RIDGE

PROPERTY & CONSTRUCTION CONSULTANTS

ST JOHN'S WOOD
ENERGY AND SUSTAINABILITY STATEMENT

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Prepared for

Indigo Planning
Aldermary House
10-15 Queen Street
London
EC4N 1TX

Prepared by

Ridge and Partners LLP
Partnership House
Moorside Road
Winchester
Hampshire
SO23 7RX

RIDGE

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CONTENTS

1. EXECUTIVE SUMMARY

1.1 Overview

This report has been produced by Ridge & Partners LLP on behalf of Indigo Planning to outline the initial energy and sustainability strategy for the proposed St John's Wood Park development, London.

The scheme is a new residential development comprising of 9no. apartments across 7 floor levels.

The report aims to demonstrate how the proposed strategy is in accordance with the requirements of Part L of the Building Regulations, local planning policy and the Greater London Authority (GLA) planning policy.

1.2 Key Energy Efficiency Design Measures

The method taken in developing the energy strategy for the scheme has followed a sequential approach in line with the principles outlined in the energy hierarchy - assessing in turn:

- The feasibility of the integration of passive design measures and energy efficient building services strategies;
- Determining the viability of a decentralised energy network; and
- An assessment of the feasibility of a number of Low or Zero Carbon (LZC) Technologies for application to the site.

Key energy efficient design measures are proposed for inclusion in the development as detailed below:

- U-values exceeding the minimum requirements of Part L1a of the Building Regulations;
- Air leakage rate is to be 70% lower than the maximum permissible under the Building Regulations. i.e. a target of 3.0m³/m².h at 50Pa;
- Enhanced thermal bridging details;
- Solar control glazing to mitigate overheating risk;
- Centralised continuous mechanical ventilation with heat recovery (MVHR) in each of the dwellings, in accordance with SAP Appendix Q;
- Reduction in hot water demand, in part due to higher insulation standards but also due to lower water consumption;
- Maximise daylighting and consequently passive solar heating;
- Reduce energy requirements for lighting by utilising daylighting and by incorporating fixed energy efficient lamps to 100% of luminaires throughout;
- Community heating scheme with centralised heating and cooling generation plant;
- High efficiency air source heat pumps (ASHPs);
- Energy display devices; and
- Recommendations to building users regarding energy efficient appliances and operation of systems and equipment.

Preliminary calculations undertaken for this development demonstrate that implementing these measures will significantly reduce the CO_2 emissions associated with the scheme. The carbon savings associated with each stage of the energy hierarchy are illustrated graphically in Figure 1.1.

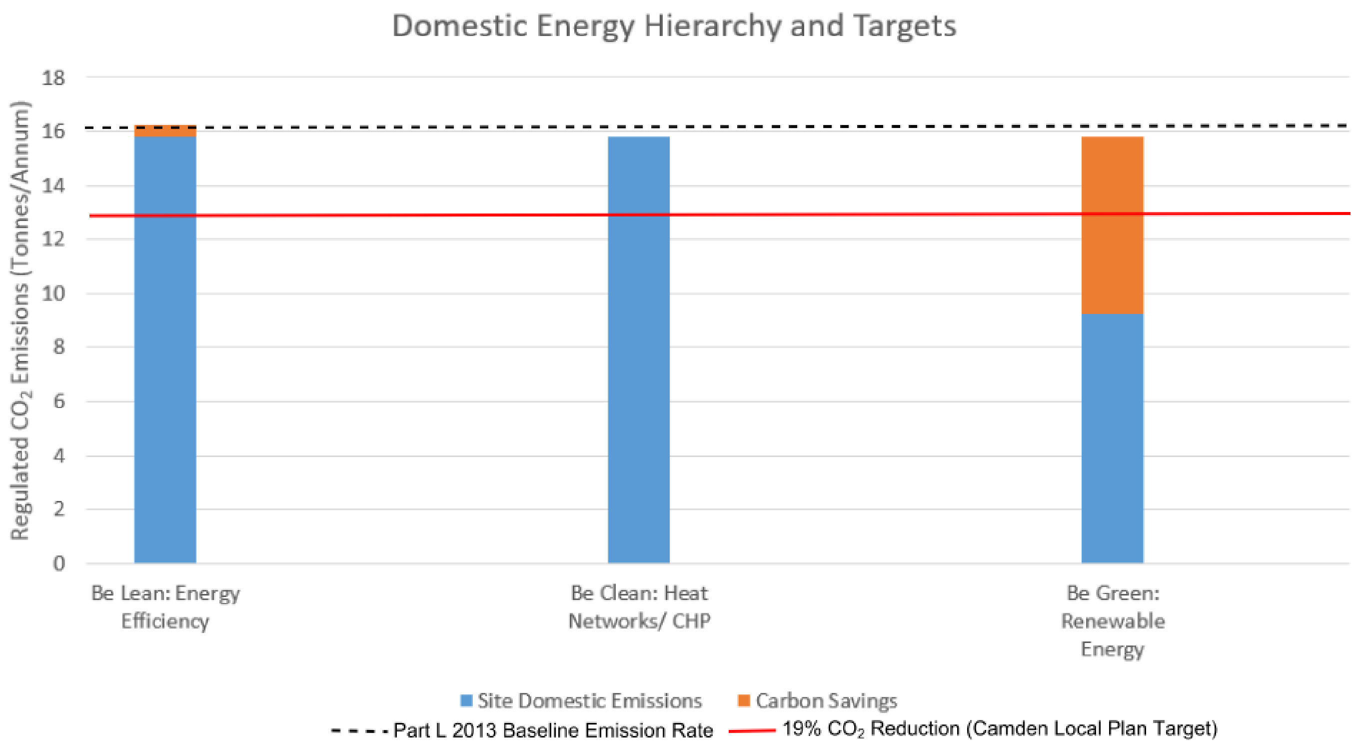


Figure 1.1 – The Energy Hierarchy

Tables 1.1 and 1.2 further illustrate the breakdown of energy savings achieved through the implementation of the energy hierarchy.

Table 1.1 – Carbon Dioxide Emissions after Each Stage of the Energy Hierarchy for Domestic Buildings

	Carbon Dioxide Emissions for Domestic Buildings (Tonnes CO_2 per Annum)	
	Regulated	**Unregulated**
Baseline: Part L 2013 of the Building Regulations Compliant Development	16.24	18.22
After Energy Demand Reduction	15.78	18.22
After Heat Network/ CHP	15.78	18.22
After Renewable Energy	9.26	18.22

Table 1.2 – Regulated Carbon Dioxide Savings from Each Stage of the Energy Hierarchy for Domestic Buildings

	Regulated Domestic Carbon Dioxide Savings	
	(Tonnes CO_2 per Annum)	**%**
Savings from Energy Demand Reduction	0.45	2.80
Savings from Heat Network/ CHP	0.00	0.00
Savings from Renewable Energy	6.52	40.14
Cumulative on Site Savings	6.97	42.94

The Camden Local Plan dictates that schemes will be required to demonstrate a 19% reduction in CO_2 emissions below the Part L 2013 baseline- Figure 1.1 demonstrates how this target has been met for the proposed St John's Wood Park development.

The Camden local authority also sets an additional renewable energy target applicable to the scheme– a requirement for a 20% reduction in carbon dioxide emissions to be met by on-site renewable technologies. It is shown in Table 1.2 that a 40.14% reduction is achievable via the implementation of high efficiency ASHP technology, exceeding this planning requirement.

In summary, it has been demonstrated that the application of passive design measures, provision of energy efficient servicing systems and specification of LZC energy sources would result in a significant reduction in regulated carbon dioxide emissions for the St John's Wood Park development.

1.3 Additional Sustainability Measures

The wider sustainability of the St John's Wood Park development has also been addressed in this study – including resource efficiency, waste mitigation and water efficiency.

A strategy has been developed for the St John's Wood Park scheme to maximise the efficient use of resources, both through the construction process and during future occupation. The waste hierarchy has been referenced throughout this assessment process to prioritise measures that would have the most significant resource saving impacts.

A summary of the key resource efficiency and waste mitigation proposals for the site are detailed below:

- The production of a Site Waste Management Plan (SWMP) to set good practice target waste benchmarks, set procedures for minimising, measuring, monitoring & reporting various waste streams and identifying potential for re-use to divert potential waste from landfill;
- Reduce the resource intensity of the detailed design architectural proposals where feasible and maximise end of life potential;
- Encourage the use of recycling and composting facilities. Provide guidance to future occupants via Home User Guides detailing Local Authority collection schemes, information on local recycling facilities & tips, guidance on procedures to discard potentially hazardous waste (i.e. batteries, fridges/ freezers etc.) and WRAP sustainable waste disposal principles.

A water efficiency strategy has been developed for the scheme to meet a water consumption target of 110 litres per person per day (including external water usage). The feasibility of a number of measures have been explored – including water butts, rainwater harvesting, greywater harvesting and the installation of water conservation appliances.

An analysis has been undertaken of various routes to meet the targeted performance level. A standard approach is proposed for the scheme utilising water conservation appliances such as dual flush toilets, low flow taps and baths with a low capacity to overflow. A Water Efficiency Calculator for New Dwellings tool has been utilised to demonstrate that this approach could meet the target of 110 l/p/day.

2. INTRODUCTION

2.1 Overview

This report has been compiled to set out the key sustainability and energy efficiency measures for the St John's Wood Park development, in support of the full planning application for the scheme.

In order to demonstrate that energy objectives defined by national, regional and local policies are met- energy performance analysis has been undertaken to identify the most appropriate, commercially viable strategies to meet the site low carbon targets. This report has been written in line with the guidance document published by the Greater London Authority (GLA), "*Energy Planning – Greater London Authority guidance on preparing energy assessments (March 2016)*" and aims to clearly outline how the energy strategy for the scheme has been developed in accordance with the energy hierarchy.

Waste, resource and water use efficiency will also be addressed in line with the requirements of the Camden Core Strategy.

2.2 Project Description

The development site is currently occupied by a row of garages and a gated access road that leads to St John's Wood Park. It is proposed to demolish the garages and redevelop the site to provide a new apartment building comprising of 9no. dwellings across 7no. floor levels, including a new basement.

The development site is shown in the Existing Site Plan drawing in Figure 2.1, below.

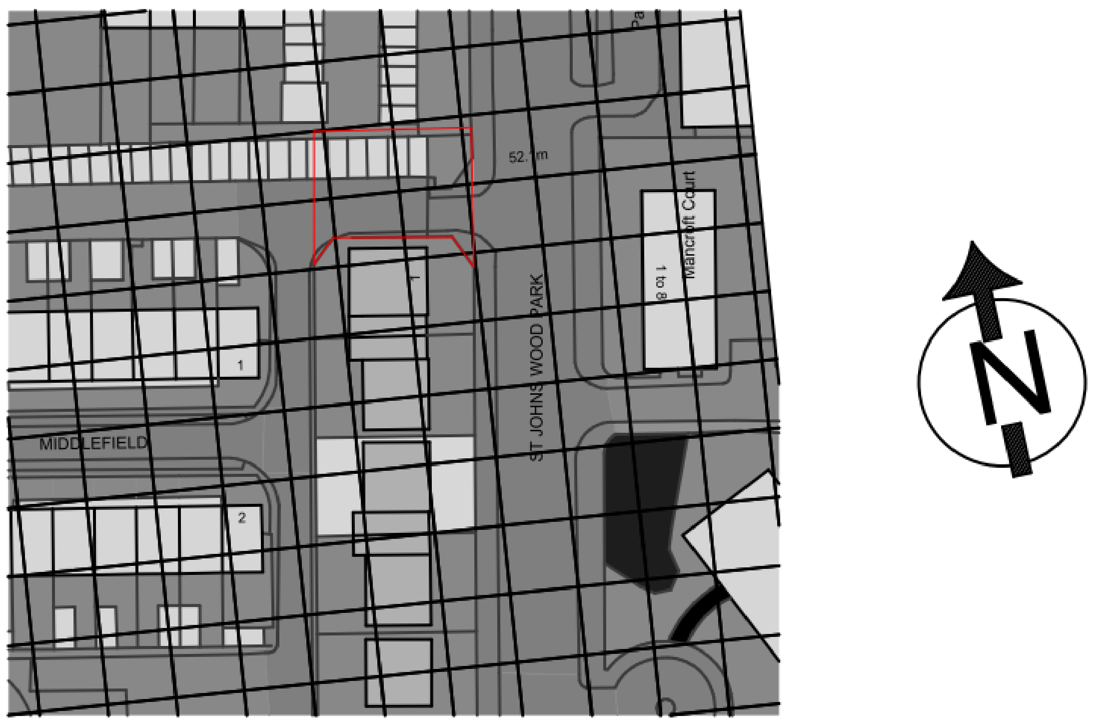


Figure 2.1 – Typical Elevation and Floorplan (Image Source: Existing Site Plans drawing by Creative Architecture)

The architectural proposals for the development are shown illustratively in Figure 2.2, below.

Figure 2.2 – 3D Visual of Proposed Development (Image Source: Maccreanor Lavington)

3. POLICY CONTEXT

3.1 Overview

The energy strategy for the St John's Wood Park scheme has been developed in accordance with the requirements set out in the London Plan and Camden Council Planning Policy.

These compliance requirements are above and beyond the performance standards outlined within the 2013 revision of Part L of the Building Regulations (Conservation of Fuel and Power).

3.2 The London Plan

The London Plan sets out the overall strategic plan for London- it integrates the economic, environmental, transport and social framework for the development of London over the next 20-25 years.

The key policies outlining London's approach to sustainable development include the following:

Policy 5.1 Climate Change Mitigation
Policy 5.2 Minimising Carbon Dioxide Emissions
Policy 5.3 Sustainable Design and Construction
Policy 5.5 Decentralised Energy Networks
Policy 5.6 Decentralised Energy in Development Proposals
Policy 5.7 Renewable Energy
Policy 5.8 Innovative Energy Technologies
Policy 5.9 Overheating and Cooling

Policy 5.2 dictates that development proposals should make the fullest contribution to minimising CO_2 emissions in accordance with the energy hierarchy:

1. **Be Lean: Use Less Energy**
2. **Be Clean: Supply Energy Efficiently**
3. **Be Green: Use Renewable Energy**

Additionally, this policy sets out defined targets for both 'Major' residential and non-domestic buildings. Due to the size of the St John's Wood Park scheme it is noted that it will not fall under the GLA definition of 'Major Development' - which is defined for residential schemes as development comprising 10 or more dwellings.

Policy 5.6 outlines a hierarchy for the adoption of clean energy systems, below:

1. **Connection to existing heating or cooling networks**
2. **Site wide CHP network**
3. **Communal heating and cooling**

A guidance document published by the GLA, "*Energy Planning – Greater London Authority guidance on preparing energy assessments (March 2016)*", defines an energy assessment process to develop energy strategies in accordance with the energy and clean energy hierarchies.

3.3 Camden Local Plan

The Camden Local Plan was adopted on the 3rd of July 2017 and has replaced the Core Strategy and Camden Development Policies documents.

Policy CC1 of the Camden Local Plan relates to the climate change mitigation measures that the council will expect to be considered for new schemes. This policy aligns with the principles of the energy hierarchy set out by the GLA. This is policy is detailed, in full, below:

Policy CC1 – Climate Change Mitigation
The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

We will:
a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;
b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;
c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;
d. support and encourage sensitive energy efficiency improvements to existing buildings;
e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and
f. expect all developments to optimise resource efficiency.

For decentralised energy networks, we will promote decentralised energy by:
g. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;
h. protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and
i. requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.

Although the St John's Wood Park development is not defined as a major development, the Camden Local Plan also sets out the following energy performance targets for schemes comprising 5 or more dwellings:-

- 19% CO_2 reduction below Part L; and
- 20% CO_2 reduction from on-site renewable energy generation

3.4 Camden Planning Guidance 3 (CPG 3) - Sustainability

CPG 3 has been developed by Camden Council to support the policies within the Local Development Framework and forms a Supplementary Planning Document (SPD).

3.4.1. The Energy Hierarchy

The key messages with regards to the energy hierarchy are outlined below.

KEY MESSAGES

- All developments are to be design to reduce carbon dioxide emissions
- Energy strategies are to be designed following the steps set out by the energy hierarchy

This guidance reiterates the GLA guidance detailed in Section 3.2.

3.4.2. Energy Efficiency: New Buildings

The key messages with regards to the energy efficiency are outlined below.

KEY MESSAGES

All new developments are to be designed to minimise carbon dioxide emissions

The most cost-effective ways to minimise energy demand are through good design and high levels of insulation and air tightness.

This guidance reiterates the GLA guidance on step 1 of the energy hierarchy: Be Lean.

Additionally, this section of the SPG details how passive overheating mitigation measures should be implemented in the first instance to mitigate overheating risk. Where air conditioning is to be specified, it is necessary to demonstrate that energy efficient ventilation and cooling methods have been considered first, and that they have been assessed for their carbon efficiency.

3.4.3. Decentralised Energy Networks and Combined Heat and Power

The key messages with regards to clean energy are outlined below.

KEY MESSAGES

Decentralised energy could provide 20% of Camden's heating demand by 2020.

Combined heat and power plants can reduce carbon dioxide emissions by 30-40% compared to a conventional gas boiler.

Where feasible and viable your development will be required to connect to a decentralised energy network or include CHP.

This guidance reiterates the GLA guidance on step 2 of the energy hierarchy: Be Clean.

3.4.4. Renewable Energy

The key messages with regards to renewable energy are outlined below.

KEY MESSAGES

There are a variety of renewable energy technologies that can be installed to supplement a development's energy needs

Developments are to target a 20% reduction in carbon dioxide emissions from on-site renewable energy technologies.

This aim for a 20% reduction in carbon dioxide emissions from on-site renewable energy technologies will form an additional energy performance target for this scheme.

3.4.5. Water Efficiency

The key messages with regards to water efficiency are outlined below.

KEY MESSAGES

At least 50% of water consumed in homes and workplaces does not need to be of drinkable quality re-using water

All developments are to be water efficient

Developments over 10 units or 1000sq m should include grey water recycling

Camden Council expects all developments to be designed to be water efficient by minimising water use and maximising the re-use of water.

With regards to greywater recycling, Camden Council will expect developments comprising 10 or more units to include a grey water harvesting system, unless the applicant can demonstrate that this would not be feasible.

3.4.6. Sustainable Use of Materials

The key messages with regards to sustainable materials use are outlined below.

KEY MESSAGES

Reduce waste by firstly re-using your building, where this is not possible you should implement the waste hierarchy

The waste hierarchy prioritises the reduction, re-use and recycling of materials

Source your materials responsibly and ensure they are safe to health.

The SPG outlines 5 key steps that are to be followed for resource efficiency:

1. Managing existing resources;
2. Specifying materials using the BRE's Green Guide to Specification;
3. Ensuring that materials are responsibly sourced;
4. Minimising the harmful effects of some materials on human health; and
5. Ensuring that specified materials are robust and sensitive to the building type and age.

4. ENERGY DEMAND REDUCTION (BE LEAN)

4.1 Overview

Passive and energy efficiency measures were addressed in the first instance across this development in order to reduce the energy demand of the scheme and the associated carbon dioxide emissions. This section will provide an overview of the proposed lean measures for the St John's Wood Park scheme.

