | 11.5237 | 11.6613 | 13.5901 | 14.8347 | 16.1095 | (46) |

Water storage loss:

Store volume 150.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.6800 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9072 (55)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total storage loss | | | | | | | | | | | | | |
| | 28.1232 | 25.4016 | 28.1232 | 27.2160 | 28.1232 | 27.2160 | 28.1232 | 28.1232 | 27.2160 | 28.1232 | 27.2160 | 28.1232 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 28.1232 | 25.4016 | 28.1232 | 27.2160 | 28.1232 | 27.2160 | 28.1232 | 28.1232 | 27.2160 | 28.1232 | 27.2160 | 28.1232 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 139.0190 | 122.3918 | 128.2084 | 114.4727 | 111.8481 | 99.4642 | 95.0718 | 104.9477 | 104.9580 | 118.7240 | 126.1139 | 135.5199 | (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 | | | | | | | | | | | | | |
| | 139.0190 | 122.3918 | 128.2084 | 114.4727 | 111.8481 | 99.4642 | 95.0718 | 104.9477 | 104.9580 | 118.7240 | 126.1139 | 135.5199 | (64) |

Total per year (kWh/year) = Sum(64)m = 1400.7394 (64)

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 36.8729 | 32.2492 | 33.2783 | 29.0129 | 27.8385 | 24.0225 | 22.2604 | 25.5441 | 25.8492 | 30.1248 | 32.8835 | 35.7094 | (65) |

---

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

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 10.9677 | 9.7414 | 7.9223 | 5.9977 | 4.4833 | 3.7850 | 4.0898 | 5.3161 | 7.1353 | 9.0599 | 10.5743 | 11.2726 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 123.0453 | 124.3222 | 121.1046 | 114.2548 | 105.6082 | 97.4815 | 92.0524 | 90.7756 | 93.9932 | 100.8430 | 109.4896 | 117.6163 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | (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) | | | | | | | | | | | | | |
| | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 49.5603 | 47.9899 | 44.7289 | 40.2956 | 37.4174 | 33.3646 | 29.9199 | 34.3335 | 35.9017 | 40.4903 | 45.6716 | 47.9965 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 227.9090 | 226.3892 | 218.0914 | 204.8837 | 191.8445 | 178.9668 | 170.3978 | 174.7609 | 181.3658 | 194.7288 | 210.0711 | 221.2209 | (73) |

---

6. Solar gains

---

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 5.5900 | 10.6334 | 0.7200 | 0.7000 | 0.7700 | 20.7610 | (74) |
| South | 3.5700 | 46.7521 | 0.7200 | 0.7000 | 0.7700 | 58.2952 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 79.0562 | 135.1478 | 189.0330 | 245.7419 | 289.1101 | 294.0081 | 280.4810 | 246.4675 | 208.0995 | 150.2043 | 94.7110 | 67.6798 | (83) |
| Total gains | 306.9651 | 361.5369 | 407.1244 | 450.6256 | 480.9546 | 472.9748 | 450.8788 | 421.2283 | 389.4653 | 344.9330 | 304.7821 | 288.9007 | (84) |

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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 | 66.2016 | 66.2016 | 66.2016 | 66.2016 | 66.2016 | 66.2016 | 66.2016 | 66.2016 | 66.2016 | 66.2016 | 66.2016 | 66.2016 | |
| alpha | 5.4134 | 5.4134 | 5.4134 | 5.4134 | 5.4134 | 5.4134 | 5.4134 | 5.4134 | 5.4134 | 5.4134 | 5.4134 | 5.4134 | |
| util living area | | | | | | | | | | | | | |
| | 0.9887 | 0.9730 | 0.9356 | 0.8428 | 0.6798 | 0.4964 | 0.3614 | 0.4037 | 0.6328 | 0.8876 | 0.9755 | 0.9916 | (86) |
| Tweekday | 19.6168 | 19.8321 | 20.0993 | 20.3573 | 20.4981 | 20.5368 | 20.5420 | 20.5414 | 20.5214 | 20.3308 | 19.9165 | 19.5533 | |
| Tweekend | 20.4467 | 20.5700 | 20.7247 | 20.8786 | 20.9678 | 20.9950 | 20.9993 | 20.9987 | 20.9830 | 20.8602 | 20.6176 | 20.4105 | |
| 24 / 16 | 9 | 8 | 9 | 8 | 9 | 9 | 9 | 9 | 8 | 9 | 8 | 9 | |
| 24 / 9 | 22 | 20 | 22 | 22 | 22 | 21 | 22 | 22 | 22 | 22 | 22 | 22 | |
| 16 / 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| MIT | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | (87) |
| Th 2 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9871 | 0.9696 | 0.9278 | 0.8261 | 0.6527 | 0.4625 | 0.3242 | 0.3642 | 0.5966 | 0.8713 | 0.9719 | 0.9905 | (89) |
| Tweekday | 19.6168 | 19.8321 | 20.0993 | 20.3573 | 20.4981 | 20.5368 | 20.5420 | 20.5414 | 20.5214 | 20.3308 | 19.9165 | 19.5533 | |
| Tweekend | 20.0183 | 20.1402 | 20.2916 | 20.4377 | 20.5174 | 20.5393 | 20.5423 | 20.5420 | 20.5306 | 20.4227 | 20.1881 | 19.9823 | |
| MIT 2 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | 20.5427 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.8670 | (91) |
| MIT | 20.9392 | 20.9392 | 20.9392 | 20.9392 | 20.9392 | 20.9392 | 20.9392 | 20.9392 | 20.9392 | 20.9392 | 20.9392 | 20.9392 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.9392 | 20.9392 | 20.9392 | 20.9392 | 20.9392 | 20.9392 | 20.9392 | 20.9392 | 20.9392 | 20.9392 | 20.9392 | 20.9392 | (93) |

---

8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9885 | 0.9725 | 0.9346 | 0.8407 | 0.6762 | 0.4919 | 0.3565 | 0.3985 | 0.6281 | 0.8855 | 0.9751 | 0.9915 | (94) |
| Useful gains | 303.4245 | 351.6069 | 380.4990 | 378.8427 | 325.2420 | 232.6598 | 160.7345 | 167.8438 | 244.6330 | 305.4481 | 297.1831 | 286.4395 | (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 | | | | | | | | | | | | | |

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 617.8733 | 595.5931 | 536.1793 | 447.0585 | 343.0843 | 235.3967 | 161.1294 | 168.5561 | 253.9635 | 383.9313 | 513.8991 | 621.5867 | (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 | 233.9499 | 163.9588 | 115.8261 | 49.1154 | 13.2747 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 58.3915 | 156.0355 | 249.3495 | (98) |

| | | | |
|---|---|---|---|
| Space heating | | 1039.9015 | (98) |
| Space heating per m2 | (98) / (4) = | 25.6133 | (99) |

---

8c. Space cooling requirement

---

Not applicable

---

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

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| | | |
|---|---|---|
| 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 %) | 265.0547 | (206) |
| Efficiency of secondary/supplementary heating system, % | 100.0000 | (208) |
| Space heating requirement | 392.3347 | (211) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 233.9499 | 163.9588 | 115.8261 | 49.1154 | 13.2747 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 58.3915 | 156.0355 | 249.3495 | (98) |
| Space heating efficiency (main heating system 1) | 265.0547 | 265.0547 | 265.0547 | 265.0547 | 265.0547 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 265.0547 | 265.0547 | 265.0547 | (210) |
| Space heating fuel (main heating system) | 88.2648 | 61.8585 | 43.6990 | 18.5303 | 5.0083 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 22.0300 | 58.8692 | 94.0747 | (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 | 139.0190 | 122.3918 | 128.2084 | 114.4727 | 111.8481 | 99.4642 | 95.0718 | 104.9477 | 104.9580 | 118.7240 | 126.1139 | 135.5199 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 186.5800 | (216) |
| (217)m | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | (217) |
| Fuel for water heating, kWh/month | 74.5091 | 65.5975 | 68.7150 | 61.3531 | 59.9464 | 53.3091 | 50.9550 | 56.2481 | 56.2536 | 63.6317 | 67.5924 | 72.6337 | (219) |
| Water heating fuel used | | | | | | | | | | | | 750.7447 | (219) |

| | | |
|---|---|---|
| Annual totals kWh/year | | |
| Space heating fuel - main system | 392.3347 | (211) |
| Space heating fuel - secondary | 0.0000 | (215) |

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.8450)

| | | |
|---|---|---|
| mechanical ventilation fans (SFP = 0.8450) | 127.8850 | (230a) |
| Total electricity for the above, kWh/year | 127.8850 | (231) |
| Electricity for lighting (calculated in Appendix L) | 193.6937 | (232) |
| Total delivered energy for all uses | 1464.6581 | (238) |

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

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| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 392.3347 | 0.5190 | 203.6217 | (261) |
| Space heating - secondary | 0.0000 | 0.5190 | 0.0000 | (263) |
| Water heating (other fuel) | 750.7447 | 0.5190 | 389.6365 | (264) |
| Space and water heating | | | 593.2582 | (265) |
| Pumps and fans | 127.8850 | 0.5190 | 66.3723 | (267) |
| Energy for lighting | 193.6937 | 0.5190 | 100.5270 | (268) |
| Total CO2, kg/year | | | 760.1576 | (272) |
| Dwelling Carbon Dioxide Emission Rate (DER) | | | 18.7200 | (273) |

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

| | | | |
|---|---|---|---|
| DER | | 18.7200 | ZC1 |
| Total Floor Area | TFA | 40.6000 | |
| Assumed number of occupants | N | 1.4224 | |
| CO2 emission factor in Table 12 for electricity displaced from grid | EF | 0.5190 | |
| CO2 emissions from appliances, equation (L14) | | 17.9591 | ZC2 |
| CO2 emissions from cooking, equation (L16) | | 3.7718 | ZC3 |
| Total CO2 emissions | | 40.4510 | 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 | | 40.4510 | 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 (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Ground floor | | 40.6000 (1b) | x | 2.5000 (2b) | = | 101.5000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 40.6000 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 101.5000 | (5) |

### 2. Ventilation rate

| | main heating | | secondary 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 | | | | | | | 2 * 10 = | 20.0000 | (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) = | 20.0000 / (5) = | 0.1970 | (8) |
| Pressure test | | | Yes | |
| Measured/design AP50 | | | 5.0000 | |
| Infiltration rate | | | 0.4470 | (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) = | 0.3800 | (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 | 0.4845 | 0.4750 | 0.4655 | 0.4180 | 0.4085 | 0.3610 | 0.3610 | 0.3515 | 0.3800 | 0.4085 | 0.4275 | 0.4465 | (22b) |
| Effective ac | 0.6174 | 0.6128 | 0.6083 | 0.5874 | 0.5834 | 0.5652 | 0.5652 | 0.5618 | 0.5722 | 0.5834 | 0.5914 | 0.5997 | (25) |