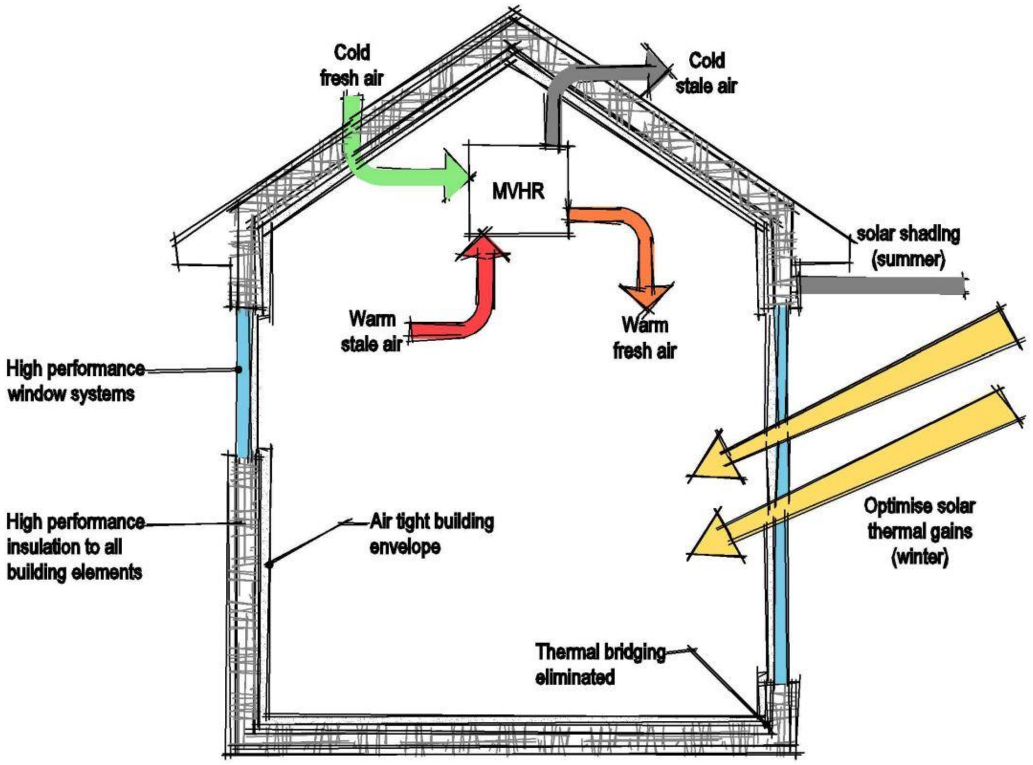


Figure 4.1 – Key Passive Design Measures to be addressed in Section 4

4.2 Sampling

In order to assess the energy performance of the residential units, a sample of representative units have been modelled using Elmhurst Design SAP 2012 (Version 4.05r02). The sample modelled includes the basement duplex apartment, 2 single level apartments from a typical mid floor level and the 2 duplex apartments that are located across floor levels 4 and 5. The sample of units is shown in the mark up included in Appendix 1. The results of these representative sample SAPs have been multiplied by the cumulative floor area for each of the respective dwelling types to inform the site wide CO_2 emission figures.

4.3 Building Fabric

Table 4.1 demonstrates the building fabric improvements that have been incorporated over Part L1a limiting standards.

Table 4.1 – Residential Building Fabric Performance Targets

ELEMENT	PERFORMANCE TARGET	PART L1A LIMITING VALUES
External Wall U Value (W/m^{2}K)	0.16	0.3
Unheated Corridor Walls (W/m^{2}K)	0.25*	0.3
Party Walls between Apartments (W/m^{2}K)	0**	
Façade Glazing U Value (W/m^{2}K)	1	2
Flat Entrance Doors U Value (W/m^{2}K)	1	2
Ground/ Exposed Floor U Value (W/m^{2}K)	0.13	0.25
Roof U Value (W/m^{2}K)	0.13	0.2
Air Permeability (m^3/hr.m^2 @ 50Pa)	3	10

*This U value is prior to the application of a shelter factor afforded by the adjacent unheated space.

**To meet this U value for the purposes of SAP calculations, it is assumed that the party walls will be solid/ fully filled and sealed.

Additionally, Table 4.2 sets out additional solar and light transmission properties for the glazed constructions on the scheme.

Table 4.2 – Further Glazing Properties (Residential Units)

ELEMENT	SOLAR TRANSMISSION (G VALUE)	VISIBLE LIGHT TRANSMISSION (LT)
Glazing	0.45*	≥60%

*This G value is proposed in all above ground level rooms – in the basement bedrooms where there will be a significant degree of shading it is proposed for a higher G value to be provided of approximately 0.6. The final glass specification properties will be confirmed at detailed design stage following a design optimisation process.

The inclusion of solar control glazing will aid in significantly reducing the solar gains into the spaces, and therefore reduce the likelihood of overheating risk/ comfort cooling system loads.

Minimising thermal bridging effects is a critical step in achieving Part L1a Target Fabric Energy Efficiency (TFEE) compliance. Therefore in addition to the properties in Table 4.1 and 4.2, enhanced thermal bridging characteristics are also proposed as detailed in Table 4.3, on the next page.

Table 4.3 – Proposed Thermal Bridging Allowances

JUNCTION TYPE	REFERENCE	PSI VALUE (W/MK)	DESCRIPTION
Other Lintels (including other steel lintels)	E2	0.3	ACD
Sill	E3	0.04	ACD
Jamb	E4	0.05	ACD
Ground Floor	E5	0.16	ACD
Intermediate Floor between Dwellings	E6	0.07	ACD
Party Floor between Dwellings	E7	0.07	ACD
Flat Roof	E14	0.08	Default
Flat Roof (with parapet)	E15	0.56	Default
Corner (normal)	E16	0.09	ACD
Corner (inverted)	E17	-0.09	ACD
Party Wall between Dwellings	E18	0.06	ACD
Basement Floor	E22	0.07	Default
Staggered Wall Between Dwellings	E25	0.12	Default
Party Wall and Roof	P4	0.24	Default

4.4 Building Services

It is proposed to incorporate 100% low energy light fittings within the dwellings. Table 4.4, below, illustrates how this exceeds the minimum requirements set in Part L1a.

Table 4.4 – Residential Lighting Performance Targets

ELEMENT	PROPOSED	PART L1A LIMITING VALUE
Internal Lighting	100% Low Energy	75%

Additionally, it is also proposed that where external light fittings are to be installed they will meet the following characteristics:

Either a)

- Lamp capacity not greater than 100 lamp-watts per light fitting, and
- All lamps automatically controlled so as to switch off after the area lit by the fitting becomes unoccupied, and
- All lamps automatically controlled so as to switch off when daylight is sufficient

Or b)

- Lamp efficacy greater than 45 lumens per circuit-watt, and
- All lamps automatically controlled so as to switch off when daylight is sufficient, and
- Light fittings controllable manually by occupants

Energy efficient external lighting has been assumed within the sample SAP calculations completed. Confirmation of whether this is to be achieved by compliance route a or b (outlined above) will be confirmed as the design for the scheme progresses.

Mechanical ventilation with heat recovery (MVHR) systems are proposed for the dwellings. This system type supplies and extracts air- routing both air streams through a high efficiency heat exchanger where the heat can be transferred from the exhausted air to the incoming fresh air. This system type can facilitate a decrease in winter heating load in a dwelling.

Figure 4.1 – MVHR Diagram (Image Source: www.nfan.co.uk)

It is proposed to provide accessible heat and electricity metering systems to each of the dwellings. The provision of these meters will aid the occupants in better understanding their energy usage, and to assist them in making more informed decisions with regards to their energy usage.

4.5 Results

The results of the integration of these energy usage reduction measures in the domestic scheme is illustrated in Figure 1.1. An example of a full SAP calculation sheet accounting for the implementation of lean measures is also included in Appendix 2.

It should be noted that the extent of improvement over the Part L 2013 Target Emission Rate shown is limited to an extent due to the proposed inclusion of solar control glass in the scheme. The G value of glazing in the notional (target) building is set to 0.63- this exceeds the proposed G value for the non- basement spaces by approximately 28%. A higher G value facilitates greater solar gains and can therefore aid in reducing space heating loads, however, it can also increase overheating risk/ cooling loads. This has informed the selection of a lower G value for the glazing which has been offset by the other energy efficiency measures detailed within this section to still result in an improvement over the Part L 2013 Target Emission Rate through lean measures alone.

5. HEATING INFRASTRUCTURE INCLUDING CHP (BE CLEAN)

5.1 Overview

In line with the Energy Hierarchy, after energy consumption has been reduced through the implementation of passive design and energy efficiency measures, the next step is to consider the connection to a low carbon heat distribution network/ the installation of CHP.

5.2 Connection to Existing Heating or Cooling Networks

In line with the first step of the clean energy hierarchy, the feasibility of a connection to an existing heating or cooling network has been investigated. The London Heat Map has been accessed to assess the infrastructure present in the vicinity of the development site, below.

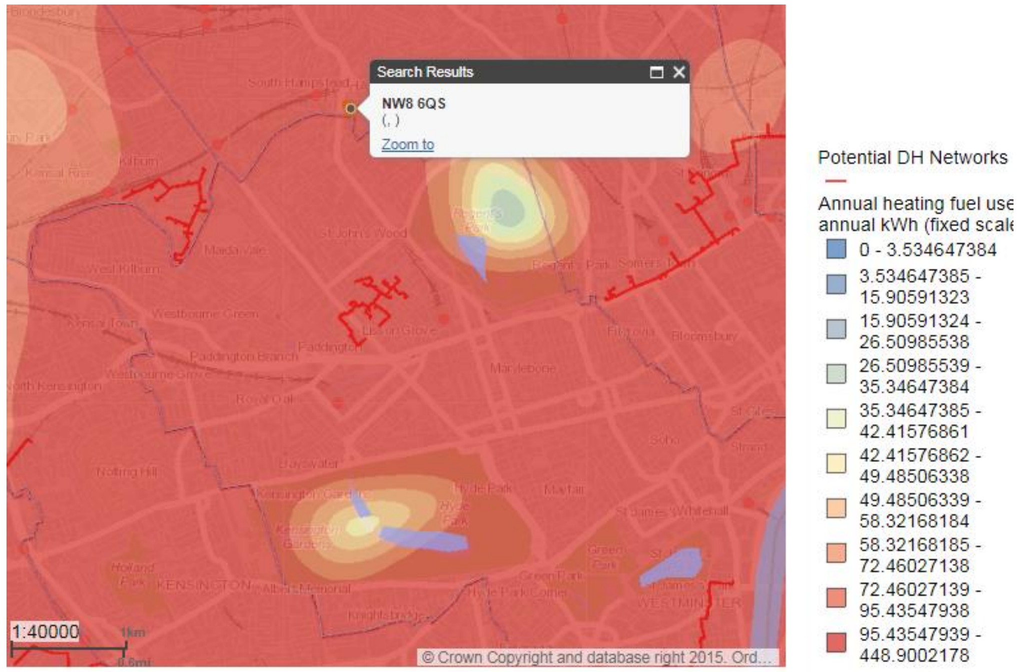


Figure 5.1 – District heating opportunity areas in the vicinity of the site (Image Source: www.london.gov.uk)

The map indicates that the development site (indicated with marker) is not in the close vicinity of an existing district heating network. It is shown, however, that it is located in a relatively high-density area of annual heating fuel usage. This means that it is possible district heating schemes may potentially be developed in the local vicinity of the development site in future. There may, therefore, be the possibility for the St John's Wood Park development to connect to a district heating scheme in the future.

5.3 Site-wide Heating Network

A community heating network is a system where more than one property is heated by a central energy centre. Heat can be supplied to the centralised system from conventional gas fired boilers, renewable fired boilers, CHP plant, ASHPs etc. The supply and demand of heat can be managed efficiently through the sharing of the heat generation plant. A community heating system can therefore provide carbon reduction benefits compared to conventional solutions for the provision of domestic hot water and space heating. A centralised energy centre may also contain centralised cooling plant, should there be a demand for this.

There are also economic benefits associated with the installation of a community heating scheme. A shared plant installation is likely to be less expensive than the combined cost of individual plant installations serving separate buildings.

This form of centralised space conditioning plant configuration has been identified as suitable for the St John's Wood Park development.

5.4 Site-wide CHP Heating Network

A CHP engine generates electricity and heat in a single process from a single fuel (typically natural gas). This cogeneration process facilitates greater fuel efficiencies being achieved and reduces transmission losses. This is illustrated in Figure 5.2, below.

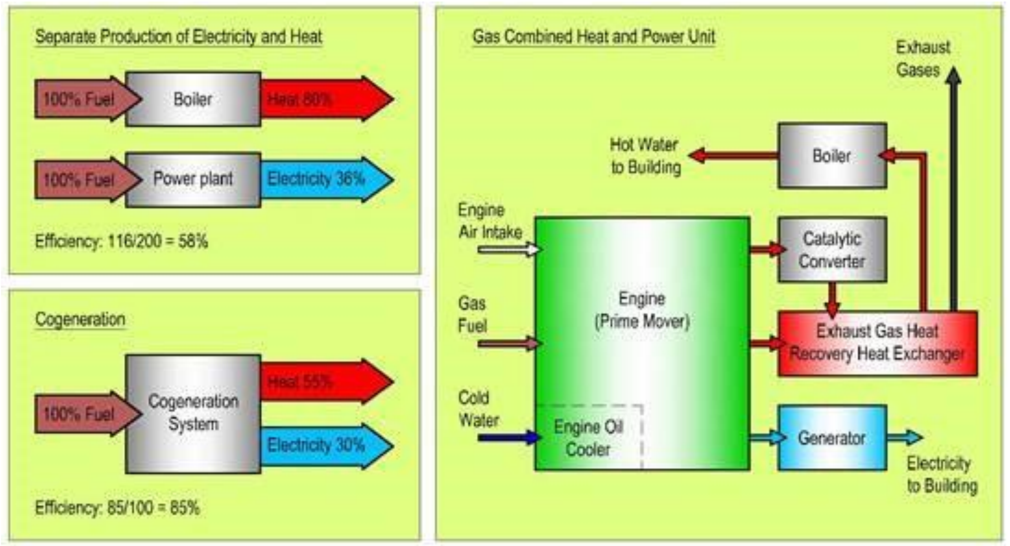


Figure 5.2 – CHP Indicative Schematic

The CHP plant, fuelled by natural gas, is defined as a low carbon technology, with a direct benefit in the better utilisation of fossil fuels for the production of electrical energy.

Design and sizing of CHP installations is usually driven by the presence of a heating base load; selection based on an electrical base load is likely to result in large quantities of heat being dumped due to there being no use for it. The adoption of combined heat and power requires a significant investment, so it is essential that CHP plant is not sat idle – providing no benefits. CHP units are often selected so that they are operating for 17 hours per day, 11 months a year and therefore it is critical that the plant is operating at maximum efficiency, utilising all the heat available.

As most small scale units produce low temperature hot water, i.e. 80˚C, they are ideal for integration into 'standard' building heating systems. In such a configuration, it is important that the CHP unit is run as the lead boiler to maximise its running hours. Balancing of water flows through the boilers and CHP unit must be carefully addressed, as the latter has a considerably higher hydraulic resistance compared to standard plant.

Due to the residential nature of this development, there will be a consistent thermal baseload. However, due to the size of the scheme - 9 dwellings - it is not proposed to install this form of technology due to financial viability and the availability of more appropriate forms of renewable technology for a scheme of this size.

6. RENEWABLE ENERGY (BE GREEN)

In line with the Energy Hierarchy, after the feasibility of lean and clean measures have been assessed, the next step is to consider the application of renewable technologies to the scheme. Renewable technologies convert natural resources such as wind, sunlight, tides and geothermal energy into useable energy. These sources of energy are naturally replenished and are therefore considered sustainable.

The renewable technologies listed below have been assessed for their applicability to this development:

- Wave Power
- Tidal Power
- Small Scale Hydropower
- Wind Power
- Air Source Heat Pumps (ASHP's)
- Ground Source Heat Pumps (GSHP's)
- Anaerobic Digestion
- Biomass boilers
- Photovoltaics
- Solar hot water (solar thermal)

A series of assessments have been undertaken to assess the viability of the above technologies from an initial feasibility assessment through to final selection.

6.1 Preliminary Assessment

To aid final renewable technology selection, a number of technologies have been disregarded at a preliminary stage due to technical and practical issues applying them to the St John's Wood Park development. Table 6.1 shows why a number of renewable technologies have been disregarded in the preliminary assessment.

Table 6.1– Preliminary Assessment of Renewable Technologies

	INCIDENT SOLAR ENERGY	COASTAL LOCATION	RIVER/ STREAM ACCESS	WIND ACCESS	ACCESS TO SOLAR WARMED AIR	ACCESS TO WARMED GROUND	ACCESS TO WASTE ORGANIC MATERIALS	THERMAL LOAD	LIMITED NOISE/ AESTHETIC IMPLICATIONS?	DEPENDENCY ON BIOMASS FUEL SOURCES ACCEPTABLE?	NOTES
Wave Power		✘									-Not a coastal location
Tidal Power		✘									-Not a coastal location
Small Scale Hydropower			✘								-No suitable river/ stream on site
Wind Power				✘					✘		-RenSMART wind map indicates that a wind speed of 4.9m/s is likely at a height of 10 metres. This is less than the recommended 5m/s for viability. At 45m the wind map indicates that a wind speed of 6.2m/s is likely, however, this will still present aesthetic and noise implications.
Ground Source Heat Pump						✘					-Very limited site area
Air Source Heat Pump					✓						-Available access to warmed air **-To be considered further**
Anaerobic Digestion							✘				-Unlikely that organic waste streams will be generated on site in the quantities required for this form of heat generation plant.
Biomass Boilers										✘	-Not considered further due potential issues with access to fuels and deliveries
Photovoltaics	✓										-Roof area available. **-To be considered further**
Solar Thermal	✓							✓			-Roof area available. **-To be considered further**

6.2 Secondary Assessment

A secondary renewable assessment was then completed to further investigate the remaining technologies. The remaining and most suitable renewable technologies for the St John's Wood Park development, are:

- Air Source Heat Pumps
- Photovoltaics
- Solar Thermal

6.2.1. Air Source Heat Pumps (ASHP)

Heat pumps use electrical energy to transfer thermal energy from a heat store to a heat sink. ASHPs extract/ reject heat from the air. Typically one unit of electricity will produce >3 units of useful heat – so although this technology is not a fully renewable technology, it can still facilitate carbon savings. An air source heat pump has much smaller space requirements than a ground source heat pump and has lower associated installation costs. The units tend to be located externally, and therefore consideration needs to be given to their placement as they may pose a noise issue when operational.

The heating distribution system for ASHP applications is generally underfloor heating or a convector designed for low temperatures.

The application of ASHPs lends itself to a scheme where cooling is required in addition to heating- as they can provide both heating and cooling. An example of a high efficiency heat pump is shown in Figure 6.1, below. These units can achieve whole system cooling seasonal energy efficiency ratio (SEER) in the range of 7.16-9.02 and complete system heating seasonal coefficient of performance (SCOP) in the range of 4.79-6.41. Reference data has been included in Appendix 3.

Figure 6.1 – Example Heat Pump Unit- Mitsubishi Electric Y Series High COP PUHY (Source: SWAT Engineering)

These units are considered an appropriate form of technology for this scheme due to the high SEER/ SCOP figures achievable, availability of roof space and their ability to meet both heating and cooling demand.

6.2.2. Photovoltaic Panels

Photovoltaics are semiconductor devices that convert sunlight into direct current (DC) electricity. Groups of panels can be electrically configured into arrays which can be used to power a building's electrical load.

A number of photovoltaic systems including monocrystalline, polycrystalline and thin film are available, generally made up into arrays using multiple panels or roof slate "substitutes". Photovoltaic panels can also replace vertical cladding systems.

The orientation and mounting angles of the panels are critical in order to maximise their output. Additionally, overshadowing should always be considered when assessing the feasibility of PV installations as this can significantly reduce the output of the panels.

The St John's Wood Park development does not have a significant area of roof available due to the size of the footprint of the building and the stepped back nature of the uppermost floor. It is also proposed for the ASHPs to be located at roof level. This would limit the size of the array feasible for the scheme.

A solar photovoltaic array has therefore not been proposed as an additional form of low or zero carbon technology on this scheme.

6.2.3. Solar Thermal

Solar thermal technology captures the sun's energy through solar collectors in order to generate hot water. This technology could be adopted to contribute to the domestic hot water loads on the scheme. This technology would require an area of roof to house the solar thermal array. Experience on previous schemes has demonstrated that significant carbon emission savings cannot be demonstrated through the implementation of this form of technology, relative to the impact that can be demonstrated with other forms of LZC technology.

The thermal loads of the development are also already going to be met by the proposed renewable ASHP installation.

A solar thermal array has therefore not been proposed as an additional form of low or zero carbon technology on this scheme.

6.2.4. Proposed Green Technology

It is proposed to utilise high efficiency ASHP technology for the St John's Wood Park residential development.

In line with the guidance set out by the GLA, the Target Emission Rate (TER) that is being used as the baseline Part L compliant emission rate has been generated based on the heating being provided by gas fired boilers. On this basis, it is indicated in Table 1.2 that an approximately 40.14% carbon emission reduction is achievable via the implementation of green technology on the St John's Wood Park scheme.