### 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.40) | | | 8.0500 | 1.3258 | 10.6723 | | | (27) |
| External Wall | 30.0000 | 8.0500 | 21.9500 | 0.1800 | 3.9510 | | | (29a) |
| Sheltered Wall | 17.2500 | 2.1000 | 15.1500 | 0.1800 | 2.7270 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 47.2500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 19.4503 | | | (33) |

| | | |
|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | 250.0000 | (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | 2.1200 | (36) |
| Total fabric heat loss (33) + (36) = | 21.5703 | (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 | 20.6786 | 20.5259 | 20.3763 | 19.6735 | 19.5420 | 18.9299 | 18.9299 | 18.8166 | 19.1657 | 19.5420 | 19.8080 | 20.0861 | (38) |
| Heat transfer coeff | 42.2489 | 42.0963 | 41.9466 | 41.2438 | 41.1124 | 40.5003 | 40.5003 | 40.3869 | 40.7360 | 41.1124 | 41.3784 | 41.6565 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 41.2432 | (39) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0406 | 1.0369 | 1.0332 | 1.0159 | 1.0126 | 0.9975 | 0.9975 | 0.9948 | 1.0034 | 1.0126 | 1.0192 | 1.0260 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0158 | (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 | 1.4224 | (42) |
| Average daily hot water use (litres/day) | 67.9814 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 74.7795 | 72.0602 | 69.3410 | 66.6217 | 63.9025 | 61.1832 | 61.1832 | 63.9025 | 66.6217 | 69.3410 | 72.0602 | 74.7795 | (44) |
| Energy conte | 110.8958 | 96.9902 | 100.0852 | 87.2567 | 83.7249 | 72.2482 | 66.9486 | 76.8245 | 77.7420 | 90.6008 | 98.8979 | 107.3967 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1069.6114 | (45) |
| Distribution loss (46)m = 0.15 x (45)m | 16.6344 | 14.5485 | 15.0128 | 13.0885 | 12.5587 | 10.8372 | 10.0423 | 11.5237 | 11.6613 | 13.5901 | 14.8347 | 16.1095 | (46) |

Water storage loss:

| | | |
|---|---|---|
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |
| Total storage loss | | |

## CALCULATION OF TARGET EMISSIONS 09 Jan 2014

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (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 | | | | | | | | | | | | | |
| | 157.4907 | 139.0759 | 146.6801 | 132.3485 | 130.3198 | 117.3400 | 113.5435 | 123.4194 | 122.8338 | 137.1957 | 143.9897 | 153.9916 | (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 | | | | | | | | | | | | | |
| | 157.4907 | 139.0759 | 146.6801 | 132.3485 | 130.3198 | 117.3400 | 113.5435 | 123.4194 | 122.8338 | 137.1957 | 143.9897 | 153.9916 | (64) |
| Total per year (kWh/year) = Sum(64)m = | | | | | | | | | | | | 1618.2288 | (64) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 74.1488 | 65.9178 | 70.5542 | 65.0863 | 65.1144 | 60.0960 | 59.5363 | 62.8201 | 61.9227 | 67.4007 | 68.9570 | 72.9853 | (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 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 11.0571 | 9.8208 | 7.9868 | 6.0465 | 4.5199 | 3.8159 | 4.1232 | 5.3594 | 7.1934 | 9.1337 | 10.6604 | 11.3644 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 123.0453 | 124.3222 | 121.1046 | 114.2548 | 105.6082 | 97.4815 | 92.0524 | 90.7756 | 93.9932 | 100.8430 | 109.4896 | 117.6163 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | (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) | | | | | | | | | | | | | |
| | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 99.6623 | 98.0920 | 94.8310 | 90.3977 | 87.5194 | 83.4667 | 80.0219 | 84.4356 | 86.0037 | 90.5923 | 95.7736 | 98.0985 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 281.1004 | 279.5706 | 271.2580 | 258.0346 | 244.9830 | 232.0997 | 223.5332 | 227.9062 | 234.5260 | 247.9046 | 263.2593 | 274.4148 | (73) |

### 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 4.9100 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 15.9560 | (74) |
| South | 3.1400 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 44.8644 | (78) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 60.8205 | 103.9692 | 145.4106 | 189.0114 | 222.3485 | 226.1073 | 215.7076 | 189.5621 | 160.0701 | 115.5489 | 72.8635 | 52.0688 | (83) |
| Total gains | 341.9209 | 383.5398 | 416.6686 | 447.0461 | 467.3316 | 458.2069 | 439.2407 | 417.4683 | 394.5960 | 363.4535 | 336.1228 | 326.4836 | (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 | 66.7341 | 66.9761 | 67.2150 | 68.3604 | 68.5790 | 69.6155 | 69.6155 | 69.8109 | 69.2125 | 68.5790 | 68.1381 | 67.6833 | |
| alpha | 5.4489 | 5.4651 | 5.4810 | 5.5574 | 5.5719 | 5.6410 | 5.6410 | 5.6541 | 5.6142 | 5.5719 | 5.5425 | 5.5122 | |
| util living area | | | | | | | | | | | | | |
| | 0.9900 | 0.9802 | 0.9567 | 0.8900 | 0.7518 | 0.5556 | 0.4042 | 0.4425 | 0.6782 | 0.9076 | 0.9782 | 0.9920 | (86) |
| MIT | 20.1336 | 20.2871 | 20.5046 | 20.7601 | 20.9264 | 20.9890 | 20.9984 | 20.9975 | 20.9680 | 20.7682 | 20.4162 | 20.1102 | (87) |
| Th 2 | 20.4797 | 20.4816 | 20.4834 | 20.4921 | 20.4937 | 20.5012 | 20.5012 | 20.5026 | 20.4983 | 20.4937 | 20.4904 | 20.4870 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9884 | 0.9772 | 0.9501 | 0.8745 | 0.7222 | 0.5152 | 0.3590 | 0.3956 | 0.6372 | 0.8912 | 0.9744 | 0.9907 | (89) |
| MIT 2 | 19.6640 | 19.8176 | 20.0328 | 20.2854 | 20.4367 | 20.4942 | 20.5005 | 20.5013 | 20.4764 | 20.2972 | 19.9535 | 19.6468 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.8670 | (91) |
| MIT | 20.0712 | 20.2247 | 20.4418 | 20.6970 | 20.8613 | 20.9232 | 20.9322 | 20.9315 | 20.9026 | 20.7055 | 20.3547 | 20.0486 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.6000 | |
| adjusted MIT | 20.6712 | 20.8247 | 21.0418 | 21.2970 | 21.4613 | 21.5232 | 21.5322 | 21.5315 | 21.5026 | 21.3055 | 20.9547 | 20.6486 | (93) |

### 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9890 | 0.9792 | 0.9571 | 0.8982 | 0.7766 | 0.5965 | 0.4518 | 0.4916 | 0.7163 | 0.9162 | 0.9779 | 0.9911 | (94) |
| Useful gains | 338.1606 | 375.5648 | 398.8092 | 401.5527 | 362.9433 | 273.3040 | 198.4705 | 205.2352 | 282.6491 | 333.0063 | 328.6853 | 323.5887 | (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 | | | | | | | | | | | | | |
| | 691.6636 | 670.3698 | 609.9801 | 511.2986 | 401.3090 | 280.3904 | 199.7558 | 207.2446 | 301.5529 | 440.1299 | 573.2828 | 685.1896 | (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 | | | | | | | | | | | | | |
| | 263.0062 | 198.1089 | 157.1111 | 79.0171 | 28.5441 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 79.6999 | 176.1102 | 269.0311 | (98) |
| Space heating | | | | | | | | | | | | 1250.6286 | (98) |
| Space heating per m2 | | | | | | | | | | | (98) / (4) = | 30.8037 | (99) |

### 8c. Space cooling requirement

Not applicable

## 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 | 1413.1397 | (211) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 263.0062 | 198.1089 | 157.1111 | 79.0171 | 28.5441 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 79.6999 | 176.1102 | 269.0311 | (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) | 297.1822 | 223.8519 | 177.5267 | 89.2848 | 32.2532 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 90.0564 | 198.9946 | 303.9899 | (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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water heating requirement | 157.4907 | 139.0759 | 146.6801 | 132.3485 | 130.3198 | 117.3400 | 113.5435 | 123.4194 | 122.8338 | 137.1957 | 143.9897 | 153.9916 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 74.8000 | (216) |
| (217)m | 81.1522 | 80.7364 | 79.9762 | 78.4713 | 76.5206 | 74.8000 | 74.8000 | 74.8000 | 74.8000 | 78.4056 | 80.3309 | 81.2681 | (217) |
| Fuel for water heating, kWh/month | 194.0685 | 172.2593 | 183.4047 | 168.6586 | 170.3067 | 156.8717 | 151.7961 | 164.9992 | 164.2164 | 174.9821 | 179.2456 | 189.4859 | (219) |

| | | |
|---|---|---|
| Water heating fuel used | 2070.2948 | (219) |
| Annual totals kWh/year | | |
| Space heating fuel - main system | 1413.1397 | (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) | 195.2718 | (232) |
| Total delivered energy for all uses | 3762.7063 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1413.1397 | 0.2160 | 305.2382 | (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 | (263) |
| Water heating (other fuel) | 2070.2948 | 0.2160 | 447.1837 | (264) |
| Space and water heating | | | 752.4219 | (265) |
| Pumps and fans | 84.0000 | 0.5190 | 43.5960 | (267) |
| Energy for lighting | 195.2718 | 0.5190 | 101.3461 | (268) |
| Total CO2, kg/m2/year | | | 897.3639 | (272) |
| Emissions per m2 for space and water heating | | | 18.5326 | (272a) |
| Fuel factor (electricity) | | | 1.5500 | |
| Emissions per m2 for lighting | | | 2.4962 | (272b) |
| Emissions per m2 for pumps and fans | | | 1.0738 | (272c) |
| Target Carbon Dioxide Emission Rate (TER) = (18.5326 * 1.55) + 2.4962 + 1.0738, rounded to 2 d.p. | | | 32.3000 | (273) |

# FULL SAP CALCULATION PRINTOUT
## Calculation Type: New Build (As Designed)

Doherty Energy

| | | | |
|---|---|---|---|
| Property Reference | E1052-02 | Issued on Date | 12/01/2021 |
| Assessment Reference | E1052-02-ASHP | Prop Type Ref | |
| Property | Flat 2, Alliance House, 29 High Holborn, London, WC1V 6AZ | | |

| | | | | | |
|---|---|---|---|---|---|
| SAP Rating | 80 C | DER | 19.96 | TER | 34.24 |
| Environmental | 82 B | % DER<TER | 41.71 | | |
| $CO_2$ Emissions (t/year) | 1.03 | DFEE | 36.37 | TFEE | 48.02 |
| General Requirements Compliance | Pass | % DFEE<TFEE | 24.26 | | |

| | | | |
|---|---|---|---|
| Assessor Details | Mr. Jason Doherty, Doherty Energy Limited, Tel: 01480451569, jason@doherty-energy.co.uk | Assessor ID | L143-0001 |
| Client | | | |

## 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 41 $m^2$

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:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 34.24 $kgCO_2/m^2$
Dwelling Carbon Dioxide Emission Rate (DER) 19.96 $kgCO_2/m^2$ OK

**1b TFEE and DFEE**
Target Fabric Energy Efficiency (TFEE) 48.0 kWh/$m^2$/yr
Dwelling Fabric Energy Efficiency (DFEE) 36.4 kWh/$m^2$/yr OK

**2 Fabric U-values**

| Element | Average | Highest | |
|---|---|---|---|
| External wall | 0.19 (max. 0.30) | 0.19 (max. 0.70) | OK |
| Floor | (no floor) | | |
| Roof | (no roof) | | |
| Openings | 1.08 (max. 2.00) | 1.20 (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: | Heat pump with radiators or underfloor - Electric |
| NIBE F205P | |
| Secondary heating system: | None |

**5 Cylinder insulation**

| | |
|---|---|
| Hot water storage | No cylinder |

**6 Controls**

| | | |
|---|---|---|
| Space heating controls: | Programmer and room thermostat | OK |
| Hot water controls: | No cylinder | |

**7 Low energy lights**
Percentage of fixed lights with low-energy fittings:100%

| | | |
|---|---|---|
| Minimum | 75% | OK |

**8 Mechanical ventilation**
Continuous extract system

| | | |
|---|---|---|
| Specific fan power: | 0.65 | |
| Maximum | 0.7 | OK |

**9 Summertime temperature**

| | | |
|---|---|---|
| Overheating risk (Thames Valley): | Medium | OK |
| Based on: | | |
| Overshading: | Average | |
| Windows facing North: | 5.59 $m^2$, No overhang | |
| Windows facing South: | 3.57 $m^2$, No overhang | |
| Air change rate: | 3.00 ach | |
| Blinds/curtains: | Light-coloured curtain or roller blind, closed 100% of daylight hours | |