7. OVERHEATING

7.1 Overview

With the improving thermal efficiency of building envelopes and air tightness, the risk of overheating in the UK has increased. The Cooling Hierarchy has been used to guide the overheating mitigation strategy for the St John's Wood Park development. The design has taken into consideration a passive and active approach to the site and building layout through strategies that mitigate overheating risk and minimise CO_2 emissions associated with comfort cooling systems.

The Cooling Hierarchy is outlined below:

1 - Minimise internal heat generation through energy efficient design

2 - Reduce the amount of heat entering a building through orientation, shading, albedo, fenestration, insulation and green roofs and walls

3 - Manage the heat within the building through exposed internal thermal mass and high ceilings

4 - Passive ventilation

5 - Mechanical ventilation

6 - Active cooling systems (ensuring they are the lowest carbon options)

This section of the report will outline the measures that have been incorporated at each stage of the hierarchy.

7.2 Minimise Internal Heat Generation

The following energy efficient design measures have been incorporated into the scheme design in order to reduce the generation of heat within dwellings:

1. Minimising LTHW Distribution Pipework Losses. It is proposed to fully insulate LTHW distribution pipework to ECA standards to reduce the associated heat losses into the apartment ceiling voids.
2. Energy Efficient Light Fittings. It is proposed to include LED light fittings throughout the apartments- this will aid in reducing the internal heat gains associated with the operational heat losses of less efficient fittings.
3. A/ A^+ white goods are proposed to be supplied to the apartments in the fit-out installation. This will aid in reducing the heat emitted into the living areas from the kitchen appliances.

7.3 Reduce the Heat Entering the Building

The following design measures have been incorporated into the scheme in order to reduce the amount of heat entering the dwellings:

1. Appropriate Proportion of Façade Glazing to Occupied Spaces. This will aid in preventing excessive solar gains to the occupied spaces.
2. Energy Efficient Façade Construction Materials. The properties of the proposed materials are detailed further within Section 4.3.
3. Minimal South Facing Glazing. This will aim to reduce excessive solar gains via south facing windows.
4. Specification of Solar Control Glass. Solar control glazing is proposed for the apartments to further limit excessive solar gains to the apartments. A G value of 0.45 is proposed for the majority of the glazing systems.

7.4 Manage the Heat within the Building

One form of managing heat within a building can be the incorporation of high thermal mass. Materials with a high thermal mass have the ability to absorb and store thermal energy during the day – facilitating a resistance to sharp temperature rises.

A medium weight construction type is proposed for the external walls on the scheme and it is proposed that floorslabs will be concrete - this will add a degree of thermal mass to each of the dwellings.

The interior finishes have been selected to be easy to maintain, meet the acoustic requirements of Part E and meet the fire safety requirements of Part B. Due to the residential nature of the development, there is also a requirement for the services being run at high level -such as pipework and ductwork - to be concealed. This therefore limits the feasibility of the adoption of an exposed thermal mass at ceiling level within the apartments.

In conclusion, thermal mass has been incorporated within the St John's Wood Park development where feasible. It is envisaged that the overall thermal mass parameter will be medium (i.e. circa 250KJ/m^2K).

7.5 Passive Ventilation

All occupied spaces are to have openable windows to facilitate natural ventilation with no associated regulated energy use. These windows can be opened to dissipate internal heat gains in the warmer months of the year. Many of the proposed windows are to be sash windows or doors, which will afford a significant free opening area.

This element of ventilation will be completely within the control of the future occupants of the scheme so they will be able to operate these openings to suit their thermal comfort requirements.

7.6 Mechanical Ventilation

MVHR units are proposed for all dwellings to provide background ventilation, whilst minimising winter heat losses. The proposed MVHR systems consist of a fresh air intake and extract discharge from/to the façade of the building, supplying fresh air to all habitable rooms and extract from 'wet areas' such as bathroom, kitchens and utility cupboards. The heat exchanger in the unit can recover high percentages of heat using it to increase the temperature of incoming fresh air in the winter months. During winter months the quantity of fresh air provided is calculated to balance minimum extract volumes from each space and the apartment overall, typically achieving around 0.75 air changes per hour (ACH). The MVHR system is sized to provide the correct quantity of fresh air and extract without the need to open windows in the winter.

The MVHR heat exchanger has a summertime by-pass to avoid heating incoming summer fresh air further with hot air being extracted. During a large part of the summer months and nearly always at night, the outside air temperature in the UK would provide beneficial 'free-cooling' to the space.

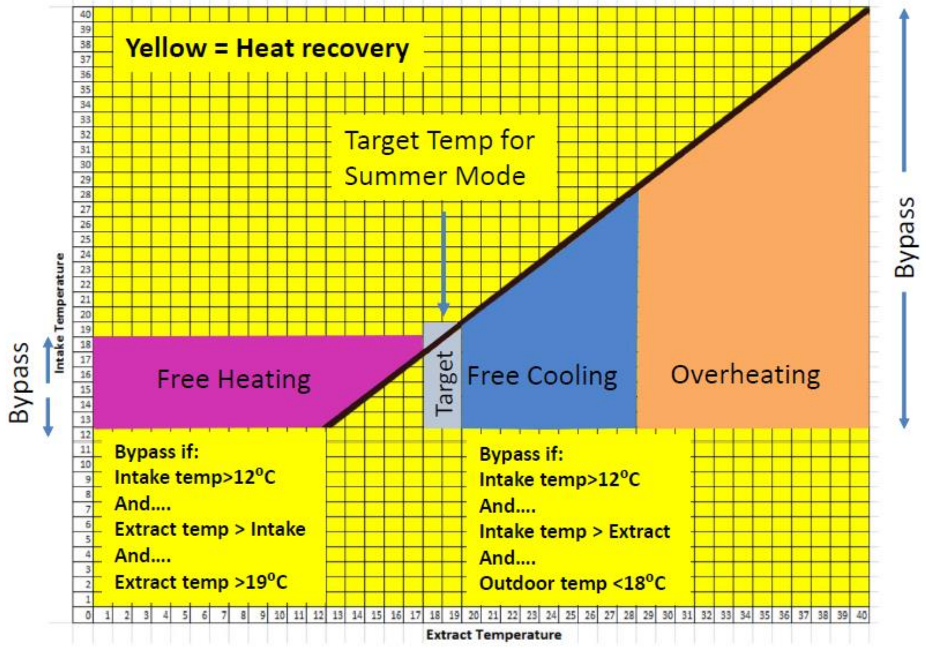


Figure 7.1 – Summertime Free-Cooling Opportunity (Image Source: Nuaire)

7.7 Active Cooling Systems

In the first instance, overheating risk has been mitigated through the adoption of passive measures outlined in the Cooling Hierarchy.

Comfort cooling systems are proposed in the primary occupied spaces within the development. These cooling loads will be served by high efficiency heat pumps to reduce the associated emissions.

An overheating study will be developed at detailed design stage to determine if comfort cooling systems are required in the remaining occupied spaces to demonstrate that the thermal comfort criteria outlined in TM59: 2017 will be met.

8. WATER EFFICIENCY

8.1 Overview

The World Economic Forum's Global Risks 2014 report listed water security as one of the top three global risks, with water supplies in Southern England coming under increasing pressure due to population growth and urbanisation. Thames Water have anticipated the number of households in their catchment area will increase by 200,000 and the population will grow by 800,000 over the next 10 years. Therefore, the importance of reducing water consumption is becoming an increasingly critical priority.

8.2 Maximising Re-use of Water

8.2.1. Water Butts

Camden Council expects buildings with gardens or landscaped areas that require regular maintenance to be fitted with water butts. In the case of this development, it should be noted that these area types are not included within the site design proposals.

8.2.2. Rainwater Harvesting

Rainwater harvesting is a simple and effective method of reducing the consumption of mains water on a site. It is usually put to use where water of drinking water quality is unnecessary. For instance, rainwater can be utilised to provide supplies for the following:

- Irrigation systems;
- WC flushing;
- Laundry facilities, i.e. washing machines; and
- Vehicle washing.

A rainwater harvesting system would normally consist of the following:

- Pre-filters located in the downpipes or integrated into the below ground pipework;
- Underground storage tank with calmed, filtered inlet and overflow;
- Submersible pump with integral filter;
- Control panel with pump pressure regulator;
- Mains water make-up (into main or header tank);
- Fine Filter(s) in main distribution pipework (optional); and
- Ultra-violet disinfection unit (optional).

It is recommended that sanitary appliances are selected to be as efficient as possible, so that the use of rainwater can be maximised.

Rainwater can be filtered and disinfected to provide water of drinking quality, but this is rare in the United Kingdom given the availability and quality of mains water.

Management of storm water is increasingly becoming an issue and rainwater harvesting can be utilised as part of an attenuation strategy.

Particular factors that need to be addressed when considering a rainwater harvesting system include:

- The supply of rainwater may not meet the demand and therefore large volumes of storage may be necessary to compensate;
- Compliance with the Water Regulations, including avoidance of backflow and cross connection into the mains water supply;
- The additional expense of a centralised system and also of maintenance, although the works necessary are relatively straightforward; and
- The relatively low impact of WC use on overall dwelling regulated water usage.

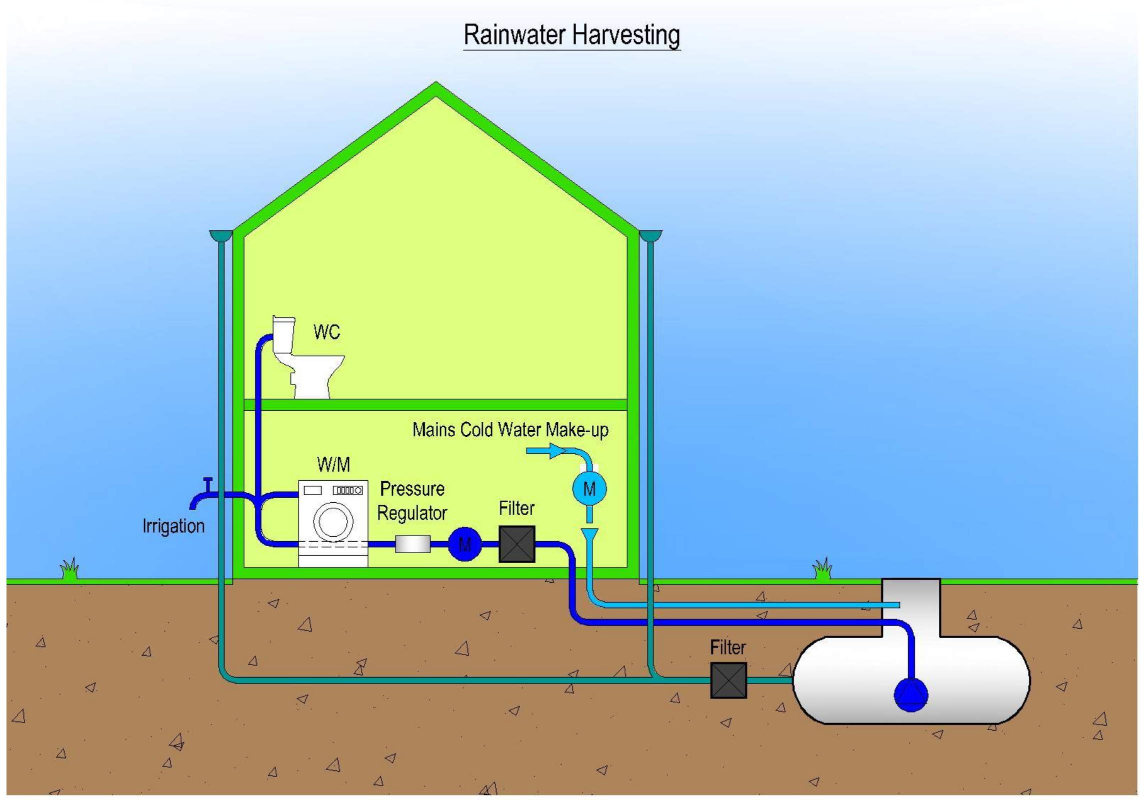


Figure 8.1 – Typical Rainwater Harvesting System Illustration

There is limited roof area available on the St John's Wood Park development for the collection of rainwater, and there is no scope for a large buried storage tank to compensate due to the restricted space of the construction site. The financial viability of a centralised rainwater harvesting systems is also facilitated by a large scale residential scheme- the St John's Wood Park is going to include 9no. dwellings.

Due to the scale of the development, limited roof collection area and limited area for the siting of a rainwater harvesting tank this system type is not proposed for the St John's Wood Park scheme.

8.2.3. Greywater Recycling

Grey water is defined as waste water collected from sources with relatively low levels of contaminants, i.e. basins, baths, sinks, showers and, in some cases, washing machines. When filtered and disinfected it is primarily used in WC flushing. Grey water is collected via a dedicated waste water pipework system and stored in tanks. Screen filtering and settlement takes place in the tank, after which the water is filtered and disinfected.

Packaged systems are now available, but filtration and disinfection methods vary between manufacturers. Reverse osmosis, sand and cartridge filters may be utilised; ultra-violet lamps, bromine and chlorination may be used for disinfection purposes.

Storage of 'raw' grey water for long periods is not recommended and a grey water installation should address all the possible health and safety issues, i.e. labelling of outlets and pipework, avoidance of cross contamination with mains water, regular maintenance.

Camden Council require developments over 10 units in size to include a greywater harvesting system, unless it can be demonstrated that this is not a feasible option for a development. It should be noted that the size of this scheme is below the 10 unit threshold, however, the feasibility of this system type has still been addressed in this section of the report.

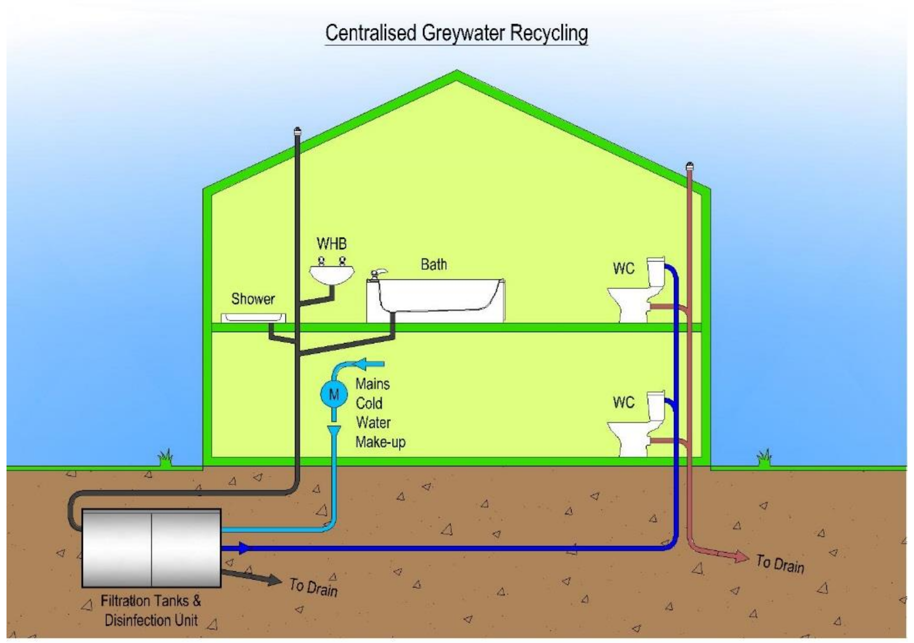


Figure 8.2 – Typical Greywater Harvesting System Illustration

Factors that need to be addressed when considering a grey water system include:

- Compliance with the Water Regulations, including avoidance of backflow and cross connection into the mains water supply;
- The additional capital expense of a centralised system;
- Ongoing maintenance, which is invariably expensive;
- The relatively low impact of WC use on overall dwelling regulated water usage; and
- Possibility of more concentrated effluent returned to the sewerage system.

The financial viability of a centralised greywater harvesting systems is facilitated by a large scale residential scheme- the St John's Wood Park is going to include 9no. dwellings.

8.3 Minimising Water Use

The Code for Sustainable Homes (CfSH) has been wound down by the government, however it still provides an applicable assessment methodology for the assessment of water usage in dwellings. The average person in the UK currently uses around 150 l/p/day. CfSH sets mandatory minimum requirements for water consumption with the entry level for achieving a Code Level 1 or 2 set at ≤120 l/p/day and to achieve a Code Level 3 or 4 water usage must be further reduced to ≤105 l/p/day.

For residential developments achieving this required reduction in the consumption of potable water can be addressed in several different ways. This calculation methodology takes a whole dwelling approach; manufacturer's data for each appliance is inputted and the theoretical amount of water that the average person would use in a dwelling fitted with those appliances is calculated.

Therefore one of the most straight forward approaches to reducing water consumption would be to specify water conservation appliances such as dual flush toilets, low flow taps and baths with a low capacity to overflow although this has the potential to conflict with user preferences.

In line with the Camden Council CPG 3, it is expected that developments are to be water efficient by installing dual flush toilets, low flow taps & shower heads and low water consumption washing machines & dishwashers.

The following strategy is proposed to achieve ≤105 l/p/d:

- WCs to have an effective flush volume of ≤3.06 litres (e.g. 4/2.6 litre dual flush);
- Wash hand basins to have a flow rate of ≤6 litres/min;
- Baths to have a capacity of ≤170 litres;
- Showers to have a flow rate of ≤8 litres/min;
- Kitchen taps to have a flow rate of ≤6 litres/min;
- Dishwashers to have a water usage of ≤1.25 litres/place setting; and
- Washing machines to have a water usage of ≤8.17 litres/dry kg load.

The above sanitaryware specification has been entered in the BRE's Water Efficiency Calculator for New Dwellings and this confirms that the overall water consumption would be 102.8 litres / person / day. The results of this are included as Figure 8.3.

Installation Type	Unit of measure	Capacity/ flow rate	Litres/ person/ day
Is a dual or single flush WC specified?		Dual	
WC	Full flush volume	4	5.84
	Part flush volume	2.6	7.70
Taps (excluding kitchen and external taps)	Flow rate (litres / minute)	6	11.06
Are both a Bath & Shower Present?		Bath & Shower	
Bath	Capacity to overflow	170	18.70
Shower	Flow rate (litres / minute)	8	34.96
Kitchen sink taps	Flow rate (litres / minute)	6	13.00
Has a washing machine been specified?		Yes	
Washing Machine	Litres / kg	8.17	17.16
Has a dishwasher been specified?		Yes	
Dishwasher	Litres / place setting	1.25	4.50
Has a waste disposal unit been specified?		No	0.00
Water Softener	Litres / person / day		0.00
Calculated Use			112.9
Normalisation factor			0.91
Code for Sustainable Homes	Total Consumption		102.8
	Mandatory level		Level 3/4
Building Regulations 17.K	External use		5.0
	Total Consumption		107.8
	17.K Compliance?		Yes

Figure 8.3 – Water Efficiency Calculator for New Dwellings

It should be noted that instructions/labelling should be specified on WC dual flush cistern system to encourage reduced water consumption.

It is also proposed to provide water meters to each of the dwellings. These meters will be located in an accessible location to allow occupiers to monitor their water usage.

8.4 Summary

In conclusion, the limiting of water flow rates and appliance capacity has been identified as the most appropriate route to achieve regulated water usage on the St John's Wood Park development of <105l/p/day.

9. RESOURCE EFFICIENCY

9.1 Overview

Resource efficiency means utilising the earth's limited natural resources in a sustainable manner and in turn mitigating negative environmental impacts. The management of waste is increasingly recognised by local authorities as an area that should be addressed in the development of design proposals. The Camden Sustainability SPG dictates that efforts should be demonstrated to minimise waste and maximise recycling & reuse of materials through both the construction process and future occupation. This section of the report will outline a strategy for a resource efficient development at St John's Wood Park.

9.2 Waste Hierarchy

The Waste Hierarchy aids in identifying actions that can improve resource efficiency by prioritising waste management options in line with their relative impact.

Figure 9.1 – The Waste Hierarchy (Image Source: BRE Website)

The Building Research Establishment (BRE) outline the following steps in identifying a route to resource efficiency:

- Where is waste being produced?
- What is the cause of this and is it avoidable?
- If not avoidable, what opportunities are there for this material to be used internally, or by another business through recycling or refurbishing?
- Can improvements be made to the way waste is currently handled?