**10 Key features**

| | |
|---|---|
| Door U-value | 0.55 W/$m^2$K |
| Thermal bridging y-value | 0.032 W/$m^2$K |
| Air permeability | 3.0 $m^3/m^2h$ |

## 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 (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|---|
| Ground floor | | 40.6000 (1b) | x | 2.5000 (2b) | = | 101.5000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 40.6000 | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 101.5000 | (5) |

### 2. Ventilation rate

| | main heating | | secondary 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 | | 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) |

Mechanical extract ventilation - centralised

| | | |
|---|---|---|
| If mechanical ventilation: | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 | (23b) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | (25) |

### 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Window (Uw = 1.20) | | | 9.1600 | 1.1450 | 10.4885 | | | (27) |
| Door | | | 2.1000 | 0.5500 | 1.1550 | | | (26) |
| External Wall | 48.0000 | 9.1600 | 38.8400 | 0.1900 | 7.3796 | 60.0000 | 2330.4000 | (29a) |
| Sheltered Wall | 17.2500 | 2.1000 | 15.1500 | 0.1800 | 2.7270 | 60.0000 | 909.0000 | (29a) |
| Total net area of external elements Aum(A, m2) | | | 65.2500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | | (26)...(30) + (32) = | 21.7501 | | | (33) |
| Party Floor 1 | | | 40.6000 | | | 40.0000 | 1624.0000 | (32d) |
| Party Ceilings 1 | | | 40.6000 | | | 40.0000 | 1624.0000 | (32b) |
| Internal Wall 1 | | | 22.5000 | | | 9.0000 | 202.5000 | (32c) |

| | | | |
|---|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 6689.9000 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 164.7759 | (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 2.0560 | (36) |
| Total fabric heat loss | (33) + (36) = | 23.8061 | (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 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | 16.7475 | (38) |
| Heat transfer coeff | 40.5536 | 40.5536 | 40.5536 | 40.5536 | 40.5536 | 40.5536 | 40.5536 | 40.5536 | 40.5536 | 40.5536 | 40.5536 | 40.5536 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 40.5536 | (39) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 0.9989 | 0.9989 | 0.9989 | 0.9989 | 0.9989 | 0.9989 | 0.9989 | 0.9989 | 0.9989 | 0.9989 | 0.9989 | 0.9989 | (40) |
| HLP (average) | | | | | | | | | | | | 0.9989 | (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 | 1.4224 | (42) |
| Average daily hot water use (litres/day) | 67.9814 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 74.7795 | 72.0602 | 69.3410 | 66.6217 | 63.9025 | 61.1832 | 61.1832 | 63.9025 | 66.6217 | 69.3410 | 72.0602 | 74.7795 | (44) |
| Energy conte | 110.8958 | 96.9902 | 100.0852 | 87.2567 | 83.7249 | 72.2482 | 66.9486 | 76.8245 | 77.7420 | 90.6008 | 98.8979 | 107.3967 | (45) |
| Energy content (annual) | | | | | | | | | | | Total = Sum(45)m = | 1069.6114 | (45) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Distribution loss (46)m = 0.15 x (45)m | 16.6344 | 14.5485 | 15.0128 | 13.0885 | 12.5587 | 10.8372 | 10.0423 | 11.5237 | 11.6613 | 13.5901 | 14.8347 | 16.1095 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.6800 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.9072 | (55) |
| Total storage loss | 28.1232 | 25.4016 | 28.1232 | 27.2160 | 28.1232 | 27.2160 | 28.1232 | 28.1232 | 27.2160 | 28.1232 | 27.2160 | 28.1232 | (56) |
| If cylinder contains dedicated solar storage | 28.1232 | 25.4016 | 28.1232 | 27.2160 | 28.1232 | 27.2160 | 28.1232 | 28.1232 | 27.2160 | 28.1232 | 27.2160 | 28.1232 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |
| Total heat required for water heating calculated for each month | 139.0190 | 122.3918 | 128.2084 | 114.4727 | 111.8481 | 99.4642 | 95.0718 | 104.9477 | 104.9580 | 118.7240 | 126.1139 | 135.5199 | (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 | 139.0190 | 122.3918 | 128.2084 | 114.4727 | 111.8481 | 99.4642 | 95.0718 | 104.9477 | 104.9580 | 118.7240 | 126.1139 | 135.5199 | (64) |
| Total per year (kWh/year) = Sum(64)m = | | | | | | | | | | | | 1400.7394 | (64) |
| Heat gains from water heating, kWh/month | 36.8729 | 32.2492 | 33.2783 | 29.0129 | 27.8385 | 24.0225 | 22.2604 | 25.5441 | 25.8492 | 30.1248 | 32.8835 | 35.7094 | (65) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Metabolic gains (Table 5), Watts (66)m | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 10.9677 | 9.7414 | 7.9223 | 5.9977 | 4.4833 | 3.7850 | 4.0898 | 5.3161 | 7.1353 | 9.0599 | 10.5743 | 11.2726 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 123.0453 | 124.3222 | 121.1046 | 114.2548 | 105.6082 | 97.4815 | 92.0524 | 90.7756 | 93.9932 | 100.8430 | 109.4896 | 117.6163 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | (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) | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | (71) |
| Water heating gains (Table 5) | 49.5603 | 47.9899 | 44.7289 | 40.2956 | 37.4174 | 33.3646 | 29.9199 | 34.3335 | 35.9017 | 40.4903 | 45.6716 | 47.9965 | (72) |
| Total internal gains | 227.9090 | 226.3892 | 218.0914 | 204.8837 | 191.8445 | 178.9668 | 170.3978 | 174.7609 | 181.3658 | 194.7288 | 210.0711 | 221.2209 | (73) |

### 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 5.5900 | 10.6334 | 0.7200 | 0.7000 | 0.7700 | 20.7610 | (74) |
| South | 3.5700 | 46.7521 | 0.7200 | 0.7000 | 0.7700 | 58.2952 | (78) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 79.0562 | 135.1478 | 189.0330 | 245.7419 | 289.1101 | 294.0081 | 280.4810 | 246.4675 | 208.0995 | 150.2043 | 94.7110 | 67.6798 | (83) |
| Total gains | 306.9651 | 361.5369 | 407.1244 | 450.6256 | 480.9546 | 472.9748 | 450.8788 | 421.2283 | 389.4653 | 344.9330 | 304.7821 | 288.9007 | (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 | 45.8234 | 45.8234 | 45.8234 | 45.8234 | 45.8234 | 45.8234 | 45.8234 | 45.8234 | 45.8234 | 45.8234 | 45.8234 | 45.8234 | |
| alpha | 4.0549 | 4.0549 | 4.0549 | 4.0549 | 4.0549 | 4.0549 | 4.0549 | 4.0549 | 4.0549 | 4.0549 | 4.0549 | 4.0549 | |
| util living area | 0.9775 | 0.9572 | 0.9179 | 0.8348 | 0.6949 | 0.5259 | 0.3901 | 0.4336 | 0.6533 | 0.8737 | 0.9603 | 0.9820 | (86) |
| Tweekday | 19.1572 | 19.4183 | 19.7592 | 20.1199 | 20.3681 | 20.4716 | 20.4950 | 20.4918 | 20.4286 | 20.1041 | 19.5533 | 19.0812 | |
| Tweekend | 20.1976 | 20.3473 | 20.5441 | 20.7564 | 20.9087 | 20.9770 | 20.9946 | 20.9917 | 20.9460 | 20.7439 | 20.4235 | 20.1542 | |
| 24 / 16 | 9 | 8 | 9 | 8 | 9 | 9 | 9 | 9 | 8 | 9 | 8 | 9 | |
| 24 / 9 | 22 | 20 | 22 | 22 | 22 | 21 | 22 | 22 | 22 | 22 | 22 | 22 | |
| 16 / 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| MIT | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | (87) |
| Th 2 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | (88) |
| util rest of house | 0.9751 | 0.9529 | 0.9098 | 0.8190 | 0.6687 | 0.4896 | 0.3476 | 0.3892 | 0.6172 | 0.8580 | 0.9555 | 0.9801 | (89) |
| Tweekday | 19.1572 | 19.4183 | 19.7592 | 20.1199 | 20.3681 | 20.4716 | 20.4950 | 20.4918 | 20.4286 | 20.1041 | 19.5533 | 19.0812 | |
| Tweekend | 19.7397 | 19.8876 | 20.0807 | 20.2850 | 20.4256 | 20.4842 | 20.4974 | 20.4956 | 20.4598 | 20.2760 | 19.9640 | 19.6967 | |
| MIT 2 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | 20.5006 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.8670 | (91) |
| MIT | 20.9336 | 20.9336 | 20.9336 | 20.9336 | 20.9336 | 20.9336 | 20.9336 | 20.9336 | 20.9336 | 20.9336 | 20.9336 | 20.9336 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.9336 | 20.9336 | 20.9336 | 20.9336 | 20.9336 | 20.9336 | 20.9336 | 20.9336 | 20.9336 | 20.9336 | 20.9336 | 20.9336 | (93) |

### 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9772 | 0.9567 | 0.9169 | 0.8328 | 0.6915 | 0.5212 | 0.3845 | 0.4278 | 0.6487 | 0.8717 | 0.9597 | 0.9818 | (94) |
| Useful gains | 299.9643 | 345.8754 | 373.2873 | 375.2694 | 332.5914 | 246.5063 | 173.3714 | 180.2049 | 252.6280 | 300.6831 | 292.4924 | 283.6301 | (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 | 674.5521 | 650.2199 | 585.3341 | 488.0053 | 374.4551 | 256.8495 | 175.7422 | 183.8529 | 277.1263 | 419.0641 | 561.0019 | 678.6075 | (97) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 278.6934 | 204.5195 | 157.7628 | 81.1699 | 31.1466 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 88.0755 | 193.3268 | 293.8632 | (98) |

| | | | |
|---|---|---|---|
| Space heating | | 1328.5577 | (98) |
| Space heating per m2 | (98) / (4) = | 32.7231 | (99) |

### 8c. Space cooling requirement

Not applicable

### 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 %) | 270.3552 | (206) |
| Efficiency of secondary/supplementary heating system, % | 100.0000 | (208) |
| Space heating requirement | 491.4120 | (211) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 278.6934 | 204.5195 | 157.7628 | 81.1699 | 31.1466 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 88.0755 | 193.3268 | 293.8632 | (98) |
| Space heating efficiency (main heating system 1) | 270.3552 | 270.3552 | 270.3552 | 270.3552 | 270.3552 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 270.3552 | 270.3552 | 270.3552 | (210) |
| Space heating fuel (main heating system) | 103.0842 | 75.6485 | 58.3539 | 30.0234 | 11.5206 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 32.5777 | 71.5085 | 108.6952 | (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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water heating requirement | 139.0190 | 122.3918 | 128.2084 | 114.4727 | 111.8481 | 99.4642 | 95.0718 | 104.9477 | 104.9580 | 118.7240 | 126.1139 | 135.5199 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 186.5800 | (216) |
| (217)m | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | (217) |
| Fuel for water heating, kWh/month | 74.5091 | 65.5975 | 68.7150 | 61.3531 | 59.9464 | 53.3091 | 50.9550 | 56.2481 | 56.2536 | 63.6317 | 67.5924 | 72.6337 | (219) |

| | | |
|---|---|---|
| Water heating fuel used | 750.7447 | (219) |
| Annual totals kWh/year | | |
| Space heating fuel - main system | 491.4120 | (211) |
| Space heating fuel - secondary | 0.0000 | (215) |
| Electricity for pumps and fans: | | |
| (MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.8450) | | |
| mechanical ventilation fans (SFP = 0.8450) | 125.7003 | (230a) |
| Total electricity for the above, kWh/year | 125.7003 | (231) |
| Electricity for lighting (calculated in Appendix L) | 193.6937 | (232) |
| Total delivered energy for all uses | 1561.5507 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 491.4120 | 0.5190 | 255.0428 | (261) |
| Space heating - secondary | 0.0000 | 0.5190 | 0.0000 | (263) |
| Water heating (other fuel) | 750.7447 | 0.5190 | 389.6365 | (264) |
| Space and water heating | | | 644.6793 | (265) |
| Pumps and fans | 125.7003 | 0.5190 | 65.2385 | (267) |
| Energy for lighting | 193.6937 | 0.5190 | 100.5270 | (268) |
| Total CO2, kg/year | | | 810.4448 | (272) |
| Dwelling Carbon Dioxide Emission Rate (DER) | | | 19.9600 | (273) |