9.3 Construction Waste

Construction waste can be minimised during the construction process via the effective and appropriate management of construction site waste.

It is proposed that this is implemented on the St John's Wood Park site through the production of a Site Waste Management Plan (SWMP) outlining procedures and good practice measures that can be adopted on site.

It is proposed that a SWMP will be developed for the site in accordance with guidance from:

- DEFRA (Department for Environment, Food and Rural Affairs);
- BRE (Building Research Establishment);
- Envirowise;
- WRAP (Waste & Resources Action Programme); and
- Environmental performance indicators and / or key performance indicators (KPI) from Envirowise or Constructing Excellence.

The SWMP will outline the following:

- Target benchmarks for resource efficiency, i.e. m^3 of waste per $100m^2$ or tonnes of waste per $100m^2$ set in accordance with best practice;
- Procedures and commitments to minimize non-hazardous construction waste at design stage. Specify waste minimisation actions relating to at least 3 waste groups and support them by appropriate monitoring of waste;
- Procedures for minimising hazardous waste;
- Monitoring, measuring and reporting of hazardous and non-hazardous site waste production according to the defined waste groups; and
- Procedures to divert waste from landfill through re-use on site, re-use on other sites, reclaim for re-use, return to the supplier via a 'take-back' scheme, recovery and recycling using an approved waste management contractor or composting according the defined waste groups.

The defined waste groups referenced in the SWMP will include the following materials as defined in the European Waste Catalogue: bricks, concrete, insulation, packaging, timber, electrical and electronic equipment, canteen / office / ad hoc, asphalt & tar, tiles and ceramics, inert materials, metals, gypsum, plastics, floor coverings, soils, hazardous materials, architectural features and other / mixed materials.

The target benchmarks for resource efficiency will be set using best practice and will be reviewed throughout the construction process.

9.4 Built Fabric Resource Efficiency

The resource intensity of the building fabric of the proposed dwellings can be addressed through the specification of 'resource light' construction and consideration of the end of life of the building.

Resource-light construction refers to the appropriate use of construction materials and building techniques to provide the most efficient response to the particular building requirements. 'Eco' materials will be considered for their applicability to the scheme as the architectural design progresses. Eco-materials are less resource intensive than alternative materials, and have a lower level of embodied carbon as a result of their sourcing, production process, delivery requirements etc. Examples of these materials are locally sourced eco-cement, wood, straw, clay etc. The application of these materials in the final site proposals will be within the site, economic and thermal performance constraints of the scheme.

The design of the scheme will also consider the end of life of the future dwellings. The following options will be explored as the scheme develops to maximise the end of life potential for the dwellings:

- The use of prefabricated components may make them easier to dismantle on demolition and therefore more appropriate for re-use;
- Utilising simple connections and avoiding non-standard connection details will allow for efficient deconstruction and will reduce the need for multiple tools;
- Designing with reusable and adaptable materials. Materials such as bricks, steel beams / columns and wood can be easily re-used / repurposed to avoid them going to landfill on demolition; and
- Resilience to climate change may extend the lifetime of the dwellings and therefore the economic life of the dwellings.

9.5 Recycling and Composting In-use

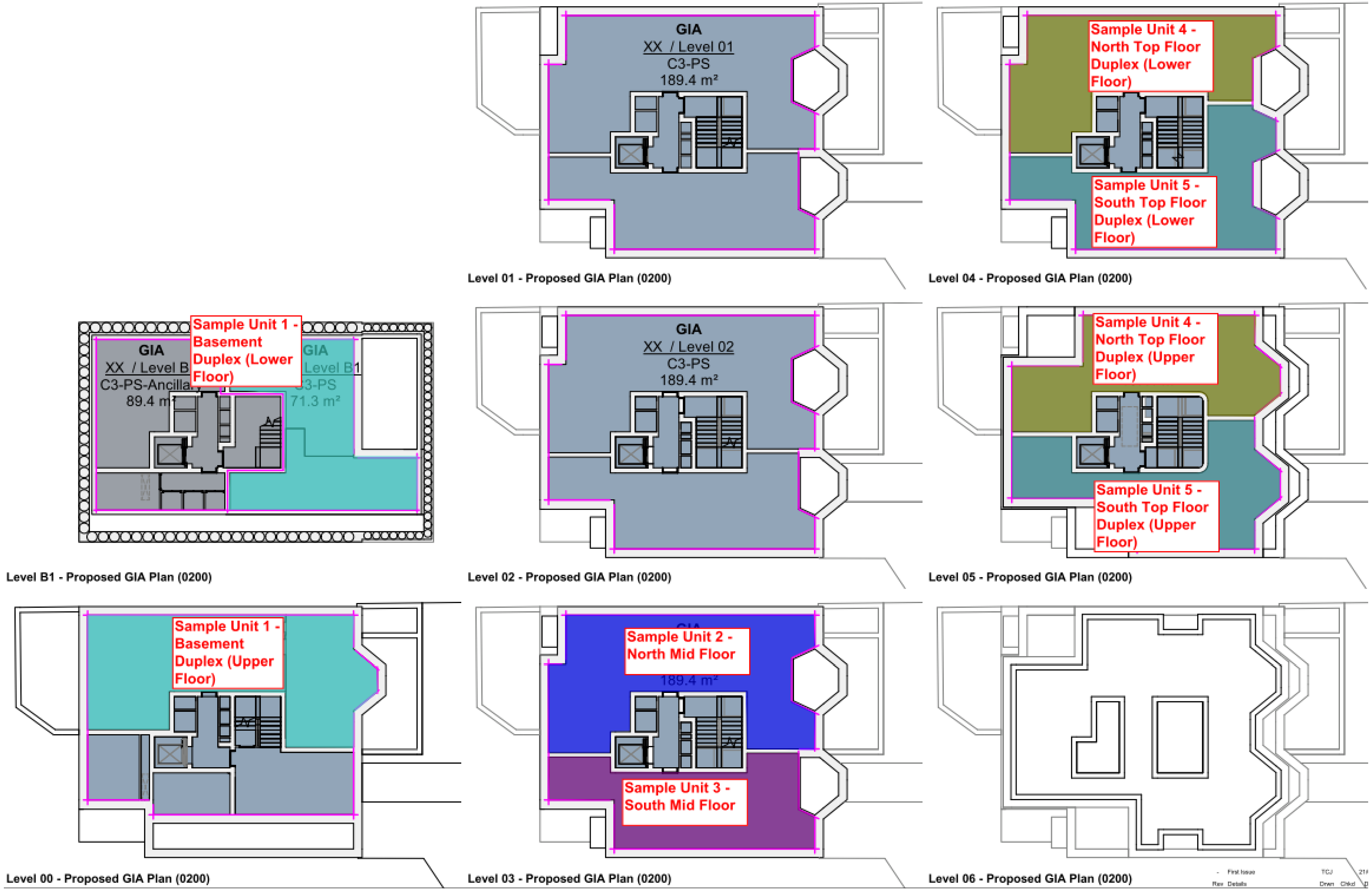
Encouraging the occupants of the development to recycle and compost biodegradable waste will aid in reducing the amount of waste being sent to landfill through the lifetime of the St John's Wood Park development. It is proposed that the Homes User Guides will include a section on Recycling and Waste to provide guidance on good practices to the future occupants.

The Waste Hierarchy aids in identifying actions that can improve resource efficiency by prioritising waste management options in line with their relative impact.

It is proposed that this section of the Home User Guide will include the following:

- Information about the Local Authority collection scheme;
- Information on the Waste and Resource Action Programme (WRAP) which can offer guidance on recycling and sustainable waste disposal;
- Information on the procedure to follow with items of waste not covered by the standard weekly Local Authority collection scheme – for example fridges / freezers, computer equipment, batteries and other potentially hazardous equipment; and
- Information and location of local recycling facilities and waste tips.

APPENDIX 1 – SAP SAMPLE APARTMENT MARK UP



APPENDIX 2 – SAMPLE RESIDENTIAL SAPS

Example Full SAP Calculation - Lean Scenario

Property Reference	Unit 3			Issued on Date	26/09/2018
Survey Reference	Lean	Prop Type Ref		Unit 3 - Mid Floor South	
Property					

SAP Rating	82 B	DER	17.92	TER	19.09
Environmental	87 B	% DER<TER	6.12		
CO Emissions (t/year)	0.93	DFEE	50.98	TFEE	55.50
General Requirements Compliance	Pass	% DFEE<TFEE	8.15		

Surveyor	Jessica Finnigan, Tel: .	Surveyor ID	Admin
Client	Almax, 5006835		

SAP2012 - 9.92 input data (DesignData) -

```
SAP2012 Input Data (Flat)     26/09/2018

FullRefNo:                    Lean

Regs Region:                  England
SAP Region:                   Thames Valley
Postcode:
DwellingOrientation:          North
Property Type:                Flat, End-Terrace
Storeys:                      1
Date Built:                   2019
Sheltered Sides:              1
Sunlight Shade:               Average or unknown
Measurements                  Perimeter, Floor Area, Storey Height
     1st Storey:              38.58, 62.3, 2.7
Living Area:                  18.7 m2, fraction: 30.0%
Thermal Mass:                 Simple calculation
Thermal Mass Simple:          Medium
Thermal MassValue:            250
External Walls                Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1               61.15, 85.4, 0, Other, Cavity, 0, 0.16, Gross
Corridor Wall                 27.66, 29.76, 0, Other, Cavity, 0.43, 0.225733634311512, Gross
External Roofs                Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
Party Ceilings                Area, Kappa, Construction, Element
     Party Ceilings 1         62.3, 0, Other
Heat Loss Floors              Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
Party Floors                  Area, Kappa, Construction, Element
     Party Floor 1            62.3, 0
Description                   Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
     Front Door               Manufacturer, Solid Door, , , , , , ,
     Windows                  Manufacturer, Window, Double glazed, , , 0.45, , 0.7,
Openings                      Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
     Front Door               Solid Door, Corridor Wall, North, , , , , 0, 0, 0, 2.10,
     East Windows             Window, External Wall 1, East, , None, 0, , 0, 0, 0, 7.49,
     West Windows             Window, External Wall 1, West, , None, 0, , 0, 0, 0, 6.61,
     South Windows            Window, External Wall 1, South, , None, 0, , 0, 0, 0, 3.75,
     South East Windows       Window, External Wall 1, South East, , None, 0, , 0, 0, 0, 3.20,
     North East Windows       Window, External Wall 1, North East, , None, 0, , 0, 0, 0, 3.20,
Conservatory:                 None
Draught Proofing:             100
Draught Lobby:                Yes
Thermal Bridges
     Bridging:                Calculate Bridges
     Y                        0.122
     List of Bridges          Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
     0.                       External wall, E2 Other lintels (including other steel lintels), Table K1 - Approved, No, 10.23, 0.3, 0.3, 3.07,
     1.                       External wall, E3 Sill, Table K1 - Approved, No, 10.23, 0.04, 0.04, 0.41,
     2.                       External wall, E4 Jamb, Table K1 - Approved, No, 33.18, 0.05, 0.05, 1.66,
     3.                       External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Approved, No, 57.22, 0.07, 0.07, 4.01,
     4.                       External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Default, No, 19.94, 0.14, 0.14, 2.79,
     5.                       External wall, E16 Corner (normal), Table K1 - Approved, No, 14.93, 0.09, 0.09, 1.34,
     6.                       External wall, E17 Corner (inverted - internal area greater than external area), Table K1 - Approved, No, 5.97, -0.09, -0.09, -
0.54,
     7.                       External wall, E17 Corner (inverted - internal area greater than external area), Table K1 - Default, No, 5.97, 0, 0, 0.00,
     8.                       External wall, E18 Party wall between dwellings, Table K1 - Approved, No, 2.99, 0.06, 0.06, 0.18,
     9.                       External wall, E18 Party wall between dwellings, Table K1 - Default, No, 5.97, 0.12, 0.12, 0.72,
     10.                      External wall, E25 Staggered party wall between dwellings, Table K1 - Default, No, 2.99, 0.12, 0.12, 0.36,
Pressure Test:                True
Designed q50:                 3
AsBuilt q50:                  15
Property Tested:              False
Mechanical Ventilation
     MV System Present        Yes
     Windows In Hot Weather   Windows fully open
     Cross Ventilation        Yes
     Night Ventilation        Yes
     Air Change Rate          6.00
     Approved Installation    Yes
     DataType                 Database
     Type                     Balanced mechanical ventilation with heat recovery
     Database Ref Number      500499
     Configuration            3
     HR Duct Insulated        Yes
     ManufacturerSFP          0.66
     DuctType                 Rigid
     HR Efficiency            87
     Wet Rooms                3
Chimneys MHS:                 0
```

SAP2012 - 9.92 input data (DesignData) -

Chimneys SHS:	0
Chimneys Other:	0
Chimneys Total:	0
Open Flues MHS:	0
Open Flues SHS:	0
Open Flues Other:	0
Open Flues Total:	0
Intermittent Fans:	0
Passive Vents:	0
Flueless Gas Fires:	0
Cooling System	
Cooled Area	30.37
Data Source	Manufacturer
Type	Split or Multi-Split
Energy Efficiency Ratio	9.02
Control	Modulating
Light Fittings:	9
LEL Fittings:	9
Percentage of LEL Fittings:	100
External Lights Fitted:	Yes
External LELs Fitted:	Yes
Electricity Tariff:	Standard
Main Heating 1	None
Main Heating 2	None
Heating Systems Interaction	Each system heats separate parts of dwelling
Smoke Control Area	Unknown
Community Heating	
Type	Space and Water Combined
PCDF Index	n/a
Distribution Loss	Piping system >= 1991, pre-insulated, low temp, variable flow
Controls	CCL
Ctrl SAP Code	2312
Community Heating Heat Sources:	Source, Fuel Type, Heating Use, Percentage, Overal Efficiency, Electrical Efficiency, Heat Power Ratio, Heat Efficiency
1	Boilers, Space and Water, 100, 95
Secondary Heating	None
Water Heating	
Type	CommunityHeating
WHS	HWP From main heating 1
Low Water Usage	Yes
SAP Code	901
Showers in Property	Non-electric only
Hot Water Cylinder	
Cylinder Type	HotWaterCylinder
Cylinder Insulation Type	Foam
Cylinder Volume	3.00
Cylinder Stat	Yes
Pipeworks Insulated	Fully insulated primary pipework
Cylinder in Heated Space	Yes
Flue Gas Heat Recovery System	None
Waste Water Heat Recovery	none
PV Unit	None
Wind Turbine	None
Terrain Type:	Urban
Small Scale Hydro	None
Special Features	None

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

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 62 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:Mains gas (c)
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.09 kgCO_2/m^2
Dwelling Carbon Dioxide Emission Rate (DER) 17.92 kgCO_2/m^{2}OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.5 kWh/m^2/yr
Dwelling Fabric Energy Efficiency (DFEE)51.0 kWh/m^2/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.23 (max. 0.70)	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.00 (max. 2.00)	1.00 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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3 Air permeability

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

---

4 Heating efficiency

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

---

5 Cylinder insulation

Hot water storage	Nominal cylinder loss: 0.25 kWh/day	
Permitted by DBSCG 0.35	OK	
Primary pipework insulated:	Yes (assumed)	OK

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


Hot water controls:                 Cylinderstat                                       OK

----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                             75%                                                OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:                 0.66
Maximum                             1.5                                                OK
MVHR efficiency:                    87%
Minimum:                            70%                                                OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):   Slight                                             OK
Based on:
Overshading:                        Average
Windows facing North East:          3.20 m², No overhang
Windows facing East:                7.49 m², No overhang
Windows facing South East:          3.20 m², No overhang
Windows facing South:               3.75 m², No overhang
Windows facing West:                6.61 m², No overhang
Air change rate:                    6.00 ach
Blinds/curtains:                    None
----------------------------------------------------------------------------------------------------
10 Key features
Door U-value                        1.00 W/m²K
Window U-value                      1.00 W/m²K
Air permeability                    3.0 m³/m²h


----------------------------------------------------------------------------------------------------
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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	62.3000 (1b)	x	2.7000 (2b)	=	168.2100	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.3000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	168.2100	(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 q50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.9500 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3072	0.3037	0.3002	0.2829	0.2794	0.2621	0.2621	0.2586	0.2690	0.2794	0.2863	0.2933	(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	
Front Door			2.1000	1.0000	2.1000			(26)
Windows (Uw = 1.00)			24.2500	0.9615	23.3173			(27)
External Wall 1	85.4000	24.2500	61.1500	0.1600	9.7840			(29a)
Corridor Wall	29.7600	2.1000	27.6600	0.2257	6.2438			(29a)
Total net area of external elements Aum(A, m2)			115.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.4451			(33)
Party Floor 1			62.3000					(32d)
Party Ceilings 1			62.3000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.9952	(36)
Total fabric heat loss	(33) + (36) =	55.4403	(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	17.0500	16.8575	16.6649	15.7022	15.5096	14.5469	14.5469	14.3544	14.9320	15.5096	15.8947	16.2798	(38)
Heat transfer coeff	72.4903	72.2978	72.1052	71.1425	70.9499	69.9872	69.9872	69.7947	70.3723	70.9499	71.3350	71.7201	(39)
Average = Sum(39)m / 12 =												71.0944	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1636	1.1605	1.1574	1.1419	1.1388	1.1234	1.1234	1.1203	1.1296	1.1388	1.1450	1.1512	(40)
HLP (average)												1.1412	(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	2.0459	(42)
Average daily hot water use (litres/day)	82.7892	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.0681	87.7566	84.4450	81.1334	77.8219	74.5103	74.5103	77.8219	81.1334	84.4450	87.7566	91.0681	(44)
Energy conte	135.0514	118.1168	121.8860	106.2632	101.9620	87.9855	81.5315	93.5586	94.6759	110.3357	120.4400	130.7901	(45)
Energy content (annual)										Total = Sum(45)m =		1302.5967	(45)
Distribution loss (46)m = 0.15 x (45)m	20.2577	17.7175	18.2829	15.9395	15.2943	13.1978	12.2297	14.0338	14.2014	16.5504	18.0660	19.6185	(46)

Water storage loss:

Store volume		3.0000	(47)
b) If manufacturer declared loss factor is not known :			
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.0240	(51)
Volume factor from Table 2a		3.4200	(52)
Temperature factor from Table 2b		0.6000	(53)
Enter (49) or (54) in (55)		0.1475	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	4.5734	4.1308	4.5734	4.4259	4.5734	4.4259	4.5734	4.5734	4.4259	4.5734	4.4259	4.5734	(56)
If cylinder contains dedicated solar storage	4.5734	4.1308	4.5734	4.4259	4.5734	4.4259	4.5734	4.5734	4.4259	4.5734	4.4259	4.5734	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	162.8872	143.2589	149.7218	133.2010	129.7978	114.9234	109.3673	121.3944	121.6138	138.1715	147.3779	158.6259	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	162.8872	143.2589	149.7218	133.2010	129.7978	114.9234	109.3673	121.3944	121.6138	138.1715	147.3779	158.6259	(64)
Total per year (kWh/year) = Sum(64)m =												1630.3410	(64)
Heat gains from water heating, kWh/month	67.1732	59.3875	62.7957	56.8828	56.1710	50.8055	49.3779	53.3769	53.0301	58.9553	61.5966	65.7564	(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	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.9320	14.1506	11.5081	8.7123	6.5126	5.4982	5.9410	7.7223	10.3649	13.1606	15.3604	16.3748	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	178.7081	180.5625	175.8894	165.9409	153.3827	141.5798	133.6947	131.8403	136.5134	146.4619	159.0201	170.8230	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	(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)	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	(71)
Water heating gains (Table 5)	90.2866	88.3742	84.4029	79.0039	75.4987	70.5632	66.3681	71.7431	73.6529	79.2410	85.5509	88.3822	(72)
Total internal gains	338.6146	336.7753	325.4883	307.3451	289.0819	271.3291	259.6918	264.9937	274.2191	292.5514	313.6192	329.2679	(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	
Northeast	3.2000	11.2829	0.4500	0.7000	0.7700	7.8816	(75)
East	7.4900	19.6403	0.4500	0.7000	0.7700	32.1124	(76)
Southeast	3.2000	36.7938	0.4500	0.7000	0.7700	25.7021	(77)
South	3.7500	46.7521	0.4500	0.7000	0.7700	38.2715	(78)
West	6.6100	19.6403	0.4500	0.7000	0.7700	28.3395	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	132.3072	240.7592	363.4008	495.9646	589.0724	597.3924	570.8754	500.9302	409.9912	275.9194	161.4436	111.2150	(83)
Total gains	470.9218	577.5345	688.8891	803.3096	878.1543	868.7216	830.5671	765.9239	684.2103	568.4708	475.0629	440.4829	(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	59.6823	59.8412	60.0010	60.8130	60.9780	61.8169	61.8169	61.9874	61.4786	60.9780	60.6489	60.3232	
alpha	4.9788	4.9894	5.0001	5.0542	5.0652	5.1211	5.1211	5.1325	5.0986	5.0652	5.0433	5.0215	
util living area	0.9944	0.9845	0.9539	0.8623	0.6981	0.5071	0.3693	0.4164	0.6688	0.9229	0.9871	0.9959	(86)
MIT	19.8838	20.1041	20.4153	20.7462	20.9292	20.9888	20.9982	20.9967	20.9576	20.6779	20.2115	19.8452	(87)
Th 2	19.9493	19.9517	19.9542	19.9667	19.9692	19.9818	19.9818	19.9843	19.9768	19.9692	19.9642	19.9592	(88)
util rest of house	0.9926	0.9797	0.9400	0.8263	0.6366	0.4302	0.2846	0.3259	0.5852	0.8930	0.9822	0.9946	(89)
MIT 2	18.4803	18.8005	19.2429	19.6936	19.9081	19.9752	19.9812	19.9831	19.9476	19.6217	18.9675	18.4314	(90)
Living area fraction									fLA = Living area / (4) =			0.3002	(91)
MIT	18.9015	19.1918	19.5948	20.0095	20.2146	20.2794	20.2864	20.2873	20.2508	19.9387	19.3409	18.8557	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9015	19.1918	19.5948	20.0095	20.2146	20.2794	20.2864	20.2873	20.2508	19.9387	19.3409	18.8557	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9901	0.9750	0.9342	0.8280	0.6519	0.4530	0.3101	0.3531	0.6086	0.8920	0.9783	0.9926	(94)
Useful gains	466.2492	563.1095	643.5397	665.1147	572.4931	393.5200	257.5564	270.4626	416.4365	507.0549	464.7465	437.2198	(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	1058.4700	1033.2639	944.2051	790.3600	604.1100	397.4865	258.0032	271.3158	432.8428	662.5807	873.2017	1051.1118	(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	440.6123	315.9437	223.6951	90.1766	23.5230	0.0000	0.0000	0.0000	0.0000	115.7112	294.0878	456.7357	(98)
Space heating												1960.4853	(98)

Space heating per m2 (98) / (4) = 31.4685 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	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	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	657.8797	517.9053	530.4394	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9680	0.9856	0.9784	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	636.8557	510.4310	519.0078	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1084.1110	1038.2602	963.5666	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	322.0238	392.7049	330.7517	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1045.4805	(104)
Cooled fraction									fC = cooled area / (4) =			0.4875	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	39.2450	47.8589	40.3087	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												127.4127	(107)
Space cooling per m2												2.0451	(108)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Boilers	1.0000	(303a)
Fraction of total space heat from community Boilers	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	1960.4853	(98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05	2058.5096	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	1630.3410	(64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05	1711.8580	(310a)
Electricity used for heat distribution	37.7037	(313)
Cooling System Energy Efficiency Ratio	12.1770	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	10.4634	(315)
Annual totals kWh/year		
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)		
mechanical ventilation fans (SFP = 0.8250)	169.3034	(330a)
Total electricity for the above, kWh/year	169.3034	(331)
Electricity for lighting (calculated in Appendix L)	281.3633	(332)
Total delivered energy for all uses	4231.4977	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			95.0000	(367a)
Space heating from Boilers	3968.8080	0.2160	857.2625	(367)
Electrical energy for heat distribution	37.7037	0.5190	19.5682	(372)
Total CO2 associated with community systems			876.8307	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			876.8307	(376)
Space cooling	10.4634	0.5190	5.4305	(377)
Pumps and fans	169.3034	0.5190	87.8684	(378)
Energy for lighting	281.3633	0.5190	146.0276	(379)
Total CO2, kg/year			1116.1572	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			17.9200	(384)

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

DER		17.9200	ZC1
Total Floor Area	TFA	62.3000	
Assumed number of occupants	N	2.0459	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.9982	ZC2
CO2 emissions from cooking, equation (L16)		2.6982	ZC3
Total CO2 emissions		37.6164	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		37.6164	ZC8

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		62.3000 (1b)	x	2.7000 (2b)	=	168.2100	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.3000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	168.2100	(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) =	0.1189	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3689	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3412	(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	0.4351	0.4265	0.4180	0.3754	0.3668	0.3242	0.3242	0.3156	0.3412	0.3668	0.3839	0.4009	(22b)
Effective ac	0.5946	0.5910	0.5874	0.5704	0.5673	0.5525	0.5525	0.5498	0.5582	0.5673	0.5737	0.5804	(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)			13.4700	1.3258	17.8580			(27)
External Wall 1	85.4000	13.4700	71.9300	0.1800	12.9474			(29a)
Corridor Wall	29.7600	2.1000	27.6600	0.1800	4.9788			(29a)
Total net area of external elements Aum(A, m2)			115.1600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.8842			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.0693	(36)
Total fabric heat loss	(33) + (36) =	46.9535	(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	33.0082	32.8042	32.6043	31.6650	31.4893	30.6713	30.6713	30.5198	30.9864	31.4893	31.8448	32.2164	(38)
Heat transfer coeff	79.9617	79.7577	79.5577	78.6185	78.4428	77.6247	77.6247	77.4732	77.9398	78.4428	78.7983	79.1699	(39)
Average = Sum(39)m / 12 =												78.6176	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2835	1.2802	1.2770	1.2619	1.2591	1.2460	1.2460	1.2436	1.2510	1.2591	1.2648	1.2708	(40)
HLP (average)												1.2619	(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	2.0459	(42)
Average daily hot water use (litres/day)	82.7892	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.0681	87.7566	84.4450	81.1334	77.8219	74.5103	74.5103	77.8219	81.1334	84.4450	87.7566	91.0681	(44)
Energy conte	135.0514	118.1168	121.8860	106.2632	101.9620	87.9855	81.5315	93.5586	94.6759	110.3357	120.4400	130.7901	(45)
Energy content (annual)										Total = Sum(45)m =		1302.5967	(45)
Distribution loss (46)m = 0.15 x (45)m	20.2577	17.7175	18.2829	15.9395	15.2943	13.1978	12.2297	14.0338	14.2014	16.5504	18.0660	19.6185	(46)

Water storage loss:		
Store volume	3.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	0.2602	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.1405	(55)
Total storage loss		

	4.3553	3.9338	4.3553	4.2148	4.3553	4.2148	4.3553	4.3553	4.2148	4.3553	4.2148	4.3553	(56)
If cylinder contains dedicated solar storage													
	4.3553	3.9338	4.3553	4.2148	4.3553	4.2148	4.3553	4.3553	4.2148	4.3553	4.2148	4.3553	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	162.6691	143.0618	149.5037	132.9899	129.5797	114.7123	109.1491	121.1762	121.4027	137.9534	147.1668	158.4078	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	162.6691	143.0618	149.5037	132.9899	129.5797	114.7123	109.1491	121.1762	121.4027	137.9534	147.1668	158.4078	(64)
								Total per year (kWh/year) = Sum(64)m =				1627.7725	(64)
Heat gains from water heating, kWh/month													
	66.9987	59.2298	62.6212	56.7139	55.9965	50.6366	49.2034	53.2024	52.8612	58.7808	61.4277	65.5818	(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	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.9484	14.1652	11.5199	8.7213	6.5193	5.5038	5.9471	7.7303	10.3756	13.1741	15.3762	16.3916	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	178.7081	180.5625	175.8894	165.9409	153.3827	141.5798	133.6947	131.8403	136.5134	146.4619	159.0201	170.8230	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	(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)													
	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	(71)
Water heating gains (Table 5)													
	90.0521	88.1396	84.1683	78.7693	75.2641	70.3286	66.1335	71.5085	73.4183	79.0064	85.3163	88.1476	(72)
Total internal gains													
	341.3964	339.5553	328.2655	310.1195	291.8541	274.1002	262.4633	267.7671	276.9952	295.3304	316.4005	332.0502	(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	
Northeast	1.7800	11.2829	0.6300	0.7000	0.7700	6.1378	(75)
East	4.1600	19.6403	0.6300	0.7000	0.7700	24.9697	(76)
Southeast	1.7800	36.7938	0.6300	0.7000	0.7700	20.0155	(77)
South	2.0800	46.7521	0.6300	0.7000	0.7700	29.7191	(78)
West	3.6700	19.6403	0.6300	0.7000	0.7700	22.0285	(80)

Solar gains	102.8706	187.1982	282.5676	385.6622	458.0780	464.5544	443.9311	389.5293	318.8006	214.5395	125.5254	86.4706	(83)
Total gains	444.2670	526.7534	610.8332	695.7817	749.9321	738.6546	706.3944	657.2963	595.7958	509.8699	441.9259	418.5208	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.1058	54.2442	54.3805	55.0302	55.1534	55.7347	55.7347	55.8436	55.5093	55.1534	54.9046	54.6469	
alpha	4.6071	4.6163	4.6254	4.6687	4.6769	4.7156	4.7156	4.7229	4.7006	4.6769	4.6603	4.6431	
util living area													
	0.9958	0.9903	0.9744	0.9249	0.8123	0.6347	0.4753	0.5280	0.7799	0.9553	0.9913	0.9968	(86)
MIT	19.6858	19.8772	20.1773	20.5453	20.8221	20.9586	20.9914	20.9862	20.8917	20.5141	20.0295	19.6535	(87)
Th 2	19.8538	19.8564	19.8589	19.8708	19.8730	19.8834	19.8834	19.8853	19.8794	19.8730	19.8685	19.8638	(88)
util rest of house													
	0.9944	0.9870	0.9657	0.8993	0.7538	0.5393	0.3589	0.4072	0.6939	0.9345	0.9878	0.9957	(89)
MIT 2	18.1252	18.4049	18.8383	19.3584	19.7088	19.8578	19.8805	19.8801	19.7991	19.3298	18.6366	18.0850	(90)
Living area fraction									fLA = Living area / (4) =			0.3002	(91)
MIT	18.5936	18.8469	19.2402	19.7147	20.0430	20.1882	20.2139	20.2121	20.1271	19.6853	19.0547	18.5558	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5936	18.8469	19.2402	19.7147	20.0430	20.1882	20.2139	20.2121	20.1271	19.6853	19.0547	18.5558	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9921	0.9830	0.9595	0.8951	0.7635	0.5666	0.3940	0.4436	0.7149	0.9301	0.9842	0.9939	(94)
Useful gains	440.7561	517.8223	586.0747	622.7759	572.5970	418.5057	278.3473	291.5800	425.9349	474.2445	434.9356	415.9545	(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													
	1142.9435	1112.3697	1013.5805	850.2321	654.4482	433.7841	280.5307	295.3362	469.7480	712.6744	942.0089	1136.5459	(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													
	522.4274	399.5359	318.0643	163.7684	60.8973	0.0000	0.0000	0.0000	0.0000	177.3918	365.0928	536.1200	(98)
Space heating												2543.2979	(98)
Space heating per m2											(98) / (4) =	40.8234	(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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2720.1048	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	522.4274	399.5359	318.0643	163.7684	60.8973	0.0000	0.0000	0.0000	0.0000	177.3918	365.0928	536.1200	(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)	558.7459	427.3111	340.1757	175.1534	65.1309	0.0000	0.0000	0.0000	0.0000	189.7239	390.4736	573.3903	(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	162.6691	143.0618	149.5037	132.9899	129.5797	114.7123	109.1491	121.1762	121.4027	137.9534	147.1668	158.4078	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.7076	87.4098	86.7795	85.3702	82.9349	79.8000	79.8000	79.8000	79.8000	85.4856	87.1431	87.8144	(217)
Fuel for water heating, kWh/month	185.4674	163.6679	172.2800	155.7803	156.2426	143.7497	136.7784	151.8499	152.1337	161.3762	168.8794	180.3892	(219)

Water heating fuel used	1928.5947	(219)
Annual totals kWh/year		
Space heating fuel - main system	2720.1048	(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)	281.6528	(232)
Total delivered energy for all uses	5005.3523	(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	2720.1048	0.2160	587.5426	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1928.5947	0.2160	416.5765	(264)
Space and water heating			1004.1191	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	281.6528	0.5190	146.1778	(268)
Total CO2, kg/m2/year			1189.2219	(272)
Emissions per m2 for space and water heating			16.1175	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.3464	(272b)
Emissions per m2 for pumps and fans			0.6248	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.1175 * 1.00) + 2.3464 + 0.6248, rounded to 2 d.p.			19.0900	(273)

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		62.3000 (1b)	x	2.7000 (2b)	=	168.2100	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.3000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	168.2100	(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) =	0.1189	(8)
Pressure test			Yes	
Measured/design q50			3.0000	
Infiltration rate			0.2689	(18)
Number of sides sheltered			1	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.2487	(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	0.3171	0.3109	0.3047	0.2736	0.2674	0.2363	0.2363	0.2301	0.2487	0.2674	0.2798	0.2923	(22b)
Effective ac	0.5503	0.5483	0.5464	0.5374	0.5357	0.5279	0.5279	0.5265	0.5309	0.5357	0.5392	0.5427	(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	
Front Door			2.1000	1.0000	2.1000			(26)
Windows (Uw = 1.00)			24.2500	0.9615	23.3173			(27)
External Wall 1	85.4000	24.2500	61.1500	0.1600	9.7840			(29a)
Corridor Wall	29.7600	2.1000	27.6600	0.2257	6.2438			(29a)
Total net area of external elements Aum(A, m2)			115.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.4451			(33)
Party Floor 1			62.3000					(32d)
Party Ceilings 1			62.3000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.9952	(36)
Total fabric heat loss	(33) + (36) =	55.4403	(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	30.5460	30.4376	30.3314	29.8324	29.7390	29.3043	29.3043	29.2239	29.4718	29.7390	29.9279	30.1253	(38)
Heat transfer coeff	85.9863	85.8779	85.7717	85.2727	85.1793	84.7446	84.7446	84.6642	84.9121	85.1793	85.3682	85.5656	(39)
Average = Sum(39)m / 12 =												85.2722	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3802	1.3785	1.3768	1.3687	1.3672	1.3603	1.3603	1.3590	1.3630	1.3672	1.3703	1.3734	(40)
HLP (average)												1.3687	(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	2.0459	(42)
Average daily hot water use (litres/day)	82.7892	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.0681	87.7566	84.4450	81.1334	77.8219	74.5103	74.5103	77.8219	81.1334	84.4450	87.7566	91.0681	(44)
Energy conte	135.0514	118.1168	121.8860	106.2632	101.9620	87.9855	81.5315	93.5586	94.6759	110.3357	120.4400	130.7901	(45)
Energy content (annual)										Total = Sum(45)m =		1302.5967	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage 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	(56)

If cylinder contains dedicated solar storage

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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)
Heat gains from water heating, kWh/month	28.6984	25.0998	25.9008	22.5809	21.6669	18.6969	17.3254	19.8812	20.1186	23.4463	25.5935	27.7929	(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	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.9320	14.1506	11.5081	8.7123	6.5126	5.4982	5.9410	7.7223	10.3649	13.1606	15.3604	16.3748	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	178.7081	180.5625	175.8894	165.9409	153.3827	141.5798	133.6947	131.8403	136.5134	146.4619	159.0201	170.8230	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	(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)	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	(71)
Water heating gains (Table 5)	38.5732	37.3509	34.8129	31.3624	29.1222	25.9679	23.2869	26.7220	27.9426	31.5139	35.5465	37.3560	(72)
Total internal gains	286.9011	285.7520	275.8983	259.7036	242.7055	226.7339	216.6105	219.9726	228.5088	244.8243	263.6149	278.2417	(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	
Northeast	3.2000	11.2829	0.4500	0.7000	0.7700	7.8816	(75)
East	7.4900	19.6403	0.4500	0.7000	0.7700	32.1124	(76)
Southeast	3.2000	36.7938	0.4500	0.7000	0.7700	25.7021	(77)
South	3.7500	46.7521	0.4500	0.7000	0.7700	38.2715	(78)
West	6.6100	19.6403	0.4500	0.7000	0.7700	28.3395	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	132.3072	240.7592	363.4008	495.9646	589.0724	597.3924	570.8754	500.9302	409.9912	275.9194	161.4436	111.2150	(83)
Total gains	419.2083	526.5112	639.2991	755.6681	831.7778	824.1263	787.4859	720.9028	638.5000	520.7437	425.0585	389.4568	(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	50.3148	50.3784	50.4408	50.7359	50.7916	51.0521	51.0521	51.1006	50.9514	50.7916	50.6792	50.5622	
alpha	4.3543	4.3586	4.3627	4.3824	4.3861	4.4035	4.4035	4.4067	4.3968	4.3861	4.3786	4.3708	
util living area	0.9967	0.9907	0.9726	0.9159	0.7939	0.6183	0.4641	0.5232	0.7781	0.9575	0.9928	0.9976	(86)
MIT	19.5269	19.7539	20.0996	20.5076	20.8089	20.9524	20.9892	20.9821	20.8707	20.4384	19.8918	19.4805	(87)
Th 2	19.7785	19.7799	19.7812	19.7874	19.7885	19.7939	19.7939	19.7949	19.7918	19.7885	19.7862	19.7838	(88)
util rest of house	0.9955	0.9876	0.9630	0.8873	0.7307	0.5178	0.3417	0.3945	0.6874	0.9369	0.9898	0.9967	(89)
MIT 2	18.4567	18.6830	19.0234	19.4135	19.6707	19.7745	19.7916	19.7905	19.7274	19.3611	18.8264	18.4145	(90)
Living area fraction									fLA = Living area / (4) =			0.3002	(91)
MIT	18.7779	19.0045	19.3464	19.7419	20.0124	20.1280	20.1511	20.1482	20.0706	19.6845	19.1462	18.7345	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7779	19.0045	19.3464	19.7419	20.0124	20.1280	20.1511	20.1482	20.0706	19.6845	19.1462	18.7345	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9942	0.9849	0.9587	0.8860	0.7435	0.5470	0.3787	0.4335	0.7107	0.9347	0.9876	0.9957	(94)
Useful gains	416.7701	518.5373	612.9116	669.5567	618.4397	450.8295	298.2288	312.5032	453.7749	486.7401	419.8038	387.7809	(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	1244.9051	1211.2619	1101.8589	924.5184	708.0422	468.4704	300.9335	317.3381	506.9739	773.8085	1028.3587	1243.6533	(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	616.1325	465.5110	363.7768	183.5724	66.6643	0.0000	0.0000	0.0000	0.0000	213.5788	438.1595	636.7690	(98)
Space heating												2984.1643	(98)
Space heating per m2											(98) / (4) =	47.8999	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	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	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	796.5996	627.1103	643.4475	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9051	0.9472	0.9269	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	720.9957	594.0275	596.4373	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1039.5158	995.1790	918.5455	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

Space cooling kWh

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	229.3344	298.4567	239.6485	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												767.4396	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	57.3336	74.6142	59.9121	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												191.8599	(107)
Space cooling per m2												3.0796	(108)
Energy for space heating												47.8999	(99)
Energy for space cooling												3.0796	(108)
Total												50.9795	(109)
Dwelling Fabric Energy Efficiency (DFEE)												51.0	(109)

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY      09 Jan 2014
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1. Overall dwelling dimensions
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                                                                                  Area          Storey height               Volume
                                                                                  (m2)               (m)                     (m3)
Ground floor                                                                   62.3000 (1b)    x       2.7000 (2b)    =     168.2100 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)               62.3000                                                  (4)
Dwelling volume                                                                     (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =     168.2100 (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                                                                                         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) =      0.1189 (8)
Pressure test                                                                                                                      Yes
Measured/design q50                                                                                                             5.0000
Infiltration rate                                                                                                               0.3689 (18)
Number of sides sheltered                                                                                                            1 (19)