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

| | | | |
|---|---|---|---|
| DER | | 19.9600 | ZC1 |
| Total Floor Area | TFA | 40.6000 | |
| Assumed number of occupants | N | 1.4224 | |
| CO2 emission factor in Table 12 for electricity displaced from grid | EF | 0.5190 | |
| CO2 emissions from appliances, equation (L14) | | 17.9591 | ZC2 |
| CO2 emissions from cooking, equation (L16) | | 3.7718 | ZC3 |
| Total CO2 emissions | | 41.6910 | 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 | | 41.6910 | ZC8 |

## 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 (m2) | | Storey height (m) | | Volume (m3) | |
|---|---|---|---|---|---|---|
| Ground floor | 40.6000 (1b) | x | 2.5000 (2b) | = | 101.5000 | (1b) - (3b) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 40.6000 | | | | | (4) |
| Dwelling volume | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = | 101.5000 | (5) |

### 2. Ventilation rate

| | main heating | | secondary 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 | | | | | | | 2 * 10 = | 20.0000 | (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) = | 20.0000 / (5) = | 0.1970 | (8) |
| Pressure test | | Yes | |
| Measured/design AP50 | | 5.0000 | |
| Infiltration rate | | 0.4470 | (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) = | 0.3800 | (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 | 0.4845 | 0.4750 | 0.4655 | 0.4180 | 0.4085 | 0.3610 | 0.3610 | 0.3515 | 0.3800 | 0.4085 | 0.4275 | 0.4465 | (22b) |
| Effective ac | 0.6174 | 0.6128 | 0.6083 | 0.5874 | 0.5834 | 0.5652 | 0.5652 | 0.5618 | 0.5722 | 0.5834 | 0.5914 | 0.5997 | (25) |

### 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| TER Opaque door | | | 2.1000 | 1.0000 | 2.1000 | | | (26) |
| TER Opening Type (Uw = 1.40) | | | 8.0500 | 1.3258 | 10.6723 | | | (27) |
| External Wall | 48.0000 | 8.0500 | 39.9500 | 0.1800 | 7.1910 | | | (29a) |
| Sheltered Wall | 17.2500 | 2.1000 | 15.1500 | 0.1800 | 2.7270 | | | (29a) |
| Total net area of external elements Aum(A, m2) | | | 65.2500 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 22.6903 | | | (33) |

| | | | |
|---|---|---|---|
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 250.0000 | (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 2.1200 | (36) |
| Total fabric heat loss | (33) + (36) = | 24.8103 | (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 | 20.6786 | 20.5259 | 20.3763 | 19.6735 | 19.5420 | 18.9299 | 18.9299 | 18.8166 | 19.1657 | 19.5420 | 19.8080 | 20.0861 | (38) |
| Heat transfer coeff | 45.4889 | 45.3363 | 45.1866 | 44.4838 | 44.3524 | 43.7403 | 43.7403 | 43.6269 | 43.9760 | 44.3524 | 44.6184 | 44.8965 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 44.4832 | (39) |
| HLP | 1.1204 | 1.1167 | 1.1130 | 1.0957 | 1.0924 | 1.0773 | 1.0773 | 1.0746 | 1.0832 | 1.0924 | 1.0990 | 1.1058 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0956 | (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 | 1.4224 | (42) |
| Average daily hot water use (litres/day) | 67.9814 | (43) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily hot water use | 74.7795 | 72.0602 | 69.3410 | 66.6217 | 63.9025 | 61.1832 | 61.1832 | 63.9025 | 66.6217 | 69.3410 | 72.0602 | 74.7795 | (44) |
| Energy conte | 110.8958 | 96.9902 | 100.0852 | 87.2567 | 83.7249 | 72.2482 | 66.9486 | 76.8245 | 77.7420 | 90.6008 | 98.8979 | 107.3967 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1069.6114 | (45) |
| Distribution loss (46)m = 0.15 x (45)m | 16.6344 | 14.5485 | 15.0128 | 13.0885 | 12.5587 | 10.8372 | 10.0423 | 11.5237 | 11.6613 | 13.5901 | 14.8347 | 16.1095 | (46) |

Water storage loss:

| | | |
|---|---|---|
| Store volume | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | 1.3938 | (48) |
| Temperature factor from Table 2b | 0.5400 | (49) |
| Enter (49) or (54) in (55) | 0.7527 | (55) |
| Total storage loss | | |

## CALCULATION OF TARGET EMISSIONS 09 Jan 2014

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (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 | | | | | | | | | | | | | |
| | 157.4907 | 139.0759 | 146.6801 | 132.3485 | 130.3198 | 117.3400 | 113.5435 | 123.4194 | 122.8338 | 137.1957 | 143.9897 | 153.9916 | (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 | | | | | | | | | | | | | |
| | 157.4907 | 139.0759 | 146.6801 | 132.3485 | 130.3198 | 117.3400 | 113.5435 | 123.4194 | 122.8338 | 137.1957 | 143.9897 | 153.9916 | (64) |
| | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | | 1618.2288 | (64) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 74.1488 | 65.9178 | 70.5542 | 65.0863 | 65.1144 | 60.0960 | 59.5363 | 62.8201 | 61.9227 | 67.4007 | 68.9570 | 72.9853 | (65) |

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

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Metabolic gains (Table 5), Watts

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (66)m | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | 71.1186 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 11.0571 | 9.8208 | 7.9868 | 6.0465 | 4.5199 | 3.8159 | 4.1232 | 5.3594 | 7.1934 | 9.1337 | 10.6604 | 11.3644 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 123.0453 | 124.3222 | 121.1046 | 114.2548 | 105.6082 | 97.4815 | 92.0524 | 90.7756 | 93.9932 | 100.8430 | 109.4896 | 117.6163 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | 30.1119 | (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) | | | | | | | | | | | | | |
| | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | -56.8949 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 99.6623 | 98.0920 | 94.8310 | 90.3977 | 87.5194 | 83.4667 | 80.0219 | 84.4356 | 86.0037 | 90.5923 | 95.7736 | 98.0985 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 281.1004 | 279.5706 | 271.2580 | 258.0346 | 244.9830 | 232.0997 | 223.5332 | 227.9062 | 234.5260 | 247.9046 | 263.2593 | 274.4148 | (73) |

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6. Solar gains

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| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 4.9100 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 15.9560 | (74) |
| South | 3.1400 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 44.8644 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 60.8205 | 103.9692 | 145.4106 | 189.0114 | 222.3485 | 226.1073 | 215.7076 | 189.5621 | 160.0701 | 115.5489 | 72.8635 | 52.0688 | (83) |
| Total gains | 341.9209 | 383.5398 | 416.6686 | 447.0461 | 467.3316 | 458.2069 | 439.2407 | 417.4683 | 394.5960 | 363.4535 | 336.1228 | 326.4836 | (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 | 61.9809 | 62.1896 | 62.3955 | 63.3813 | 63.5692 | 64.4588 | 64.4588 | 64.6263 | 64.1132 | 63.5692 | 63.1902 | 62.7988 | |
| alpha | 5.1321 | 5.1460 | 5.1597 | 5.2254 | 5.2379 | 5.2973 | 5.2973 | 5.3084 | 5.2742 | 5.2379 | 5.2127 | 5.1866 | |
| util living area | | | | | | | | | | | | | |
| | 0.9908 | 0.9824 | 0.9625 | 0.9063 | 0.7831 | 0.5926 | 0.4350 | 0.4756 | 0.7139 | 0.9214 | 0.9808 | 0.9926 | (86) |
| MIT | 20.0211 | 20.1781 | 20.4080 | 20.6890 | 20.8912 | 20.9803 | 20.9968 | 20.9949 | 20.9491 | 20.7045 | 20.3216 | 19.9968 | (87) |
| Th 2 | 20.4398 | 20.4417 | 20.4435 | 20.4522 | 20.4538 | 20.4613 | 20.4613 | 20.4627 | 20.4584 | 20.4538 | 20.4505 | 20.4471 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9893 | 0.9796 | 0.9565 | 0.8917 | 0.7531 | 0.5478 | 0.3830 | 0.4220 | 0.6707 | 0.9062 | 0.9773 | 0.9914 | (89) |
| MIT 2 | 19.5190 | 19.6762 | 19.9043 | 20.1829 | 20.3689 | 20.4488 | 20.4598 | 20.4602 | 20.4234 | 20.2021 | 19.8266 | 19.5009 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.8670 | (91) |
| MIT | 19.9543 | 20.1114 | 20.3410 | 20.6217 | 20.8218 | 20.9096 | 20.9254 | 20.9238 | 20.8792 | 20.6377 | 20.2558 | 19.9308 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.6000 | |
| adjusted MIT | 20.5543 | 20.7114 | 20.9410 | 21.2217 | 21.4218 | 21.5096 | 21.5254 | 21.5238 | 21.4792 | 21.2377 | 20.8558 | 20.5308 | (93) |

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8. Space heating requirement

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| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9896 | 0.9810 | 0.9619 | 0.9116 | 0.8041 | 0.6329 | 0.4847 | 0.5262 | 0.7487 | 0.9271 | 0.9799 | 0.9916 | (94) |
| Useful gains | 338.3790 | 376.2461 | 400.7845 | 407.5184 | 375.7697 | 289.9891 | 212.8864 | 219.6917 | 295.4354 | 336.9718 | 329.3730 | 323.7389 | (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 | | | | | | | | | | | | | |
| | 739.3918 | 716.8283 | 652.5423 | 548.1167 | 431.1832 | 302.2298 | 215.4363 | 223.5363 | 324.5085 | 471.8071 | 613.7609 | 733.1965 | (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 | | | | | | | | | | | | | |
| | 298.3535 | 228.8712 | 187.3078 | 101.2308 | 41.2276 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.3175 | 204.7593 | 304.6365 | (98) |
| Space heating | | | | | | | | | | | | 1466.7042 | (98) |
| Space heating per m2 | | | | | | | | | | | (98) / (4) = | 36.1257 | (99) |

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8c. Space cooling requirement

---

Not applicable

## 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 | 1657.2929 | (211) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 298.3535 | 228.8712 | 187.3078 | 101.2308 | 41.2276 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 100.3175 | 204.7593 | 304.6365 | (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) | 337.1226 | 258.6116 | 211.6472 | 114.3851 | 46.5849 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 113.3531 | 231.3664 | 344.2220 | (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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water heating requirement | 157.4907 | 139.0759 | 146.6801 | 132.3485 | 130.3198 | 117.3400 | 113.5435 | 123.4194 | 122.8338 | 137.1957 | 143.9897 | 153.9916 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 74.8000 | (216) |
| (217)m | 81.4734 | 81.1142 | 80.4461 | 79.0896 | 77.1195 | 74.8000 | 74.8000 | 74.8000 | 74.8000 | 78.9744 | 80.7319 | 81.5816 | (217) |
| Fuel for water heating, kWh/month | 193.3032 | 171.4569 | 182.3334 | 167.3400 | 168.9843 | 156.8717 | 151.7961 | 164.9992 | 164.2164 | 173.7218 | 178.3554 | 188.7578 | (219) |

| | | |
|---|---|---|
| Water heating fuel used | 2062.1362 | (219) |
| Annual totals kWh/year | | |
| Space heating fuel - main system | 1657.2929 | (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) | 195.2718 | (232) |
| Total delivered energy for all uses | 3998.7009 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1657.2929 | 0.2160 | 357.9753 | (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 | (263) |
| Water heating (other fuel) | 2062.1362 | 0.2160 | 445.4214 | (264) |
| Space and water heating | | | 803.3967 | (265) |
| Pumps and fans | 84.0000 | 0.5190 | 43.5960 | (267) |
| Energy for lighting | 195.2718 | 0.5190 | 101.3461 | (268) |
| Total CO2, kg/m2/year | | | 948.3388 | (272) |
| Emissions per m2 for space and water heating | | | 19.7881 | (272a) |
| Fuel factor (electricity) | | | 1.5500 | |
| Emissions per m2 for lighting | | | 2.4962 | (272b) |
| Emissions per m2 for pumps and fans | | | 1.0738 | (272c) |
| Target Carbon Dioxide Emission Rate (TER) = (19.7881 * 1.55) + 2.4962 + 1.0738, rounded to 2 d.p. | | | 34.2400 | (273) |

# FULL SAP CALCULATION PRINTOUT
## Calculation Type: New Build (As Designed)

Doherty Energy

| | | | |
|---|---|---|---|
| **Property Reference** | E1052-05 | **Issued on Date** | 12/01/2021 |
| **Assessment Reference** | E1052-05-ASHP | **Prop Type Ref** | |
| **Property** | Flat 5, Alliance House, 29 High Holborn, London, WC1V 6AZ | | |

| | | | | | |
|---|---|---|---|---|---|
| **SAP Rating** | 86 B | **DER** | 16.24 | **TER** | 26.59 |
| **Environmental** | 87 B | **% DER<TER** | 38.92 | | |
| **$CO_2$ Emissions (t/year)** | 1.10 | **DFEE** | 40.34 | **TFEE** | 52.85 |
| **General Requirements Compliance** | Pass | **% DFEE<TFEE** | 23.67 | | |

| | | | |
|---|---|---|---|
| **Assessor Details** | Mr. Jason Doherty, Doherty Energy Limited, Tel: 01480451569, jason@doherty-energy.co.uk | **Assessor ID** | L143-0001 |
| **Client** | | | |

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

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

DWELLING AS DESIGNED

Top-floor flat, total floor area 81 m²

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:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 26.59 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.24 kgCO□/m²OK
----------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)52.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)40.3 kWh/m²/yrOK
----------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                Highest
External wall   0.19 (max. 0.30)       0.19 (max. 0.70)         OK
Floor           (no floor)
Roof            0.09 (max. 0.20)       0.09 (max. 0.35)         OK
Openings        1.08 (max. 2.00)       1.20 (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:                   Heat pump with radiators or underfloor - Electric
NIBE F205P


Secondary heating system:              None
----------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                      No cylinder
----------------------------------------------------------------------------------------------------
6 Controls
Space heating controls:                Programmer and room thermostat                   OK


Hot water controls:                    No cylinder


----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                                75%                                              OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous extract system
Specific fan power:                    0.65
Maximum                                0.7                                              OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):      Slight                                           OK
Based on:
Overshading:                           Average
Windows facing North:                  11.18 m², No overhang
Windows facing South:                  7.14 m², No overhang
Air change rate:                       3.00 ach
Blinds/curtains:                       Light-coloured curtain or roller blind, closed 100% of daylight hours
----------------------------------------------------------------------------------------------------
10 Key features
Roof U-value                           0.09 W/m²K
Door U-value                           0.55 W/m²K
Thermal bridging y-value               0.037 W/m²K
Air permeability                       3.0 m³/m²h