Shelter factor                                                                              (20) = 1  -  [0.075 x (19)]  =      0.9250 (20)
Infiltration rate adjusted to include shelter factor                                                  (21) = (18) x (20)  =      0.3412 (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
                0.4351     0.4265     0.4180     0.3754     0.3668     0.3242     0.3242     0.3156     0.3412     0.3668     0.3839     0.4009 (22b)
Effective ac    0.5946     0.5910     0.5874     0.5704     0.5673     0.5525     0.5525     0.5498     0.5582     0.5673     0.5737     0.5804 (25)



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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                                                                 2.1000         1.0000         2.1000                              (26)
TER Opening Type (Uw = 1.40)                                                   13.4700         1.3258        17.8580                              (27)
External Wall 1                                 85.4000        13.4700         71.9300         0.1800        12.9474                              (29a)
Corridor Wall                                   29.7600         2.1000         27.6600         0.1800         4.9788                              (29a)
Total net area of external elements Aum(A, m2)                                115.1600                                                            (31)
Fabric heat loss, W/K = Sum (A x U)                                          (26)...(30) + (32) =        37.8842                              (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                 250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                          9.0693 (36)
Total fabric heat loss                                                                                           (33) + (36) =     46.9535 (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          33.0082    32.8042    32.6043    31.6650    31.4893    30.6713    30.6713    30.5198    30.9864    31.4893    31.8448    32.2164 (38)
Heat transfer coeff
               79.9617    79.7577    79.5577    78.6185    78.4428    77.6247    77.6247    77.4732    77.9398    78.4428    78.7983    79.1699 (39)
Average = Sum(39)m / 12 =                                                                                                          78.6176 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP             1.2835     1.2802     1.2770     1.2619     1.2591     1.2460     1.2460     1.2436     1.2510     1.2591     1.2648     1.2708 (40)
HLP (average)                                                                                                                       1.2619 (40)
Days in month
                    31         28         31         30         31         30         31         31         30         31         30         31 (41)



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4. Water heating energy requirements (kWh/year)
-------------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                   2.0459 (42)
Average daily hot water use (litres/day)                                                                                           82.7892 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
               91.0681    87.7566    84.4450    81.1334    77.8219    74.5103    74.5103    77.8219    81.1334    84.4450    87.7566    91.0681 (44)
Energy conte  135.0514   118.1168   121.8860   106.2632   101.9620    87.9855    81.5315    93.5586    94.6759   110.3357   120.4400   130.7901 (45)
Energy content (annual)                                                                                    Total = Sum(45)m =    1302.5967 (45)
Distribution loss  (46)m = 0.15 x (45)m
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (46)
Water storage loss:
Total storage 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 (56)
If cylinder contains dedicated solar storage
                0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (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)
```

Heat gains from water heating, kWh/month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	28.6984	25.0998	25.9008	22.5809	21.6669	18.6969	17.3254	19.8812	20.1186	23.4463	25.5935	27.7929	(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	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.9484	14.1652	11.5199	8.7213	6.5193	5.5038	5.9471	7.7303	10.3756	13.1741	15.3762	16.3916	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	178.7081	180.5625	175.8894	165.9409	153.3827	141.5798	133.6947	131.8403	136.5134	146.4619	159.0201	170.8230	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	(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)													
	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	(71)
Water heating gains (Table 5)													
	38.5732	37.3509	34.8129	31.3624	29.1222	25.9679	23.2869	26.7220	27.9426	31.5139	35.5465	37.3560	(72)
Total internal gains													
	286.9175	285.7665	275.9101	259.7125	242.7122	226.7395	216.6167	219.9805	228.5194	244.8379	263.6307	278.2586	(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	
Northeast	1.7800	11.2829	0.6300	0.7000	0.7700	6.1378	(75)
East	4.1600	19.6403	0.6300	0.7000	0.7700	24.9697	(76)
Southeast	1.7800	36.7938	0.6300	0.7000	0.7700	20.0155	(77)
South	2.0800	46.7521	0.6300	0.7000	0.7700	29.7191	(78)
West	3.6700	19.6403	0.6300	0.7000	0.7700	22.0285	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	102.8706	187.1982	282.5676	385.6622	458.0780	464.5544	443.9311	389.5293	318.8006	214.5395	125.5254	86.4706	(83)
Total gains	389.7881	472.9647	558.4777	645.3748	700.7902	691.2939	660.5478	609.5098	547.3201	459.3774	389.1561	364.7292	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.1058	54.2442	54.3805	55.0302	55.1534	55.7347	55.7347	55.8436	55.5093	55.1534	54.9046	54.6469	
alpha	4.6071	4.6163	4.6254	4.6687	4.6769	4.7156	4.7156	4.7229	4.7006	4.6769	4.6603	4.6431	
util living area													
	0.9976	0.9937	0.9817	0.9409	0.8400	0.6685	0.5057	0.5645	0.8173	0.9690	0.9948	0.9982	(86)
MIT	19.6070	19.8012	20.1081	20.4917	20.7918	20.9486	20.9888	20.9818	20.8661	20.4521	19.9543	19.5752	(87)
Th 2	19.8538	19.8564	19.8589	19.8708	19.8730	19.8834	19.8834	19.8853	19.8794	19.8730	19.8685	19.8638	(88)
util rest of house													
	0.9967	0.9915	0.9751	0.9194	0.7853	0.5716	0.3832	0.4377	0.7361	0.9536	0.9926	0.9976	(89)
MIT 2	18.5952	18.7903	19.0954	19.4732	19.7388	19.8612	19.8808	19.8805	19.8089	19.4454	18.9532	18.5713	(90)
Living area fraction									fLA = Living area / (4) =			0.3002	(91)
MIT	18.8989	19.0937	19.3993	19.7789	20.0549	20.1876	20.2134	20.2111	20.1263	19.7476	19.2537	18.8726	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8989	19.0937	19.3993	19.7789	20.0549	20.1876	20.2134	20.2111	20.1263	19.7476	19.2537	18.8726	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9957	0.9896	0.9718	0.9173	0.7952	0.5995	0.4203	0.4761	0.7562	0.9514	0.9910	0.9968	(94)
Useful gains	388.1262	468.0286	542.7030	592.0276	557.2476	414.4530	277.6236	290.2117	413.9034	437.0745	385.6594	363.5731	(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													
	1167.3526	1132.0602	1026.2423	855.2823	655.3800	433.7358	280.4874	295.2550	469.6849	717.5596	957.6920	1161.6295	(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													
	579.7444	446.2293	359.7533	189.5433	73.0105	0.0000	0.0000	0.0000	0.0000	208.6809	411.8634	593.7539	(98)
Space heating												2862.5791	(98)
Space heating per m2											(98) / (4) =	45.9483	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	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	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	729.6725	574.4230	588.7967	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8940	0.9421	0.9214	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	652.3427	541.1724	542.5379	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	884.2646	846.8178	788.3565	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	166.9838	227.4002	182.8890	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												577.2730	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                                                fC = cooled area / (4) =       1.0000 (105)
Intermittency factor (Table 10b)
                 0.0000      0.0000      0.0000      0.0000      0.0000      0.2500      0.2500      0.2500      0.0000      0.0000      0.0000      0.0000 (106)
Space cooling kWh
                 0.0000      0.0000      0.0000      0.0000      0.0000     41.7459     56.8500     45.7223      0.0000      0.0000      0.0000      0.0000 (107)
Space cooling                                                                                                                               144.3182 (107)
Space cooling per m2                                                                                                                          2.3165 (108)
Energy for space heating                                                                                                                     45.9483 (99)
Energy for space cooling                                                                                                                      2.3165 (108)
Total                                                                                                                                        48.2648 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                          55.5 (109)


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

1. Overall dwelling dimensions

	Area (m2)			Storey height (m)		Volume (m3)	
Ground floor	62.3000	(1b)	x	2.7000	(2b) =	168.2100	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 62.3000							(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		168.2100	(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 q50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1457	0.1388	0.1388	0.1283	0.1283	0.1145	0.1179	0.1110	0.1145	0.1214	0.1214	0.1318	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	73.9500	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2759	0.2690	0.2690	0.2586	0.2586	0.2447	0.2482	0.2413	0.2447	0.2517	0.2517	0.2621	(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	
Front Door			2.1000	1.0000	2.1000			(26)
Windows (Uw = 1.00)			24.2500	0.9615	23.3173			(27)
External Wall 1	85.4000	24.2500	61.1500	0.1600	9.7840			(29a)
Corridor Wall	29.7600	2.1000	27.6600	0.2257	6.2438			(29a)
Total net area of external elements Aum(A, m2)			115.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.4451			(33)
Party Floor 1			62.3000					(32d)
Party Ceilings 1			62.3000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.9952	(36)
Total fabric heat loss	(33) + (36) =	55.4403	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	15.3171	14.9320	14.9320	14.3544	14.3544	13.5842	13.7767	13.3916	13.5842	13.9693	13.9693	14.5469	(38)
Heat transfer coeff	70.7574	70.3723	70.3723	69.7947	69.7947	69.0245	69.2170	68.8319	69.0245	69.4096	69.4096	69.9872	(39)
Average = Sum(39)m / 12 =												69.6663	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1358	1.1296	1.1296	1.1203	1.1203	1.1079	1.1110	1.1048	1.1079	1.1141	1.1141	1.1234	(40)
HLP (average)												1.1182	(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	2.0459	(42)
Average daily hot water use (litres/day)	82.7892	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.0681	87.7566	84.4450	81.1334	77.8219	74.5103	74.5103	77.8219	81.1334	84.4450	87.7566	91.0681	(44)
Energy conte	135.0514	118.1168	121.8860	106.2632	101.9620	87.9855	81.5315	93.5586	94.6759	110.3357	120.4400	130.7901	(45)
Energy content (annual)										Total = Sum(45)m =		1302.5967	(45)
Distribution loss (46)m = 0.15 x (45)m	20.2577	17.7175	18.2829	15.9395	15.2943	13.1978	12.2297	14.0338	14.2014	16.5504	18.0660	19.6185	(46)

Water storage loss:

Store volume	3.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0240	(51)
Volume factor from Table 2a	3.4200	(52)
Temperature factor from Table 2b	0.6000	(53)
Enter (49) or (54) in (55)	0.1475	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	4.5734	4.1308	4.5734	4.4259	4.5734	4.4259	4.5734	4.5734	4.4259	4.5734	4.4259	4.5734	(56)
If cylinder contains dedicated solar storage	4.5734	4.1308	4.5734	4.4259	4.5734	4.4259	4.5734	4.5734	4.4259	4.5734	4.4259	4.5734	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	162.8872	143.2589	149.7218	133.2010	129.7978	114.9234	109.3673	121.3944	121.6138	138.1715	147.3779	158.6259	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	162.8872	143.2589	149.7218	133.2010	129.7978	114.9234	109.3673	121.3944	121.6138	138.1715	147.3779	158.6259	(64)
Total per year (kWh/year) = Sum(64)m =												1630.3410	(64)
RHI water heating demand												1630	(64)
Heat gains from water heating, kWh/month	67.1732	59.3875	62.7957	56.8828	56.1710	50.8055	49.3779	53.3769	53.0301	58.9553	61.5966	65.7564	(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	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.8299	35.3766	28.7701	21.7809	16.2814	13.7455	14.8525	19.3058	25.9122	32.9015	38.4009	40.9369	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.7285	269.4963	262.5215	247.6730	228.9295	211.3132	199.5444	196.7766	203.7514	218.5999	237.3434	254.9597	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	(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)	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	(71)
Water heating gains (Table 5)	90.2866	88.3742	84.4029	79.0039	75.4987	70.5632	66.3681	71.7431	73.6529	79.2410	85.5509	88.3822	(72)
Total internal gains	487.0833	483.4853	465.9328	438.6960	410.9479	385.8601	371.0032	378.0638	393.5547	420.9806	451.5335	474.5171	(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	
Northeast	3.2000	12.9236	0.4500	0.7000	0.7700	9.0277	(75)
East	7.4900	22.3313	0.4500	0.7000	0.7700	36.5124	(76)
Southeast	3.2000	40.4699	0.4500	0.7000	0.7700	28.2700	(77)
South	3.7500	50.9848	0.4500	0.7000	0.7700	41.7365	(78)
West	6.6100	22.3313	0.4500	0.7000	0.7700	32.2225	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	147.7691	242.2342	361.7973	509.8524	590.8352	641.6272	606.3533	543.4568	442.7927	296.5908	184.7814	122.9762	(83)
Total gains	634.8523	725.7195	827.7301	948.5484	1001.7831	1027.4873	977.3566	921.5206	836.3474	717.5714	636.3148	597.4933	(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	61.1440	61.4786	61.4786	61.9874	61.9874	62.6791	62.5047	62.8544	62.6791	62.3313	62.3313	61.8169	
alpha	5.0763	5.0986	5.0986	5.1325	5.1325	5.1786	5.1670	5.1903	5.1786	5.1554	5.1554	5.1211	
util living area	0.9754	0.9532	0.8903	0.7423	0.5447	0.3351	0.2195	0.2389	0.4731	0.7953	0.9449	0.9804	(86)
MIT	20.2355	20.4069	20.6669	20.8929	20.9808	20.9988	20.9999	20.9998	20.9929	20.8759	20.5431	20.2017	(87)
Th 2	19.9717	19.9768	19.9768	19.9843	19.9843	19.9944	19.9918	19.9969	19.9944	19.9893	19.9893	19.9818	(88)
util rest of house	0.9680	0.9402	0.8627	0.6927	0.4803	0.2681	0.1481	0.1641	0.3937	0.7395	0.9270	0.9744	(89)
MIT 2	19.0027	19.2467	19.5978	19.8805	19.9703	19.9939	19.9918	19.9969	19.9907	19.8745	19.4508	18.9626	(90)
Living area fraction									fLA = Living area / (4) =			0.3002	(91)
MIT	19.3728	19.5949	19.9187	20.1844	20.2736	20.2955	20.2944	20.2979	20.2915	20.1750	19.7787	19.3345	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3728	19.5949	19.9187	20.1844	20.2736	20.2955	20.2944	20.2979	20.2915	20.1750	19.7787	19.3345	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9626	0.9343	0.8609	0.7030	0.4990	0.2882	0.1696	0.1866	0.4175	0.7505	0.9225	0.9695	(94)
Useful gains	611.0979	678.0590	712.6230	666.8083	499.8940	296.1562	165.7194	171.9132	349.1423	538.5687	587.0269	579.2522	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1009.9028	984.8546	880.9710	717.7945	507.6619	296.4944	165.7338	171.9362	351.4397	595.1904	817.5526	996.2359	(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	296.7108	206.1666	125.2509	36.7101	5.7793	0.0000	0.0000	0.0000	0.0000	42.1265	165.9785	310.2359	(98)

Space heating	1188.9587 (98)
RHI space heating demand	1189 (98)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	62.3000 (1b)	x	2.7000 (2b)	=	168.2100	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 62.3000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	168.2100	(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 q50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.9500 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3072	0.3037	0.3002	0.2829	0.2794	0.2621	0.2621	0.2586	0.2690	0.2794	0.2863	0.2933	(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	
Front Door			2.1000	1.0000	2.1000			(26)
Windows (Uw = 1.00)			24.2500	0.9615	23.3173			(27)
External Wall 1	85.4000	24.2500	61.1500	0.1600	9.7840			(29a)
Corridor Wall	29.7600	2.1000	27.6600	0.2257	6.2438			(29a)
Total net area of external elements Aum(A, m2)			115.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.4451			(33)
Party Floor 1			62.3000					(32d)
Party Ceilings 1			62.3000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.9952	(36)
Total fabric heat loss	(33) + (36) =	55.4403	(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	17.0500	16.8575	16.6649	15.7022	15.5096	14.5469	14.5469	14.3544	14.9320	15.5096	15.8947	16.2798	(38)
Heat transfer coeff	72.4903	72.2978	72.1052	71.1425	70.9499	69.9872	69.9872	69.7947	70.3723	70.9499	71.3350	71.7201	(39)
Average = Sum(39)m / 12 =												71.0944	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1636	1.1605	1.1574	1.1419	1.1388	1.1234	1.1234	1.1203	1.1296	1.1388	1.1450	1.1512	(40)
HLP (average)												1.1412	(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 2.0459 (42)
Average daily hot water use (litres/day) 82.7892 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.0681	87.7566	84.4450	81.1334	77.8219	74.5103	74.5103	77.8219	81.1334	84.4450	87.7566	91.0681	(44)
Energy conte	135.0514	118.1168	121.8860	106.2632	101.9620	87.9855	81.5315	93.5586	94.6759	110.3357	120.4400	130.7901	(45)
Energy content (annual)										Total = Sum(45)m =		1302.5967	(45)
Distribution loss (46)m = 0.15 x (45)m	20.2577	17.7175	18.2829	15.9395	15.2943	13.1978	12.2297	14.0338	14.2014	16.5504	18.0660	19.6185	(46)

Water storage loss:

Store volume	3.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0240	(51)
Volume factor from Table 2a	3.4200	(52)
Temperature factor from Table 2b	0.6000	(53)
Enter (49) or (54) in (55)	0.1475	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	4.5734	4.1308	4.5734	4.4259	4.5734	4.4259	4.5734	4.5734	4.4259	4.5734	4.4259	4.5734	(56)
If cylinder contains dedicated solar storage	4.5734	4.1308	4.5734	4.4259	4.5734	4.4259	4.5734	4.5734	4.4259	4.5734	4.4259	4.5734	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	162.8872	143.2589	149.7218	133.2010	129.7978	114.9234	109.3673	121.3944	121.6138	138.1715	147.3779	158.6259	(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	162.8872	143.2589	149.7218	133.2010	129.7978	114.9234	109.3673	121.3944	121.6138	138.1715	147.3779	158.6259	(64)

Total per year (kWh/year) = Sum(64)m = 1630.3410 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	67.1732	59.3875	62.7957	56.8828	56.1710	50.8055	49.3779	53.3769	53.0301	58.9553	61.5966	65.7564	(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	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.8299	35.3766	28.7701	21.7809	16.2814	13.7455	14.8525	19.3058	25.9122	32.9015	38.4009	40.9369	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.7285	269.4963	262.5215	247.6730	228.9295	211.3132	199.5444	196.7766	203.7514	218.5999	237.3434	254.9597	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	(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)	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	(71)
Water heating gains (Table 5)	90.2866	88.3742	84.4029	79.0039	75.4987	70.5632	66.3681	71.7431	73.6529	79.2410	85.5509	88.3822	(72)
Total internal gains	487.0833	483.4853	465.9328	438.6960	410.9479	385.8601	371.0032	378.0638	393.5547	420.9806	451.5335	474.5171	(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	
Northeast	3.2000	11.2829	0.4500	0.7000	0.7700	7.8816	(75)
East	7.4900	19.6403	0.4500	0.7000	0.7700	32.1124	(76)
Southeast	3.2000	36.7938	0.4500	0.7000	0.7700	25.7021	(77)
South	3.7500	46.7521	0.4500	0.7000	0.7700	38.2715	(78)
West	6.6100	19.6403	0.4500	0.7000	0.7700	28.3395	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	132.3072	240.7592	363.4008	495.9646	589.0724	597.3924	570.8754	500.9302	409.9912	275.9194	161.4436	111.2150	(83)
Total gains	619.3905	724.2445	829.3336	934.6606	1000.0202	983.2525	941.8786	878.9940	803.5460	696.9000	612.9771	585.7321	(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	59.6823	59.8412	60.0010	60.8130	60.9780	61.8169	61.8169	61.9874	61.4786	60.9780	60.6489	60.3232	
alpha	4.9788	4.9894	5.0001	5.0542	5.0652	5.1211	5.1211	5.1325	5.0986	5.0652	5.0433	5.0215	
util living area	0.9823	0.9624	0.9135	0.7987	0.6301	0.4511	0.3262	0.3639	0.5851	0.8580	0.9643	0.9861	(86)
MIT	20.0945	20.2974	20.5666	20.8274	20.9551	20.9934	20.9990	20.9982	20.9766	20.7886	20.3957	20.0545	(87)
Th 2	19.9493	19.9517	19.9542	19.9667	19.9692	19.9818	19.9818	19.9843	19.9768	19.9692	19.9642	19.9592	(88)
util rest of house	0.9771	0.9519	0.8913	0.7560	0.5697	0.3813	0.2511	0.2843	0.5061	0.8148	0.9525	0.9819	(89)
MIT 2	18.7836	19.0730	19.4451	19.7882	19.9317	19.9780	19.9814	19.9837	19.9614	19.7548	19.2265	18.7338	(90)

Living area fraction — fLA = Living area / (4) = 0.3002 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	19.1771	19.4405	19.7817	20.1002	20.2389	20.2828	20.2869	20.2882	20.2662	20.0651	19.5775	19.1303	(92)

Temperature adjustment 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
adjusted MIT	19.1771	19.4405	19.7817	20.1002	20.2389	20.2828	20.2869	20.2882	20.2662	20.0651	19.5775	19.1303	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9721	0.9457	0.8871	0.7619	0.5860	0.4021	0.2737	0.3082	0.5290	0.8193	0.9470	0.9775	(94)
Useful gains	602.0912	684.9197	735.7259	712.1099	586.0263	395.4128	257.7862	270.9248	425.0948	570.9521	580.4765	572.5574	(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	1078.4461	1051.2453	957.6803	796.8068	605.8361	397.7202	258.0335	271.3754	433.9270	671.5502	890.0794	1070.7999	(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	354.4081	246.1708	165.1341	60.9818	14.7385	0.0000	0.0000	0.0000	0.0000	74.8450	222.9141	370.6924	(98)

Space heating 1509.8848 (98)

Space heating per m2	(98) / (4) =	24.2357	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	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	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	657.8797	517.9053	530.4394	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9680	0.9856	0.9784	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	636.8557	510.4310	519.0078	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1084.1110	1038.2602	963.5666	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	322.0238	392.7049	330.7517	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1045.4805	(104)
Cooled fraction										fC = cooled area / (4) =		0.4875	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	39.2450	47.8589	40.3087	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												127.4127	(107)
Space cooling per m2												2.0451	(108)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Boilers	1.0000	(303a)
Fraction of total space heat from community Boilers	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	1509.8848	(98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05	1585.3790	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	1630.3410	(64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05	1711.8580	(310a)
Electricity used for heat distribution	32.9724	(313)
Cooling System Energy Efficiency Ratio	12.1770	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	10.4634	(315)
Annual totals kWh/year		
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)		
mechanical ventilation fans (SFP = 0.8250)	169.3034	(330a)
Total electricity for the above, kWh/year	169.3034	(331)
Electricity for lighting (calculated in Appendix L)	281.3633	(332)
Total delivered energy for all uses	3758.3671	(338)

10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating from Boilers	1585.3790	4.2400	67.2201	(340a)
Space heating - secondary	0.0000	0.0000	0.0000	(341)
Water heating from Boilers	1711.8580	4.2400	72.5828	(342a)
Space cooling	10.4634	13.1900	1.3801	(348)
Mechanical ventilation fans	169.3034	13.1900	22.3311	(349)
Pumps and fans for heating	0.0000	0.0000	0.0000	(349)
Energy for lighting	281.3633	13.1900	37.1118	(350)
Additional standing charges			120.0000	(351)
Total energy cost			320.6259	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12):		0.4200	(356)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.2550	(357)
SAP value		82.4926	
SAP rating (Section 12)		82	(358)
SAP band		B	

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			95.0000	(367a)
Space heating from Boilers	3470.7758	0.2160	749.6876	(367)
Electrical energy for heat distribution	32.9724	0.5190	17.1127	(372)
Total CO2 associated with community systems			766.8002	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			766.8002	(376)
Space cooling	10.4634	0.5190	5.4305	(377)

Pumps and fans	169.3034	0.5190	87.8684 (378)
Energy for lighting	281.3633	0.5190	146.0276 (379)
Total kg/year			1006.1267 (383)
CO2 emissions per m2			16.1500 (384)
EI value			87.4351 (384a)
EI rating			87 (385)
EI band			B

Calculation of stars for heating and DHW

Space heating energy efficiency	1.00 × 4.240 × 1.05	
= 4.452, stars = 4		
Space heating environmental impact	1.00 × 0.216 × 1.05 / 0.9500	
= 0.2387, stars = 4		
Water heating energy efficiency		4.452, stars = 4
Water heating environmental impact		0.2387, stars = 4

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY      09 Jan 2014
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-------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-------------------------------------------------------------------------------------------------
                                                                                                 Area          Storey height                 Volume
                                                                                                 (m2)               (m)                        (m3)
Ground floor                                                                                  62.3000 (1b)     x       2.7000 (2b)     =     168.2100 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)               62.3000                                                                     (4)
Dwelling volume                                                                                     (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =     168.2100 (5)



-------------------------------------------------------------------------------------------------
2. Ventilation rate
-------------------------------------------------------------------------------------------------
                                                                   main          secondary              other               total        m3 per hour
                                                                heating            heating
Number of chimneys                                                    0       +          0       +          0       =           0 * 40 =       0.0000 (6a)
Number of open flues                                                  0       +          0       +          0       =           0 * 20 =       0.0000 (6b)
Number of intermittent fans                                                                                                     0 * 10 =       0.0000 (7a)
Number of passive vents                                                                                                         0 * 10 =       0.0000 (7b)
Number of flueless gas fires                                                                                                    0 * 40 =       0.0000 (7c)

                                                                                                                                 Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                                             0.0000 / (5) =       0.0000 (8)
Pressure test                                                                                                                                  Yes
Measured/design q50                                                                                                                         3.0000
Infiltration rate                                                                                                                           0.1500 (18)
Number of sides sheltered                                                                                                                        1 (19)

Shelter factor                                                                                        (20) = 1  -  [0.075 x (19)]  =       0.9250 (20)
Infiltration rate adjusted to include shelter factor                                                            (21) = (18) x (20)  =       0.1388 (21)

                  Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Wind speed      4.2000      4.0000      4.0000      3.7000      3.7000      3.3000      3.4000      3.2000      3.3000      3.5000      3.5000      3.8000 (22)
Wind factor     1.0500      1.0000      1.0000      0.9250      0.9250      0.8250      0.8500      0.8000      0.8250      0.8750      0.8750      0.9500 (22a)
Adj infilt rate
                0.1457      0.1388      0.1388      0.1283      0.1283      0.1145      0.1179      0.1110      0.1145      0.1214      0.1214      0.1318 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                                  0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                                               73.9500 (23c)

Effective ac    0.2759      0.2690      0.2690      0.2586      0.2586      0.2447      0.2482      0.2413      0.2447      0.2517      0.2517      0.2621 (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
Front Door                                                                          2.1000         1.0000         2.1000                                    (26)
Windows (Uw = 1.00)                                                                24.2500         0.9615        23.3173                                    (27)
External Wall 1                                     85.4000        24.2500         61.1500         0.1600         9.7840                                    (29a)
Corridor Wall                                       29.7600         2.1000         27.6600         0.2257         6.2438                                    (29a)
Total net area of external elements Aum(A, m2)                                    115.1600                                                                  (31)
Fabric heat loss, W/K = Sum (A x U)                                     (26)...(30) + (32) =      41.4451                                                   (33)
Party Floor 1                                                                      62.3000                                                                  (32d)
Party Ceilings 1                                                                   62.3000                                                                  (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                         250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                                 13.9952 (36)
Total fabric heat loss                                                                                                (33) + (36) =      55.4403 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                  Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
(38)m          15.3171     14.9320     14.9320     14.3544     14.3544     13.5842     13.7767     13.3916     13.5842     13.9693     13.9693     14.5469 (38)
Heat transfer coeff
               70.7574     70.3723     70.3723     69.7947     69.7947     69.0245     69.2170     68.8319     69.0245     69.4096     69.4096     69.9872 (39)
Average = Sum(39)m / 12 =                                                                                                                  69.6663 (39)

                  Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
HLP             1.1358      1.1296      1.1296      1.1203      1.1203      1.1079      1.1110      1.1048      1.1079      1.1141      1.1141      1.1234 (40)
HLP (average)                                                                                                                               1.1182 (40)
Days in month
                    31          28          31          30          31          30          31          31          30          31          30          31 (41)



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4. Water heating energy requirements (kWh/year)
-------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                                           2.0459 (42)
Average daily hot water use (litres/day)                                                                                                   82.7892 (43)

                  Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Daily hot water use
               91.0681     87.7566     84.4450     81.1334     77.8219     74.5103     74.5103     77.8219     81.1334     84.4450     87.7566     91.0681 (44)
Energy conte  135.0514    118.1168    121.8860    106.2632    101.9620     87.9855     81.5315     93.5586     94.6759    110.3357    120.4400    130.7901 (45)
Energy content (annual)                                                                                          Total = Sum(45)m =     1302.5967 (45)
Distribution loss  (46)m = 0.15 x (45)m
               20.2577     17.7175     18.2829     15.9395     15.2943     13.1978     12.2297     14.0338     14.2014     16.5504     18.0660     19.6185 (46)
```