----------------------------------------------------------------------------------------------------
```

## 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 (m2) | | | Storey height (m) | | | Volume (m3) | |
|---|---|---|---|---|---|---|---|---|
| Ground floor | 40.6000 | (1b) | x | 2.7000 | (2b) | = | 109.6200 | (1b) - (3b) |
| First floor | 40.6000 | (1c) | x | 2.5000 | (2c) | = | 101.5000 | (1c) - (3c) |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 81.2000 | | | | | | | | (4) |
| Dwelling volume | | | | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | | = | 211.1200 | (5) |

### 2. Ventilation rate

| | main heating | | secondary 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 | | 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) |

Mechanical extract ventilation - centralised

| | | |
|---|---|---|
| If mechanical ventilation: | 0.5000 | (23a) |
| If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) | 0.5000 | (23b) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Effective ac | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | 0.5000 | (25) |

### 3. Heat losses and heat loss parameter

| Element | Gross m2 | Openings m2 | NetArea m2 | U-value W/m2K | A x U W/K | K-value kJ/m2K | A x K kJ/K | |
|---|---|---|---|---|---|---|---|---|
| Window (Uw = 1.20) | | | 18.3200 | 1.1450 | 20.9771 | | | (27) |
| Door | | | 4.2000 | 0.5500 | 2.3100 | | | (26) |
| External Wall | 99.8400 | 18.3200 | 81.5200 | 0.1900 | 15.4888 | 60.0000 | 4891.2000 | (29a) |
| Sheltered Wall | 25.8800 | 4.2000 | 21.6800 | 0.1800 | 3.9024 | 60.0000 | 1300.8000 | (29a) |
| External Roof 1 | 40.6000 | | 40.6000 | 0.0900 | 3.6540 | 9.0000 | 365.4000 | (30) |
| Total net area of external elements Aum(A, m2) | | | 166.3200 | | | | | (31) |
| Fabric heat loss, W/K = Sum (A x U) | | | (26)...(30) + (32) = | | 46.3323 | | | (33) |
| Party Floor 1 | | | 40.6000 | | | 40.0000 | 1624.0000 | (32d) |
| Internal Wall 1 | | | 22.5000 | | | 9.0000 | 202.5000 | (32c) |
| Internal Floor 1 | | | 40.6000 | | | 18.0000 | 730.8000 | (32d) |
| Internal Ceiling 1 | | | 40.6000 | | | 18.0000 | 730.8000 | (32e) |

| | | | |
|---|---|---|---|
| Heat capacity Cm = Sum(A x k) | (28)...(30) + (32) + (32a)...(32e) = | 9845.5000 | (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K | | 121.2500 | (35) |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K) | | 6.1570 | (36) |
| Total fabric heat loss | (33) + (36) = | 52.4893 | (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 | 34.8348 | 34.8348 | 34.8348 | 34.8348 | 34.8348 | 34.8348 | 34.8348 | 34.8348 | 34.8348 | 34.8348 | 34.8348 | 34.8348 | (38) |
| Heat transfer coeff | 87.3241 | 87.3241 | 87.3241 | 87.3241 | 87.3241 | 87.3241 | 87.3241 | 87.3241 | 87.3241 | 87.3241 | 87.3241 | 87.3241 | (39) |
| Average = Sum(39)m / 12 = | | | | | | | | | | | | 87.3241 | (39) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HLP | 1.0754 | 1.0754 | 1.0754 | 1.0754 | 1.0754 | 1.0754 | 1.0754 | 1.0754 | 1.0754 | 1.0754 | 1.0754 | 1.0754 | (40) |
| HLP (average) | | | | | | | | | | | | 1.0754 | (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 | 2.4852 | (42) |
| Average daily hot water use (litres/day) | 93.2243 | (43) |

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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 102.5468 | 98.8178 | 95.0888 | 91.3599 | 87.6309 | 83.9019 | 83.9019 | 87.6309 | 91.3599 | 95.0888 | 98.8178 | 102.5468 | (44) |
| Energy conte | 152.0739 | 133.0048 | 137.2491 | 119.6571 | 114.8138 | 99.0756 | 91.8081 | 105.3511 | 106.6093 | 124.2429 | 135.6208 | 147.2755 | (45) |
| Energy content (annual) | | | | | | | | | | Total = Sum(45)m = | | 1466.7819 | (45) |
| Distribution loss (46)m = 0.15 x (45)m | | | | | | | | | | | | | |
| | 22.8111 | 19.9507 | 20.5874 | 17.9486 | 17.2221 | 14.8613 | 13.7712 | 15.8027 | 15.9914 | 18.6364 | 20.3431 | 22.0913 | (46) |
| Water storage loss: | | | | | | | | | | | | | |
| Store volume | | | | | | | | | | | | 150.0000 | (47) |
| a) If manufacturer declared loss factor is known (kWh/day): | | | | | | | | | | | | 1.6800 | (48) |
| Temperature factor from Table 2b | | | | | | | | | | | | 0.5400 | (49) |
| Enter (49) or (54) in (55) | | | | | | | | | | | | 0.9072 | (55) |
| Total storage loss | | | | | | | | | | | | | |
| | 28.1232 | 25.4016 | 28.1232 | 27.2160 | 28.1232 | 27.2160 | 28.1232 | 28.1232 | 27.2160 | 28.1232 | 27.2160 | 28.1232 | (56) |
| If cylinder contains dedicated solar storage | | | | | | | | | | | | | |
| | 28.1232 | 25.4016 | 28.1232 | 27.2160 | 28.1232 | 27.2160 | 28.1232 | 28.1232 | 27.2160 | 28.1232 | 27.2160 | 28.1232 | (57) |
| Primary loss | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | (59) |
| Total heat required for water heating calculated for each month | | | | | | | | | | | | | |
| | 180.1971 | 158.4064 | 165.3723 | 146.8731 | 142.9370 | 126.2916 | 119.9313 | 133.4743 | 133.8253 | 152.3661 | 162.8368 | 175.3987 | (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 | | | | | | | | | | | | | |
| | 180.1971 | 158.4064 | 165.3723 | 146.8731 | 142.9370 | 126.2916 | 119.9313 | 133.4743 | 133.8253 | 152.3661 | 162.8368 | 175.3987 | (64) |
| | | | | | | | | Total per year (kWh/year) = Sum(64)m = | | | | 1797.9099 | (64) |
| Heat gains from water heating, kWh/month | | | | | | | | | | | | | |
| | 50.5646 | 44.2241 | 45.6353 | 39.7860 | 38.1756 | 32.9426 | 30.5262 | 35.0292 | 35.4476 | 41.3108 | 45.0939 | 48.9691 | (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 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | | | | | | | | | | | | | |
| | 19.7819 | 17.5701 | 14.2890 | 10.8177 | 8.0863 | 6.8268 | 7.3766 | 9.5884 | 12.8696 | 16.3409 | 19.0722 | 20.3317 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | | | | | | | | | | | | | |
| | 221.9302 | 224.2332 | 218.4298 | 206.0752 | 190.4797 | 175.8222 | 166.0300 | 163.7271 | 169.5304 | 181.8850 | 197.4805 | 212.1381 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | | | | | | | | | | | | | |
| | 35.4262 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | (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) | | | | | | | | | | | | | |
| | -99.4094 | -99.4094 | -99.4094 | -99.4094 | -99.4094 | -99.4094 | -99.4094 | -99.4094 | -99.4094 | -99.4094 | -99.4094 | -99.4094 | (71) |
| Water heating gains (Table 5) | | | | | | | | | | | | | |
| | 67.9631 | 65.8097 | 61.3378 | 55.2583 | 51.3113 | 45.7536 | 41.0298 | 47.0823 | 49.2328 | 55.5252 | 62.6305 | 65.8187 | (72) |
| Total internal gains | | | | | | | | | | | | | |
| | 369.9538 | 367.8915 | 354.3351 | 332.4297 | 310.1559 | 288.6812 | 274.7150 | 280.6763 | 291.9113 | 314.0297 | 339.4617 | 358.5670 | (73) |

---

6. Solar gains

---

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 11.1800 | 10.6334 | 0.7200 | 0.7000 | 0.7700 | 41.5219 | (74) |
| South | 7.1400 | 46.7521 | 0.7200 | 0.7000 | 0.7700 | 116.5904 | (78) |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 158.1123 | 270.2955 | 378.0660 | 491.4839 | 578.2202 | 588.0161 | 560.9620 | 492.9349 | 416.1990 | 300.4085 | 189.4220 | 135.3596 | (83) |
| Total gains | 528.0661 | 638.1870 | 732.4011 | 823.9136 | 888.3761 | 876.6973 | 835.6770 | 773.6113 | 708.1103 | 614.4382 | 528.8837 | 493.9265 | (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 | 31.3185 | 31.3185 | 31.3185 | 31.3185 | 31.3185 | 31.3185 | 31.3185 | 31.3185 | 31.3185 | 31.3185 | 31.3185 | 31.3185 | |
| alpha | 3.0879 | 3.0879 | 3.0879 | 3.0879 | 3.0879 | 3.0879 | 3.0879 | 3.0879 | 3.0879 | 3.0879 | 3.0879 | 3.0879 | |
| util living area | | | | | | | | | | | | | |
| | 0.9719 | 0.9504 | 0.9130 | 0.8399 | 0.7205 | 0.5691 | 0.4362 | 0.4838 | 0.6914 | 0.8786 | 0.9551 | 0.9767 | (86) |
| Tweekday | 18.4125 | 18.7414 | 19.1950 | 19.7123 | 20.1284 | 20.3586 | 20.4338 | 20.4212 | 20.2573 | 19.7109 | 18.9488 | 18.3231 | |
| Tweekend | 19.7801 | 19.9682 | 20.2287 | 20.5294 | 20.7779 | 20.9226 | 20.9746 | 20.9646 | 20.8542 | 20.5246 | 20.0853 | 19.7291 | |
| 24 / 16 | 9 | 8 | 9 | 8 | 9 | 9 | 9 | 9 | 8 | 9 | 8 | 9 | |
| 24 / 9 | 22 | 20 | 22 | 22 | 22 | 21 | 22 | 22 | 22 | 22 | 22 | 22 | |
| 16 / 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| MIT | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | 21.0000 | (87) |
| Th 2 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | (88) |
| util rest of house | | | | | | | | | | | | | |
| | 0.9694 | 0.9461 | 0.9055 | 0.8260 | 0.6964 | 0.5320 | 0.3886 | 0.4352 | 0.6576 | 0.8650 | 0.9506 | 0.9747 | (89) |
| Tweekday | 18.4125 | 18.7414 | 19.1950 | 19.7123 | 20.1284 | 20.3586 | 20.4338 | 20.4212 | 20.2573 | 19.7109 | 18.9488 | 18.3231 | |
| Tweekend | 19.3013 | 19.4876 | 19.7445 | 20.0375 | 20.2732 | 20.4036 | 20.4461 | 20.4390 | 20.3462 | 20.0367 | 19.6051 | 19.2507 | |
| MIT 2 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | 20.4623 | (90) |
| Living area fraction | | | | | | | | | fLA = Living area / (4) = | | | 0.4089 | (91) |
| MIT | 20.6821 | 20.6821 | 20.6821 | 20.6821 | 20.6821 | 20.6821 | 20.6821 | 20.6821 | 20.6821 | 20.6821 | 20.6821 | 20.6821 | (92) |
| Temperature adjustment | | | | | | | | | | | | 0.0000 | |
| adjusted MIT | 20.6821 | 20.6821 | 20.6821 | 20.6821 | 20.6821 | 20.6821 | 20.6821 | 20.6821 | 20.6821 | 20.6821 | 20.6821 | 20.6821 | (93) |

---

8. Space heating requirement

---

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9704 | 0.9479 | 0.9086 | 0.8319 | 0.7065 | 0.5475 | 0.4084 | 0.4555 | 0.6718 | 0.8708 | 0.9525 | 0.9755 | (94) |
| Useful gains | 512.4497 | 604.9598 | 665.4795 | 685.3985 | 627.6413 | 479.9837 | 341.2819 | 352.3630 | 475.7362 | 535.0606 | 503.7549 | 481.8388 | (95) |

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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 | 1430.5558 | 1378.1613 | 1238.4428 | 1028.8649 | 784.3574 | 531.1176 | 356.4694 | 373.9342 | 574.7796 | 880.4140 | 1186.0483 | 1439.2882 | (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 | 683.0709 | 519.5914 | 426.2847 | 247.2958 | 116.5968 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 256.9429 | 491.2512 | 712.3424 | (98) |

| | | | |
|---|---|---|---|
| Space heating | | 3453.3761 | (98) |
| Space heating per m2 | (98) / (4) = | 42.5293 | (99) |

---

8c. Space cooling requirement

---

Not applicable

---

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 %) | 305.6515 | (206) |
| Efficiency of secondary/supplementary heating system, % | 100.0000 | (208) |
| Space heating requirement | 1129.8411 | (211) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 683.0709 | 519.5914 | 426.2847 | 247.2958 | 116.5968 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 256.9429 | 491.2512 | 712.3424 | (98) |
| Space heating efficiency (main heating system 1) | 305.6515 | 305.6515 | 305.6515 | 305.6515 | 305.6515 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 305.6515 | 305.6515 | 305.6515 | (210) |
| Space heating fuel (main heating system) | 223.4803 | 169.9947 | 139.4676 | 80.9078 | 38.1470 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 84.0640 | 160.7227 | 233.0571 | (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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water heating requirement | 180.1971 | 158.4064 | 165.3723 | 146.8731 | 142.9370 | 126.2916 | 119.9313 | 133.4743 | 133.8253 | 152.3661 | 162.8368 | 175.3987 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 186.5800 | (216) |
| (217)m | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | 186.5800 | (217) |
| Fuel for water heating, kWh/month | 96.5790 | 84.9000 | 88.6334 | 78.7185 | 76.6090 | 67.6876 | 64.2787 | 71.5373 | 71.7254 | 81.6626 | 87.2745 | 94.0072 | (219) |

| | | |
|---|---|---|
| Water heating fuel used | 963.6134 | (219) |
| Annual totals kWh/year | | |
| Space heating fuel - main system | 1129.8411 | (211) |
| Space heating fuel - secondary | 0.0000 | (215) |

Electricity for pumps and fans:
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.8450)

| | | |
|---|---|---|
| mechanical ventilation fans (SFP = 0.8450) | 98.3906 | (230a) |
| Total electricity for the above, kWh/year | 98.3906 | (231) |
| Electricity for lighting (calculated in Appendix L) | 349.3548 | (232) |
| Total delivered energy for all uses | 2541.2000 | (238) |

---

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

---

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 1129.8411 | 0.5190 | 586.3876 | (261) |
| Space heating - secondary | 0.0000 | 0.5190 | 0.0000 | (263) |
| Water heating (other fuel) | 963.6134 | 0.5190 | 500.1154 | (264) |
| Space and water heating | | | 1086.5029 | (265) |
| Pumps and fans | 98.3906 | 0.5190 | 51.0647 | (267) |
| Energy for lighting | 349.3548 | 0.5190 | 181.3152 | (268) |
| Total CO2, kg/year | | | 1318.8828 | (272) |
| Dwelling Carbon Dioxide Emission Rate (DER) | | | 16.2400 | (273) |

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

| | | | |
|---|---|---|---|
| DER | | 16.2400 | ZC1 |
| Total Floor Area | TFA | 81.2000 | |
| Assumed number of occupants | N | 2.4852 | |
| CO2 emission factor in Table 12 for electricity displaced from grid | EF | 0.5190 | |
| CO2 emissions from appliances, equation (L14) | | 16.1960 | ZC2 |
| CO2 emissions from cooking, equation (L16) | | 2.2001 | ZC3 |
| Total CO2 emissions | | 34.6360 | 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 | | 34.6360 | 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          Storey height              Volume
                                                                                (m2)               (m)                    (m3)
Ground floor                                                                 40.6000 (1b)    x       2.7000 (2b)     =     109.6200 (1b) - (3b)
First floor                                                                  40.6000 (1c)    x       2.5000 (2c)     =     101.5000 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)              81.2000                                                        (4)
Dwelling volume                                                                    (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =     211.1200 (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                                                                                            3 * 10 =     30.0000 (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) =                                  30.0000 / (5) =      0.1421 (8)
Pressure test                                                                                                                         Yes
Measured/design AP50                                                                                                               5.0000
Infiltration rate                                                                                                                  0.3921 (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)  =      0.3333 (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
                 0.4249     0.4166     0.4083     0.3666     0.3583     0.3166     0.3166     0.3083     0.3333     0.3583     0.3749     0.3916 (22b)
Effective ac     0.5903     0.5868     0.5833     0.5672     0.5642     0.5501     0.5501     0.5475     0.5555     0.5642     0.5703     0.5767 (25)


------------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
------------------------------------------------------------------------------------------------------
Element                                       Gross        Openings        NetArea       U-value          A x U        K-value          A x K
                                                 m2              m2             m2         W/m2K            W/K         kJ/m2K           kJ/K
TER Opaque door                                                             4.2000        1.0000         4.2000                                (26)
TER Opening Type (Uw = 1.40)                                               16.1000        1.3258        21.3447                                (27)
External Wall                               99.8400         16.1000        83.7400        0.1800        15.0732                                (29a)
Sheltered Wall                              25.8800          4.2000        21.6800        0.1800         3.9024                                (29a)
External Roof 1                             40.6000                        40.6000        0.1300         5.2780                                (30)
Total net area of external elements Aum(A, m2)                            166.3200                                                             (31)
Fabric heat loss, W/K = Sum (A x U)                                         (26)...(30) + (32) =         49.7983                                (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                   250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                            4.3940 (36)
Total fabric heat loss                                                                                           (33) + (36) =      54.1923 (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           41.1250    40.8807    40.6413    39.5168    39.3064    38.3269    38.3269    38.1456    38.7042    39.3064    39.7320    40.1770 (38)
Heat transfer coeff
                95.3173    95.0730    94.8336    93.7091    93.4987    92.5192    92.5192    92.3378    92.8965    93.4987    93.9243    94.3693 (39)
Average = Sum(39)m / 12 =                                                                                                                93.7081 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              1.1739     1.1709     1.1679     1.1541     1.1515     1.1394     1.1394     1.1372     1.1440     1.1515     1.1567     1.1622 (40)
HLP (average)                                                                                                                              1.1540 (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                                                                                                                          2.4852 (42)
Average daily hot water use (litres/day)                                                                                                  93.2243 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
               102.5468    98.8178    95.0888    91.3599    87.6309    83.9019    83.9019    87.6309    91.3599    95.0888    98.8178   102.5468 (44)
Energy conte   152.0739   133.0048   137.2491   119.6571   114.8138    99.0756    91.8081   105.3511   106.6093   124.2429   135.6208   147.2755 (45)
Energy content (annual)                                                                                       Total = Sum(45)m =    1466.7819 (45)
Distribution loss  (46)m = 0.15 x (45)m
                22.8111    19.9507    20.5874    17.9486    17.2221    14.8613    13.7712    15.8027    15.9914    18.6364    20.3431    22.0913 (46)
Water storage loss:
Store volume                                                                                                                             150.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                              1.3938 (48)
  Temperature factor from Table 2b                                                                                                         0.5400 (49)
```

## CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Enter (49) or (54) in (55) 0.7527 (55)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total storage loss | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (56) |
| If cylinder contains dedicated solar storage | 23.3325 | 21.0745 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | 23.3325 | 22.5798 | 23.3325 | 22.5798 | 23.3325 | (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 | 198.6688 | 175.0905 | 183.8440 | 164.7489 | 161.4087 | 144.1674 | 138.4030 | 151.9460 | 151.7012 | 170.8378 | 180.7127 | 193.8704 | (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)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Output from w/h | 198.6688 | 175.0905 | 183.8440 | 164.7489 | 161.4087 | 144.1674 | 138.4030 | 151.9460 | 151.7012 | 170.8378 | 180.7127 | 193.8704 | (64) |

Total per year (kWh/year) = Sum(64)m = 2015.3993 (64)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Heat gains from water heating, kWh/month | 87.8405 | 77.8927 | 82.9112 | 75.8594 | 75.4515 | 69.0161 | 67.8021 | 72.3052 | 71.5211 | 78.5867 | 81.1674 | 86.2450 | (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 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | 124.2618 | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5 | 19.9431 | 17.7133 | 14.4054 | 10.9058 | 8.1522 | 6.8825 | 7.4367 | 9.6665 | 12.9744 | 16.4740 | 19.2276 | 20.4974 | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 221.9302 | 224.2332 | 218.4298 | 206.0752 | 190.4797 | 175.8222 | 166.0300 | 163.7271 | 169.5304 | 181.8850 | 197.4805 | 212.1381 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | 35.4262 | (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) | -99.4094 | -99.4094 | -99.4094 | -99.4094 | -99.4094 | -99.4094 | -99.4094 | -99.4094 | -99.4094 | -99.4094 | -99.4094 | -99.4094 | (71) |
| Water heating gains (Table 5) | 118.0652 | 115.9117 | 111.4398 | 105.3603 | 101.4133 | 95.8557 | 91.1319 | 97.1844 | 99.3348 | 105.6273 | 112.7325 | 115.9207 | (72) |
| Total internal gains | 423.2170 | 421.1367 | 407.5536 | 385.6199 | 363.3238 | 341.8388 | 327.8771 | 333.8565 | 345.1182 | 367.2648 | 392.7192 | 411.8347 | (73) |

### 6. Solar gains

| [Jan] | Area m2 | Solar flux Table 6a W/m2 | g Specific data or Table 6b | FF Specific data or Table 6c | Access factor Table 6d | Gains W | |
|---|---|---|---|---|---|---|---|
| North | 9.8300 | 10.6334 | 0.6300 | 0.7000 | 0.7700 | 31.9446 | (74) |
| South | 6.2700 | 46.7521 | 0.6300 | 0.7000 | 0.7700 | 89.5860 | (78) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar gains | 121.5306 | 207.7665 | 290.6287 | 377.8555 | 444.5744 | 452.1211 | 431.3133 | 378.9846 | 319.9556 | 230.9193 | 145.5977 | 104.0411 | (83) |
| Total gains | 544.7476 | 628.9032 | 698.1823 | 763.4754 | 807.8982 | 793.9600 | 759.1905 | 712.8412 | 665.0738 | 598.1842 | 538.3169 | 515.8758 | (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 | 59.1591 | 59.3111 | 59.4609 | 60.1744 | 60.3098 | 60.9483 | 60.9483 | 61.0680 | 60.7008 | 60.3098 | 60.0365 | 59.7534 | |
| alpha | 4.9439 | 4.9541 | 4.9641 | 5.0116 | 5.0207 | 5.0632 | 5.0632 | 5.0712 | 5.0467 | 5.0207 | 5.0024 | 4.9836 | |
| util living area | 0.9967 | 0.9928 | 0.9827 | 0.9504 | 0.8630 | 0.6941 | 0.5254 | 0.5776 | 0.8189 | 0.9645 | 0.9930 | 0.9975 | (86) |
| MIT | 19.7922 | 19.9557 | 20.2057 | 20.5281 | 20.8007 | 20.9525 | 20.9905 | 20.9849 | 20.8884 | 20.5428 | 20.1093 | 19.7642 | (87) |
| Th 2 | 19.9410 | 19.9434 | 19.9458 | 19.9569 | 19.9590 | 19.9688 | 19.9688 | 19.9706 | 19.9650 | 19.9590 | 19.9548 | 19.9504 | (88) |
| util rest of house | 0.9956 | 0.9904 | 0.9766 | 0.9322 | 0.8145 | 0.6025 | 0.4079 | 0.4575 | 0.7419 | 0.9479 | 0.9902 | 0.9966 | (89) |
| MIT 2 | 18.3412 | 18.5809 | 18.9440 | 19.4078 | 19.7657 | 19.9376 | 19.9653 | 19.9645 | 19.8779 | 19.4373 | 18.8138 | 18.3071 | (90) |

Living area fraction fLA = Living area / (4) = 0.4089 (91)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MIT | 18.9344 | 19.1430 | 19.4599 | 19.8659 | 20.1889 | 20.3525 | 20.3845 | 20.3817 | 20.2910 | 19.8893 | 19.3435 | 18.9029 | (92) |

Temperature adjustment 0.0000

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| adjusted MIT | 18.9344 | 19.1430 | 19.4599 | 19.8659 | 20.1889 | 20.3525 | 20.3845 | 20.3817 | 20.2910 | 19.8893 | 19.3435 | 18.9029 | (93) |

### 8. Space heating requirement

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Utilisation | 0.9941 | 0.9879 | 0.9730 | 0.9303 | 0.8264 | 0.6383 | 0.4562 | 0.5069 | 0.7687 | 0.9465 | 0.9879 | 0.9955 | (94) |
| Useful gains | 541.5567 | 621.2849 | 679.3290 | 710.2878 | 667.6673 | 506.8189 | 346.3534 | 361.3522 | 511.2254 | 566.1595 | 531.8245 | 513.5292 | (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 | 1394.9137 | 1354.1245 | 1229.0325 | 1027.6016 | 793.6991 | 532.2214 | 350.1365 | 367.6646 | 575.1255 | 868.5369 | 1149.9642 | 1387.4990 | (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 | 634.8976 | 492.4682 | 408.9794 | 228.4659 | 93.7677 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 224.9687 | 445.0606 | 650.2335 | (98) |

Space heating 3178.8417 (98)

Space heating per m2 (98) / (4) = 39.1483 (99)

### 8c. Space cooling requirement

Not applicable

## 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 | 3399.8307 | (211) |

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space heating requirement | 634.8976 | 492.4682 | 408.9794 | 228.4659 | 93.7677 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 224.9687 | 445.0606 | 650.2335 | (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) | 679.0348 | 526.7040 | 437.4112 | 244.3486 | 100.2863 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 240.6083 | 476.0007 | 695.4369 | (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

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water heating requirement | 198.6688 | 175.0905 | 183.8440 | 164.7489 | 161.4087 | 144.1674 | 138.4030 | 151.9460 | 151.7012 | 170.8378 | 180.7127 | 193.8704 | (64) |
| Efficiency of water heater | | | | | | | | | | | | 79.8000 | (216) |
| (217)m | 87.6974 | 87.4254 | 86.8871 | 85.6862 | 83.4244 | 79.8000 | 79.8000 | 79.8000 | 79.8000 | 85.5490 | 87.1263 | 87.7962 | (217) |
| Fuel for water heating, kWh/month | 226.5389 | 200.2743 | 211.5896 | 192.2700 | 193.4789 | 180.6609 | 173.4373 | 190.4085 | 190.1017 | 199.6960 | 207.4145 | 220.8186 | (219) |

| | | |
|---|---|---|
| Water heating fuel used | 2386.6892 | (219) |
| Annual totals kWh/year | | |
| Space heating fuel - main system | 3399.8307 | (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) | 352.2012 | (232) |
| Total delivered energy for all uses | 6213.7211 | (238) |

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

| | Energy kWh/year | Emission factor kg CO2/kWh | Emissions kg CO2/year | |
|---|---|---|---|---|
| Space heating - main system 1 | 3399.8307 | 0.2160 | 734.3634 | (261) |
| Space heating - secondary | 0.0000 | 0.0000 | 0.0000 | (263) |
| Water heating (other fuel) | 2386.6892 | 0.2160 | 515.5249 | (264) |
| Space and water heating | | | 1249.8883 | (265) |
| Pumps and fans | 75.0000 | 0.5190 | 38.9250 | (267) |
| Energy for lighting | 352.2012 | 0.5190 | 182.7924 | (268) |
| Total CO2, kg/m2/year | | | 1471.6057 | (272) |
| Emissions per m2 for space and water heating | | | 15.3927 | (272a) |
| Fuel factor (electricity) | | | 1.5500 | |
| Emissions per m2 for lighting | | | 2.2511 | (272b) |
| Emissions per m2 for pumps and fans | | | 0.4794 | (272c) |
| Target Carbon Dioxide Emission Rate (TER) = (15.3927 * 1.55) + 2.2511 + 0.4794, rounded to 2 d.p. | | | 26.5900 | (273) |

## Appendix B – Water Calculations

# Water Efficiency Calculator for New Dwellings (V1f - Aug 2010)

## Project Details

| | | | |
|---|---|---|---|
| Adress/Reference | 29 High Holbron - Studio | Case Reference | E1052 |
| Number of Bedrooms | 1 | Occupancy for Calculation Purposes | 2 |

## Appliance/Useage Details

### Taps (Excluding Kitchen Taps)

| Tap Fitting Type | Flow Rate Litres/Min | Quantity (No.) | Total per Fitting type |
|---|---|---|---|
| Mixer Taps | 3.00 | 1 | 3.00 |
| | | | 0.00 |
| | | | 0.00 |
| | | | 0.00 |
| | | | 0.00 |
| | | | 0.00 |
| **Total No. of Fittings (No.)** | | 1 | |
| **Total Flow (l/s)** | | | 3.00 |
| **Maximum Flow (l/s)** | | | 3.00 |
| **Average Flow (l/s)** | | | 3.00 |
| **Weighted Average Flow (l/s)** | | | 2.10 |
| **Flow for Calculation (l/s)** | | | **3.00** |

### Showers

| Shower fitting Type | Flow Rate Litres/Min | Quantity (No.) | Total per Fitting type |
|---|---|---|---|
| Thermostatic Shower | 8.00 | 1 | 8.00 |
| | | | 0.00 |
| | | | 0.00 |
| | | | 0.00 |
| | | | 0.00 |
| | | | 0.00 |
| **Total No. of Fittings (No.)** | | 1 | |
| **Total Flow (l/s)** | | | 8.00 |
| **Maximum Flow (l/s)** | | | 8.00 |
| **Average Flow (l/s)** | | | 8.00 |
| **Weighted Average Flow (l/s)** | | | 5.60 |
| **Flow for Calculation (l/s)** | | | **8.00** |

### Baths

| Bath Type | Capacity to Overflow | Quantity (No.) | Total per Fitting type |
|---|---|---|---|
| | | | 0.00 |
| | | | 0.00 |
| | | | 0.00 |
| | | | 0.00 |
| **Total No. of Fittings (No.)** | | 0 | |
| **Total Capacity (l)** | | | 0.00 |
| **Maximum Capacity (l)** | | | 0.00 |
| **Average Capacity (l)** | | | 0.00 |
| **Weighted Average Capacity (l)** | | | 0.00 |
| **Capacity for Calculation (l)** | | | **0.00** |

### WCs

| WC Type | Full Flush Volume | Part Flush Volume | Quantity (No) |
|---|---|---|---|
| Dual WC | 4.50 | 3.00 | 1 |
| | | | |
| | | | |
| | | | |
| **Total number of fittings** | | | **1** |
| **Average effective flushing volume** | | | **N/a** |