Water storage loss:

Store volume	3.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0240	(51)
Volume factor from Table 2a	3.4200	(52)
Temperature factor from Table 2b	0.6000	(53)
Enter (49) or (54) in (55)	0.1475	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	4.5734	4.1308	4.5734	4.4259	4.5734	4.4259	4.5734	4.5734	4.4259	4.5734	4.4259	4.5734	(56)
If cylinder contains dedicated solar storage	4.5734	4.1308	4.5734	4.4259	4.5734	4.4259	4.5734	4.5734	4.4259	4.5734	4.4259	4.5734	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	162.8872	143.2589	149.7218	133.2010	129.7978	114.9234	109.3673	121.3944	121.6138	138.1715	147.3779	158.6259	(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	162.8872	143.2589	149.7218	133.2010	129.7978	114.9234	109.3673	121.3944	121.6138	138.1715	147.3779	158.6259	(64)

Total per year (kWh/year) = Sum(64)m = 1630.3410 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	67.1732	59.3875	62.7957	56.8828	56.1710	50.8055	49.3779	53.3769	53.0301	58.9553	61.5966	65.7564	(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	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.8299	35.3766	28.7701	21.7809	16.2814	13.7455	14.8525	19.3058	25.9122	32.9015	38.4009	40.9369	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.7285	269.4963	262.5215	247.6730	228.9295	211.3132	199.5444	196.7766	203.7514	218.5999	237.3434	254.9597	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	(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)	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	(71)
Water heating gains (Table 5)	90.2866	88.3742	84.4029	79.0039	75.4987	70.5632	66.3681	71.7431	73.6529	79.2410	85.5509	88.3822	(72)
Total internal gains	487.0833	483.4853	465.9328	438.6960	410.9479	385.8601	371.0032	378.0638	393.5547	420.9806	451.5335	474.5171	(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	
Northeast	3.2000	12.9236	0.4500	0.7000	0.7700	9.0277	(75)
East	7.4900	22.3313	0.4500	0.7000	0.7700	36.5124	(76)
Southeast	3.2000	40.4699	0.4500	0.7000	0.7700	28.2700	(77)
South	3.7500	50.9848	0.4500	0.7000	0.7700	41.7365	(78)
West	6.6100	22.3313	0.4500	0.7000	0.7700	32.2225	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	147.7691	242.2342	361.7973	509.8524	590.8352	641.6272	606.3533	543.4568	442.7927	296.5908	184.7814	122.9762	(83)
Total gains	634.8523	725.7195	827.7301	948.5484	1001.7831	1027.4873	977.3566	921.5206	836.3474	717.5714	636.3148	597.4933	(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	61.1440	61.4786	61.4786	61.9874	61.9874	62.6791	62.5047	62.8544	62.6791	62.3313	62.3313	61.8169	
alpha	5.0763	5.0986	5.0986	5.1325	5.1325	5.1786	5.1670	5.1903	5.1786	5.1554	5.1554	5.1211	
util living area	0.9754	0.9532	0.8903	0.7423	0.5447	0.3351	0.2195	0.2389	0.4731	0.7953	0.9449	0.9804	(86)
MIT	20.2355	20.4069	20.6669	20.8929	20.9808	20.9988	20.9999	20.9998	20.9929	20.8759	20.5431	20.2017	(87)
Th 2	19.9717	19.9768	19.9768	19.9843	19.9843	19.9944	19.9918	19.9969	19.9944	19.9893	19.9893	19.9818	(88)
util rest of house	0.9680	0.9402	0.8627	0.6927	0.4803	0.2681	0.1481	0.1641	0.3937	0.7395	0.9270	0.9744	(89)
MIT 2	19.0027	19.2467	19.5978	19.8805	19.9703	19.9939	19.9918	19.9969	19.9907	19.8745	19.4508	18.9626	(90)

Living area fraction — fLA = Living area / (4) = 0.3002 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	19.3728	19.5949	19.9187	20.1844	20.2736	20.2955	20.2944	20.2979	20.2915	20.1750	19.7787	19.3345	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3728	19.5949	19.9187	20.1844	20.2736	20.2955	20.2944	20.2979	20.2915	20.1750	19.7787	19.3345	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9626	0.9343	0.8609	0.7030	0.4990	0.2882	0.1696	0.1866	0.4175	0.7505	0.9225	0.9695	(94)
Useful gains	611.0979	678.0590	712.6230	666.8083	499.8940	296.1562	165.7194	171.9132	349.1423	538.5687	587.0269	579.2522	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1009.9028	984.8546	880.9710	717.7945	507.6619	296.4944	165.7338	171.9362	351.4397	595.1904	817.5526	996.2359	(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	296.7108	206.1666	125.2509	36.7101	5.7793	0.0000	0.0000	0.0000	0.0000	42.1265	165.9785	310.2359	(98)

Space heating 1188.9587 (98)

Space heating per m2	(98) / (4) =	19.0844	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	552.1957	422.2238	426.7579	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9876	0.9952	0.9935	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	545.3413	420.2077	423.9679	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1135.8139	1079.7279	1013.2730	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	425.1403	490.6830	438.4430	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1354.2664	(104)
Cooled fraction									fC = cooled area / (4) =			0.4875	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	51.8118	59.7995	53.4330	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												165.0444	(107)
Space cooling per m2												2.6492	(108)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Boilers	1.0000	(303a)
Fraction of total space heat from community Boilers	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	1188.9587	(98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.05	1248.4066	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	1630.3410	(64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.05	1711.8580	(310a)
Electricity used for heat distribution	29.6026	(313)
Cooling System Energy Efficiency Ratio	12.1770	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	13.5538	(315)
Annual totals kWh/year		
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)		
mechanical ventilation fans (SFP = 0.8250)	169.3034	(330a)
Total electricity for the above, kWh/year	169.3034	(331)
Electricity for lighting (calculated in Appendix L)	281.3633	(332)
Total delivered energy for all uses	3424.4851	(338)

10b. Fuel costs - using BEDF prices (424)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating from Boilers	1248.4066	4.8900	61.0471	(340a)
Space heating - secondary	0.0000	0.0000	0.0000	(341)
Water heating from Boilers	1711.8580	4.8900	83.7099	(342a)
Space cooling	13.5538	16.1200	2.1849	(348)
Mechanical ventilation fans	169.3034	16.1200	27.2917	(349)
Pumps and fans for heating	0.0000	0.0000	0.0000	(349)
Energy for lighting	281.3633	16.1200	45.3558	(350)
Additional standing charges			87.0000	(351)
Total energy cost			306.5893	(355)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			95.0000	(367a)
Space heating from Boilers	3116.0680	0.2160	673.0707	(367)
Electrical energy for heat distribution	29.6026	0.5190	15.3638	(372)
Total CO2 associated with community systems			688.4345	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			688.4345	(376)
Space cooling	13.5538	0.5190	7.0344	(377)
Pumps and fans	169.3034	0.5190	87.8684	(378)
Energy for lighting	281.3633	0.5190	146.0276	(379)
Total kg/year			929.3649	(383)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year

Efficiency of heat source Boilers			95.0000 (367a)
Space heating from Boilers	3116.0680	1.2200	3801.6030 (367)
Electrical energy for heat distribution	29.6026	3.0700	90.8801 (372)
Total CO2 associated with community systems			3892.4831 (373)
(negative value allowed since DFEE <= TFEE)			
Space and water heating			3892.4831 (376)
Space cooling	13.5538	3.0700	41.6101 (377)
Pumps and fans	169.3034	3.0700	519.7613 (378)
Energy for lighting	281.3633	3.0700	863.7854 (379)
Primary energy kWh/year			5317.6399 (383)
Primary energy kWh/m2/year			85.3554 (384)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 82
Current environmental impact rating: B 87

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Not applicable
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Not applicable
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures: SAP change Cost change CO2 change
(none)

	Typical annual savings	Energy efficiency	Environmental impact
Recommended measures			
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: B 82
Potential environmental impact rating: B 87

Fuel prices for cost data on this page from database revision number 424 TEST (27 Feb 2018)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£75	£75	£0
Community scheme	£232	£232	£0
Space heating	£175	£175	£0
Space cooling	£2	£2	£0
Water heating	£84	£84	£0
Lighting	£45	£45	£0
Total cost of fuels	£307	£307	£0
Total cost of uses	£306	£306	£0
Delivered energy	55 kWh/m²	55 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.9 tonnes	0.0 tonnes
CO2 emissions per m²	15 kg/m²	15 kg/m²	0 kg/m²
Primary energy	85 kWh/m²	85 kWh/m²	0 kWh/m²

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SAP 2012 WORKSHEET FOR New Build (As Designed)    (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING      09 Jan 2014
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No improvements selected / applicable



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SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

No improvements selected / applicable

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	EndTerrace Flat
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	250.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	333.06	(P1)
Transmission heat loss coefficient	55.44	(37)
Summer heat loss coefficient	388.50	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
East	0.000	1.000	None
South East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	3.2000	98.8453	0.4500	0.7000	0.9000	80.7052
East	7.4900	117.5071	0.4500	0.7000	0.9000	224.5646
South East	3.2000	119.9223	0.4500	0.7000	0.9000	97.9142
South	3.7500	112.2060	0.4500	0.7000	0.9000	107.3601
West	6.6100	117.5071	0.4500	0.7000	0.9000	198.1805
total:						708.7247

	Jun	Jul	Aug	
Solar gains	750	709	635	(P3)
Internal gains	386	371	378	
Total summer gains	1136	1080	1013	(P5)
Summer gain/loss ratio	2.92	2.78	2.61	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	19.17	20.93	20.66	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

Example Full SAP Calculation - Green Scenario

Property Reference	Unit 3			Issued on Date	25/09/2018
Survey Reference	Green	Prop Type Ref		Unit 3 - Mid Floor South	
Property					

SAP Rating	82 B	DER	10.44	TER	27.95
Environmental	93 A	% DER<TER	62.65		
CO_2 Emissions (t/year)	0.56	DFEE	50.98	TFEE	55.50
General Requirements Compliance	Pass	% DFEE<TFEE	8.15		