### Dishwashers

| Dishwasher Type | L per Place Setting | Quantity (No.) | Total per Fitting type |
|---|---|---|---|
| | | | 0.00 |
| | | | 0.00 |
| **Total No. of Fittings (No.)** | | 0 | |
| **Total Consumption (l)** | | | 1.25 |
| **Maximum Consumption (l)** | | | 1.25 |
| **Average Consumption (l/s)** | | | 1.25 |
| **Weighted Average Consumption (l)** | | | 0.88 |
| **Consumption for Calculation (l/s)** | | | **1.25** |

### Washing Machines

| Washing Machine Type | L per Kg Dry Load | Quantity (No.) | Total per Fitting type |
|---|---|---|---|
| | | | 0.00 |
| | | | 0.00 |
| **Total No. of Fittings (No.)** | | 0 | |
| **Total Consumption (l)** | | | 8.17 |
| **Maximum Consumption (l)** | | | 8.17 |
| **Average Consumption (l/s)** | | | 8.17 |
| **Weighted Average Consumption (l)** | | | 5.72 |
| **Consumption for Calculation (l/s)** | | | **8.17** |

### Kitchen Taps

| Tap Fitting Type | Flow Rate Litres/Min | Quantity (No.) | Total per Fitting type |
|---|---|---|---|
| Kitchen Tap | 8.00 | 1 | 8.00 |
| | | | 0.00 |
| | | | 0.00 |
| **Total No. of Fittings (No.)** | | 1 | |
| **Total Flow (l/s)** | | | 8.00 |
| **Maximum Flow (l/s)** | | | 8.00 |
| **Average Flow (l/s)** | | | 8.00 |
| **Weighted Average Flow (l/s)** | | | 5.60 |
| **Flow for Calculation (l/s)** | | | **8.00** |

### Other Fittings

| | |
|---|---|
| **Waste Disposal Y/N** | N |
| **Water softner** | |
| **Consumption beyond 4% l/p/d** | |

### Use of grey water and harvested rainwater

| | |
|---|---|
| **Total Grey water from WHB taps (l)** | 0 |
| **Total Availble Grey Water Supply (l)** | 89.60 |
| **Possible Demand (l)** | 65.21 |
| **Grey/Rain Installed Capacity (l)** | 0.00 |
| **Figure for Calculation lit/person/day** | 0.00 |

## Water Use Assessment

| **Installation Type** | Unit | Capacity/ Flow Rate | Use Factor | Fixed use (l/p/day) | **Total Use (l/p/day)** | |
|---|---|---|---|---|---|---|
| WC Single Flush | Volume (l) | 0.00 | 4.42 | 0.00 | 0.00 | |
| WC Dual Flush | Full Flush (l) | 4.50 | 1.46 | 0.00 | 6.57 | |
| | Pt Flush (l) | 3.00 | 2.96 | 0.00 | 8.88 | |
| WC's (Multiple) | Volume (l) | 0.00 | 4.42 | 0.00 | 0.00 | |
| Taps Exc. Kitchen | Flow Rate | 3.00 | 1.58 | 1.58 | 6.32 | |
| Bath (shower present) | (l/s) | 0.00 | 0.11 | 0.00 | 0.00 | |
| Shower (bath present) | (l/s) | 0.00 | 4.37 | 0.00 | 0.00 | |
| Bath Only | (l) | 0.00 | 0.50 | 0.00 | 0.00 | |
| Shower Only | (l/s) | 8.00 | 5.60 | 0.00 | 44.80 | |
| Kitchen Taps | (l/s) | 8.00 | 0.44 | 10.36 | 13.88 | |
| Washing Machines | (l/kgdry) | 8.17 | 2.10 | 0.00 | 17.16 | << Note - these may be default values. |
| Dishwashers | (l/place) | 1.25 | 3.60 | 0.00 | 4.50 | << You can change them by entering |
| Waste Disposal | (l/s) | 0.00 | 3.08 | 0.00 | 0.00 | ___the actual applicances in the |
| Water Softner | (l/s) | 0.00 | 1.00 | 0.00 | 0.00 | ___appropriate sections above |
| **Total Calculated Water Use (l/p/day)** | | | | | **102.11** | |
| Grey/RainWater Reused (l) | | | | | 0.00 | |
| Normalisation Factor | (Factor) | | | | 0.91 | |
| **Total Consumption CSH (l/p/day)** | | | | | **92.92** | |
| External Water Use Allowance (l) | | | | | 5.00 | |
| **Total Comsumption Part G (l/p/day)** | | | | | **97.92** | |

| | |
|---|---|
| Assesment Result | **PASS** |

# Water Efficiency Calculator for New Dwellings (V1f - Aug 2010)

## Project Details

| | | | |
|---|---|---|---|
| Adress/Reference | 29 High Holborn - 2 Bed | Case Reference | E1052 |
| Number of Bedrooms | 2 | Occupancy for Calculation Purposes | 3 |

## Appliance/Useage Details

### Taps (Excluding Kitchen Taps)

| Tap Fitting Type | Flow Rate Litres/Min | Quantity (No.) | Total per Fitting type |
|---|---|---|---|
| Mixer Taps | 3.00 | 3 | 9.00 |
| | | | 0.00 |
| | | | 0.00 |
| | | | 0.00 |
| | | | 0.00 |
| | | | 0.00 |
| **Total No. of Fittings (No.)** | | 3 | |
| **Total Flow (l/s)** | | | 9.00 |
| **Maximum Flow (l/s)** | | | 3.00 |
| **Average Flow (l/s)** | | | 3.00 |
| **Weighted Average Flow (l/s)** | | | 2.10 |
| **Flow for Calculation (l/s)** | | | **3.00** |

### Showers

| Shower fitting Type | Flow Rate Litres/Min | Quantity (No.) | Total per Fitting type |
|---|---|---|---|
| Thermostatic Shower | 8.00 | 2 | 16.00 |
| | | | 0.00 |
| | | | 0.00 |
| | | | 0.00 |
| | | | 0.00 |
| | | | 0.00 |
| **Total No. of Fittings (No.)** | | 2 | |
| **Total Flow (l/s)** | | | 16.00 |
| **Maximum Flow (l/s)** | | | 8.00 |
| **Average Flow (l/s)** | | | 8.00 |
| **Weighted Average Flow (l/s)** | | | 5.60 |
| **Flow for Calculation (l/s)** | | | **8.00** |

### Baths

| Bath Type | Capacity to Overflow | Quantity (No.) | Total per Fitting type |
|---|---|---|---|
| | | | 0.00 |
| | | | 0.00 |
| | | | 0.00 |
| | | | 0.00 |
| **Total No. of Fittings (No.)** | | 0 | |
| **Total Capacity (l)** | | | 0.00 |
| **Maximum Capacity (l)** | | | 0.00 |
| **Average Capacity (l)** | | | 0.00 |
| **Weighted Average Capacity (l)** | | | 0.00 |
| **Capacity for Calculation (l)** | | | **0.00** |

### WCs

| WC Type | Full Flush Volume | Part Flush Volume | Quantity (No) |
|---|---|---|---|
| Dual WC | 4.50 | 3.00 | 3 |
| | | | |
| | | | |
| | | | |
| **Total number of fittings** | | | **3** |
| **Average effective flushing volume** | | | **3.50** |

### Dishwashers

| Dishwasher Type | L per Place Setting | Quantity (No.) | Total per Fitting type |
|---|---|---|---|
| | | | 0.00 |
| | | | 0.00 |
| **Total No. of Fittings (No.)** | | 0 | |
| **Total Consumption (l)** | | | 1.25 |
| **Maximum Consumption (l)** | | | 1.25 |
| **Average Consumption (l/s)** | | | 1.25 |
| **Weighted Average Consumption (l)** | | | 0.88 |
| **Consumption for Calculation (l/s)** | | | **1.25** |

### Washing Machines

| Washing Machine Type | L per Kg Dry Load | Quantity (No.) | Total per Fitting type |
|---|---|---|---|
| | | | 0.00 |
| | | | 0.00 |
| **Total No. of Fittings (No.)** | | 0 | |
| **Total Consumption (l)** | | | 8.17 |
| **Maximum Consumption (l)** | | | 8.17 |
| **Average Consumption (l/s)** | | | 8.17 |
| **Weighted Average Consumption (l)** | | | 5.72 |
| **Consumption for Calculation (l/s)** | | | **8.17** |

### Kitchen Taps

| Tap Fitting Type | Flow Rate Litres/Min | Quantity (No.) | Total per Fitting type |
|---|---|---|---|
| Kitchen Tap | 8.00 | 1 | 8.00 |
| | | | 0.00 |
| | | | 0.00 |
| **Total No. of Fittings (No.)** | | 1 | |
| **Total Flow (l/s)** | | | 8.00 |
| **Maximum Flow (l/s)** | | | 8.00 |
| **Average Flow (l/s)** | | | 8.00 |
| **Weighted Average Flow (l/s)** | | | 5.60 |
| **Flow for Calculation (l/s)** | | | **8.00** |

### Other Fittings

| | |
|---|---|
| **Waste Disposal Y/N** | N |
| **Water softner** | |
| **Consumption beyond 4% l/p/d** | |

### Use of grey water and harvested rainwater

| | |
|---|---|
| **Total Grey water from WHB taps (l)** | 0 |
| **Total Availble Grey Water Supply (l)** | 134.40 |
| **Possible Demand (l)** | 97.88 |
| **Grey/Rain Installed Capacity (l)** | 0.00 |
| **Figure for Calculation lit/person/day** | 0.00 |

## Water Use Assessment

| **Installation Type** | Unit | Capacity/ Flow Rate | Use Factor | Fixed use (l/p/day) | **Total Use (l/p/day)** | |
|---|---|---|---|---|---|---|
| WC Single Flush | Volume (l) | 0.00 | 4.42 | 0.00 | 0.00 | |
| WC Dual Flush | Full Flush (l) | 0.00 | 1.46 | 0.00 | 0.00 | |
| | Pt Flush (l) | 0.00 | 2.96 | 0.00 | 0.00 | |
| WC's (Multiple) | Volume (l) | 3.50 | 4.42 | 0.00 | 15.47 | |
| Taps Exc. Kitchen | Flow Rate | 3.00 | 1.58 | 1.58 | 6.32 | |
| Bath (shower present) | (l/s) | 0.00 | 0.11 | 0.00 | 0.00 | |
| Shower (bath present) | (l/s) | 0.00 | 4.37 | 0.00 | 0.00 | |
| Bath Only | (l) | 0.00 | 0.50 | 0.00 | 0.00 | |
| Shower Only | (l/s) | 8.00 | 5.60 | 0.00 | 44.80 | |
| Kitchen Taps | (l/s) | 8.00 | 0.44 | 10.36 | 13.88 | |
| Washing Machines | (l/kgdry) | 8.17 | 2.10 | 0.00 | 17.16 | << Note - these may be default values. |
| Dishwashers | (l/place) | 1.25 | 3.60 | 0.00 | 4.50 | << You can change them by entering |
| Waste Disposal | (l/s) | 0.00 | 3.08 | 0.00 | 0.00 | ___the actual applicances in the |
| Water Softner | (l/s) | 0.00 | 1.00 | 0.00 | 0.00 | ___appropriate sections above |
| **Total Calculated Water Use (l/p/day)** | | | | | **102.13** | |
| Grey/RainWater Reused (l) | | | | | 0.00 | |
| Normalisation Factor | (Factor) | | | | 0.91 | |
| **Total Consumption CSH (l/p/day)** | | | | | **92.94** | |
| External Water Use Allowance (l) | | | | | 5.00 | |
| **Total Comsumption Part G (l/p/day)** | | | | | **97.94** | |

| | |
|---|---|
| Assesment Result | **PASS** |