Surveyor	Jessica Finnigan, Tel: .	Surveyor ID	Admin
Client	Almax, 5006835		

SAP2012 - 9.92 input data (DesignData) -

```
SAP2012 Input Data (Flat)       26/09/2018

FullRefNo:                      Green

Regs Region:                    England
SAP Region:                     Thames Valley
Postcode:
DwellingOrientation:            North
Property Type:                  Flat, End-Terrace
Storeys:                        1
Date Built:                     2019
Sheltered Sides:                1
Sunlight Shade:                 Average or unknown
Measurements                    Perimeter, Floor Area, Storey Height
     1st Storey:                38.58, 62.3, 2.7
Living Area:                    18.7 m2, fraction: 30.0%
Thermal Mass:                   Simple calculation
Thermal Mass Simple:            Medium
Thermal MassValue:              250
External Walls                  Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1                 61.15, 85.4, 0, Other, Cavity, 0, 0.16, Gross
Corridor Wall                   27.66, 29.76, 0, Other, Cavity, 0.43, 0.225733634311512, Gross
External Roofs                  Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
Party Ceilings                  Area, Kappa, Construction, Element
     Party Ceilings 1           62.3, 0, Other
Heat Loss Floors                Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
Party Floors                    Area, Kappa, Construction, Element
     Party Floor 1              62.3, 0
Description                     Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
     Front Door                 Manufacturer, Solid Door, , , , , , ,
     Windows                    Manufacturer, Window, Double glazed, , , 0.45, , 0.7,
Openings                        Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
     Front Door                 Solid Door, Corridor Wall, North, , , , , 0, 0, 0, 2.10,
     East Windows               Window, External Wall 1, East, , None, 0, , 0, 0, 0, 7.49,
     West Windows               Window, External Wall 1, West, , None, 0, , 0, 0, 0, 6.61,
     South Windows              Window, External Wall 1, South, , None, 0, , 0, 0, 0, 3.75,
     South East Windows         Window, External Wall 1, South East, , None, 0, , 0, 0, 0, 3.20,
     North East Windows         Window, External Wall 1, North East, , None, 0, , 0, 0, 0, 3.20,
Conservatory:                   None
Draught Proofing:               100
Draught Lobby:                  Yes
Thermal Bridges
     Bridging:                  Calculate Bridges
     Y                          0.122
     List of Bridges            Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
     0.                         External wall, E2 Other lintels (including other steel lintels), Table K1 - Approved, No, 10.23, 0.3, 0.3, 3.07,
     1.                         External wall, E3 Sill, Table K1 - Approved, No, 10.23, 0.04, 0.04, 0.41,
     2.                         External wall, E4 Jamb, Table K1 - Approved, No, 33.18, 0.05, 0.05, 1.66,
     3.                         External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Approved, No, 57.22, 0.07, 0.07, 4.01,
     4.                         External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Default, No, 19.94, 0.14, 0.14, 2.79,
     5.                         External wall, E16 Corner (normal), Table K1 - Approved, No, 14.93, 0.09, 0.09, 1.34,
     6.                         External wall, E17 Corner (inverted - internal area greater than external area), Table K1 - Approved, No, 5.97, -0.09, -0.09, -
0.54,
     7.                         External wall, E17 Corner (inverted - internal area greater than external area), Table K1 - Default, No, 5.97, 0, 0, 0.00,
     8.                         External wall, E18 Party wall between dwellings, Table K1 - Approved, No, 2.99, 0.06, 0.06, 0.18,
     9.                         External wall, E18 Party wall between dwellings, Table K1 - Default, No, 5.97, 0.12, 0.12, 0.72,
     10.                        External wall, E25 Staggered party wall between dwellings, Table K1 - Default, No, 2.99, 0.12, 0.12, 0.36,
Pressure Test:                  True
Designed q50:                   3
AsBuilt q50:                    15
Property Tested:                False
Mechanical Ventilation
     MV System Present          Yes
     Windows In Hot Weather     Windows fully open
     Cross Ventilation          Yes
     Night Ventilation          Yes
     Air Change Rate            6.00
     Approved Installation      Yes
     DataType                   Database
     Type                       Balanced mechanical ventilation with heat recovery
     Database Ref Number        500499
     Configuration              3
     HR Duct Insulated          Yes
     ManufacturerSFP            0.66
     DuctType                   Rigid
     HR Efficiency              87
     Wet Rooms                  3
Chimneys MHS:                   0
```

Chimneys SHS:	0
Chimneys Other:	0
Chimneys Total:	0
Open Flues MHS:	0
Open Flues SHS:	0
Open Flues Other:	0
Open Flues Total:	0
Intermittent Fans:	0
Passive Vents:	0
Flueless Gas Fires:	0
Cooling System	
Cooled Area	30.37
Data Source	Manufacturer
Type	Split or Multi-Split
Energy Efficiency Ratio	9.02
Control	Modulating
Light Fittings:	9
LEL Fittings:	9
Percentage of LEL Fittings:	100
External Lights Fitted:	Yes
External LELs Fitted:	Yes
Electricity Tariff:	Standard
Main Heating 1	None
Main Heating 2	None
Heating Systems Interaction	Each system heats separate parts of dwelling
Smoke Control Area	Unknown
Community Heating	
Type	Space and Water Combined
PCDF Index	n/a
Distribution Loss	Piping system >= 1991, pre-insulated, low temp, variable flow
Controls	CCL
Ctrl SAP Code	2312
Community Heating Heat Sources:	Source, Fuel Type, Heating Use, Percentage, Overal Efficiency, Electrical Efficiency, Heat Power Ratio, Heat Efficiency
1	Heat pump, Space and Water, 100, 500
Secondary Heating	None
Water Heating	
Type	CommunityHeating
WHS	HWP From main heating 1
Low Water Usage	Yes
SAP Code	901
Showers in Property	Non-electric only
Hot Water Cylinder	
Cylinder Type	HotWaterCylinder
Cylinder Insulation Type	Foam
Cylinder Volume	3.00
Cylinder Stat	Yes
Pipeworks Insulated	Fully insulated primary pipework
Cylinder in Heated Space	Yes
Flue Gas Heat Recovery System	None
Waste Water Heat Recovery	none
PV Unit	None
Wind Turbine	None
Terrain Type:	Urban
Small Scale Hydro	None
Special Features	None

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

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 62 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 (c)
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 27.95 $kgCO_2/m^2$
Dwelling Carbon Dioxide Emission Rate (DER) 10.44 $kgCO_2/m^2$OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE) 55.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 51.0 kWh/m²/yrOK

---

2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.23 (max. 0.70)	OK
Floor	(no floor)		
Roof	(no roof)		
Openings	1.00 (max. 2.00)	1.00 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

---

3 Air permeability

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

---

4 Heating efficiency

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

---

5 Cylinder insulation

Hot water storage	Nominal cylinder loss: 0.25 kWh/day	
Permitted by DBSCG 0.35	OK	
Primary pipework insulated:	Yes (assumed)	OK

SAP2012 - 9.92 input data (DesignData) -

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


Hot water controls:              Cylinderstat                                      OK


----------------------------------------------------------------------------------------------------
7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum                          75%                                               OK
----------------------------------------------------------------------------------------------------
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power:              0.66
Maximum                          1.5                                               OK
MVHR efficiency:                 87%
Minimum:                         70%                                               OK
----------------------------------------------------------------------------------------------------
9 Summertime temperature
Overheating risk (Thames Valley):       Slight                                     OK
Based on:
Overshading:                     Average
Windows facing North East:       3.20 m², No overhang
Windows facing East:             7.49 m², No overhang
Windows facing South East:       3.20 m², No overhang
Windows facing South:            3.75 m², No overhang
Windows facing West:             6.61 m², No overhang
Air change rate:                 6.00 ach
Blinds/curtains:                 None
----------------------------------------------------------------------------------------------------
10 Key features
Door U-value                     1.00 W/m²K
Window U-value                   1.00 W/m²K
Air permeability                 3.0 m³/m²h



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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		62.3000 (1b)	x	2.7000 (2b)	=	168.2100	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.3000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	168.2100	(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 q50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.9500 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3072	0.3037	0.3002	0.2829	0.2794	0.2621	0.2621	0.2586	0.2690	0.2794	0.2863	0.2933	(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	
Front Door			2.1000	1.0000	2.1000			(26)
Windows (Uw = 1.00)			24.2500	0.9615	23.3173			(27)
External Wall 1	85.4000	24.2500	61.1500	0.1600	9.7840			(29a)
Corridor Wall	29.7600	2.1000	27.6600	0.2257	6.2438			(29a)
Total net area of external elements Aum(A, m2)			115.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.4451			(33)
Party Floor 1			62.3000					(32d)
Party Ceilings 1			62.3000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 13.9952 (36)
Total fabric heat loss (33) + (36) = 55.4403 (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	17.0500	16.8575	16.6649	15.7022	15.5096	14.5469	14.5469	14.3544	14.9320	15.5096	15.8947	16.2798	(38)
Heat transfer coeff	72.4903	72.2978	72.1052	71.1425	70.9499	69.9872	69.9872	69.7947	70.3723	70.9499	71.3350	71.7201	(39)

Average = Sum(39)m / 12 = 71.0944 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1636	1.1605	1.1574	1.1419	1.1388	1.1234	1.1234	1.1203	1.1296	1.1388	1.1450	1.1512	(40)
HLP (average)												1.1412	(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 2.0459 (42)
Average daily hot water use (litres/day) 82.7892 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.0681	87.7566	84.4450	81.1334	77.8219	74.5103	74.5103	77.8219	81.1334	84.4450	87.7566	91.0681	(44)
Energy conte	135.0514	118.1168	121.8860	106.2632	101.9620	87.9855	81.5315	93.5586	94.6759	110.3357	120.4400	130.7901	(45)
Energy content (annual)										Total = Sum(45)m =		1302.5967	(45)
Distribution loss (46)m = 0.15 x (45)m	20.2577	17.7175	18.2829	15.9395	15.2943	13.1978	12.2297	14.0338	14.2014	16.5504	18.0660	19.6185	(46)

```
Water storage loss:
Store volume                                                                                                                3.0000 (47)
  b) If manufacturer declared loss factor is not known :
  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                               0.0240 (51)
  Volume factor from Table 2a                                                                                               3.4200 (52)
  Temperature factor from Table 2b                                                                                          0.6000 (53)
Enter (49) or (54) in (55)                                                                                                  0.1475 (55)
Total storage loss
                  4.5734     4.1308     4.5734     4.4259     4.5734     4.4259     4.5734     4.5734     4.4259     4.5734     4.4259     4.5734 (56)
If cylinder contains dedicated solar storage
                  4.5734     4.1308     4.5734     4.4259     4.5734     4.4259     4.5734     4.5734     4.4259     4.5734     4.4259     4.5734 (57)
Primary loss     23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
                162.8872   143.2589   149.7218   133.2010   129.7978   114.9234   109.3673   121.3944   121.6138   138.1715   147.3779   158.6259 (62)
Solar input       0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (63)
                                                                                     Solar input (sum of months) = Sum(63)m =     0.0000 (63)
Output from w/h
                162.8872   143.2589   149.7218   133.2010   129.7978   114.9234   109.3673   121.3944   121.6138   138.1715   147.3779   158.6259 (64)
                                                                                       Total per year (kWh/year) = Sum(64)m =  1630.3410 (64)
Heat gains from water heating, kWh/month
                 67.1732    59.3875    62.7957    56.8828    56.1710    50.8055    49.3779    53.3769    53.0301    58.9553    61.5966    65.7564 (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           102.2931   102.2931   102.2931   102.2931   102.2931   102.2931   102.2931   102.2931   102.2931   102.2931   102.2931   102.2931 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                 15.9320    14.1506    11.5081     8.7123     6.5126     5.4982     5.9410     7.7223    10.3649    13.1606    15.3604    16.3748 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
                178.7081   180.5625   175.8894   165.9409   153.3827   141.5798   133.6947   131.8403   136.5134   146.4619   159.0201   170.8230 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                 33.2293    33.2293    33.2293    33.2293    33.2293    33.2293    33.2293    33.2293    33.2293    33.2293    33.2293    33.2293 (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)
                -81.8345   -81.8345   -81.8345   -81.8345   -81.8345   -81.8345   -81.8345   -81.8345   -81.8345   -81.8345   -81.8345   -81.8345 (71)
Water heating gains (Table 5)
                 90.2866    88.3742    84.4029    79.0039    75.4987    70.5632    66.3681    71.7431    73.6529    79.2410    85.5509    88.3822 (72)
Total internal gains
                338.6146   336.7753   325.4883   307.3451   289.0819   271.3291   259.6918   264.9937   274.2191   292.5514   313.6192   329.2679 (73)


----------------------------------------------------------------------------------------------------
6. Solar gains
----------------------------------------------------------------------------------------------------
[Jan]                                       Area        Solar flux              g              FF          Access           Gains
                                              m2          Table 6a   Specific data   Specific data          factor               W
                                                              W/m2     or Table 6b     or Table 6c        Table 6d
----------------------------------------------------------------------------------------------------
Northeast                                 3.2000           11.2829          0.4500          0.7000          0.7700          7.8816 (75)
East                                      7.4900           19.6403          0.4500          0.7000          0.7700         32.1124 (76)
Southeast                                 3.2000           36.7938          0.4500          0.7000          0.7700         25.7021 (77)
South                                     3.7500           46.7521          0.4500          0.7000          0.7700         38.2715 (78)
West                                      6.6100           19.6403          0.4500          0.7000          0.7700         28.3395 (80)
----------------------------------------------------------------------------------------------------

Solar gains     132.3072   240.7592   363.4008   495.9646   589.0724   597.3924   570.8754   500.9302   409.9912   275.9194   161.4436   111.2150 (83)
Total gains     470.9218   577.5345   688.8891   803.3096   878.1543   868.7216   830.5671   765.9239   684.2103   568.4708   475.0629   440.4829 (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              59.6823    59.8412    60.0010    60.8130    60.9780    61.8169    61.8169    61.9874    61.4786    60.9780    60.6489    60.3232
alpha             4.9788     4.9894     5.0001     5.0542     5.0652     5.1211     5.1211     5.1325     5.0986     5.0652     5.0433     5.0215
util living area
                  0.9944     0.9845     0.9539     0.8623     0.6981     0.5071     0.3693     0.4164     0.6688     0.9229     0.9871     0.9959 (86)

MIT              19.8838    20.1041    20.4153    20.7462    20.9292    20.9888    20.9982    20.9967    20.9576    20.6779    20.2115    19.8452 (87)
Th 2             19.9493    19.9517    19.9542    19.9667    19.9692    19.9818    19.9818    19.9843    19.9768    19.9692    19.9642    19.9592 (88)
util rest of house
                  0.9926     0.9797     0.9400     0.8263     0.6366     0.4302     0.2846     0.3259     0.5852     0.8930     0.9822     0.9946 (89)
MIT 2            18.4803    18.8005    19.2429    19.6936    19.9081    19.9752    19.9812    19.9831    19.9476    19.6217    18.9675    18.4314 (90)
Living area fraction                                                                          fLA = Living area / (4) =     0.3002 (91)
MIT              18.9015    19.1918    19.5948    20.0095    20.2146    20.2794    20.2864    20.2873    20.2508    19.9387    19.3409    18.8557 (92)
Temperature adjustment                                                                                                     0.0000
adjusted MIT     18.9015    19.1918    19.5948    20.0095    20.2146    20.2794    20.2864    20.2873    20.2508    19.9387    19.3409    18.8557 (93)


----------------------------------------------------------------------------------------------------
8. Space heating requirement
----------------------------------------------------------------------------------------------------

                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation       0.9901     0.9750     0.9342     0.8280     0.6519     0.4530     0.3101     0.3531     0.6086     0.8920     0.9783     0.9926 (94)
Useful gains    466.2492   563.1095   643.5397   665.1147   572.4931   393.5200   257.5564   270.4626   416.4365   507.0549   464.7465   437.2198 (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
               1058.4700  1033.2639   944.2051   790.3600   604.1100   397.4865   258.0032   271.3158   432.8428   662.5807   873.2017  1051.1118 (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
                440.6123   315.9437   223.6951    90.1766    23.5230     0.0000     0.0000     0.0000     0.0000   115.7112   294.0878   456.7357 (98)
Space heating                                                                                                           1960.4853 (98)
```

Space heating per m2 (98) / (4) = 31.4685 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	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	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	657.8797	517.9053	530.4394	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9680	0.9856	0.9784	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	636.8557	510.4310	519.0078	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1084.1110	1038.2602	963.5666	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	322.0238	392.7049	330.7517	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1045.4805	(104)
Cooled fraction									fC = cooled area / (4) =			0.4875	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	39.2450	47.8589	40.3087	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												127.4127	(107)
Space cooling per m2												2.0451	(108)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	1960.4853	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	2058.5096	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	1630.3410	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	1711.8580	(310a)
Electricity used for heat distribution	37.7037	(313)
Cooling System Energy Efficiency Ratio	12.1770	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	10.4634	(315)
Annual totals kWh/year		
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)		
mechanical ventilation fans (SFP = 0.8250)	169.3034	(330a)
Total electricity for the above, kWh/year	169.3034	(331)
Electricity for lighting (calculated in Appendix L)	281.3633	(332)
Total delivered energy for all uses	4231.4977	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			500.0000	(367a)
Space heating from Heat pump	754.0735	0.5190	391.3642	(367)
Electrical energy for heat distribution	37.7037	0.5190	19.5682	(372)
Total CO2 associated with community systems			410.9324	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			410.9324	(376)
Space cooling	10.4634	0.5190	5.4305	(377)
Pumps and fans	169.3034	0.5190	87.8684	(378)
Energy for lighting	281.3633	0.5190	146.0276	(379)
Total CO2, kg/year			650.2589	(383)
Dwelling Carbon Dioxide Emission Rate (DER)			10.4400	(384)

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

DER		10.4400	ZC1
Total Floor Area	TFA	62.3000	
Assumed number of occupants	N	2.0459	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.9982	ZC2
CO2 emissions from cooking, equation (L16)		2.6982	ZC3
Total CO2 emissions		30.1364	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		30.1364	ZC8

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		62.3000	(1b)	x 2.7000	(2b)	=	168.2100	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.3000							(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	168.2100	(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) =	0.1189	(8)
Pressure test			Yes	
Measured/design q50			5.0000	
Infiltration rate			0.3689	(18)
Number of sides sheltered			1	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.3412	(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	0.4351	0.4265	0.4180	0.3754	0.3668	0.3242	0.3242	0.3156	0.3412	0.3668	0.3839	0.4009	(22b)
Effective ac	0.5946	0.5910	0.5874	0.5704	0.5673	0.5525	0.5525	0.5498	0.5582	0.5673	0.5737	0.5804	(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)			13.4700	1.3258	17.8580			(27)
External Wall 1	85.4000	13.4700	71.9300	0.1800	12.9474			(29a)
Corridor Wall	29.7600	2.1000	27.6600	0.1800	4.9788			(29a)
Total net area of external elements Aum(A, m2)			115.1600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.8842			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	9.0693	(36)
Total fabric heat loss (33) + (36) =	46.9535	(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	33.0082	32.8042	32.6043	31.6650	31.4893	30.6713	30.6713	30.5198	30.9864	31.4893	31.8448	32.2164	(38)
Heat transfer coeff	79.9617	79.7577	79.5577	78.6185	78.4428	77.6247	77.6247	77.4732	77.9398	78.4428	78.7983	79.1699	(39)
Average = Sum(39)m / 12 =												78.6176	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2835	1.2802	1.2770	1.2619	1.2591	1.2460	1.2460	1.2436	1.2510	1.2591	1.2648	1.2708	(40)
HLP (average)												1.2619	(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	2.0459	(42)
Average daily hot water use (litres/day)	82.7892	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.0681	87.7566	84.4450	81.1334	77.8219	74.5103	74.5103	77.8219	81.1334	84.4450	87.7566	91.0681	(44)
Energy conte	135.0514	118.1168	121.8860	106.2632	101.9620	87.9855	81.5315	93.5586	94.6759	110.3357	120.4400	130.7901	(45)
Energy content (annual)										Total = Sum(45)m =		1302.5967	(45)
Distribution loss (46)m = 0.15 x (45)m	20.2577	17.7175	18.2829	15.9395	15.2943	13.1978	12.2297	14.0338	14.2014	16.5504	18.0660	19.6185	(46)

Water storage loss:

Store volume	3.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	0.2602	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.1405	(55)
Total storage loss		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	4.3553	3.9338	4.3553	4.2148	4.3553	4.2148	4.3553	4.3553	4.2148	4.3553	4.2148	4.3553	(56)
If cylinder contains dedicated solar storage													
	4.3553	3.9338	4.3553	4.2148	4.3553	4.2148	4.3553	4.3553	4.2148	4.3553	4.2148	4.3553	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	162.6691	143.0618	149.5037	132.9899	129.5797	114.7123	109.1491	121.1762	121.4027	137.9534	147.1668	158.4078	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	162.6691	143.0618	149.5037	132.9899	129.5797	114.7123	109.1491	121.1762	121.4027	137.9534	147.1668	158.4078	(64)
Total per year (kWh/year) = Sum(64)m =												1627.7725	(64)
Heat gains from water heating, kWh/month													
	66.9987	59.2298	62.6212	56.7139	55.9965	50.6366	49.2034	53.2024	52.8612	58.7808	61.4277	65.5818	(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	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.9484	14.1652	11.5199	8.7213	6.5193	5.5038	5.9471	7.7303	10.3756	13.1741	15.3762	16.3916	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	178.7081	180.5625	175.8894	165.9409	153.3827	141.5798	133.6947	131.8403	136.5134	146.4619	159.0201	170.8230	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	(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)													
	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	(71)
Water heating gains (Table 5)													
	90.0521	88.1396	84.1683	78.7693	75.2641	70.3286	66.1335	71.5085	73.4183	79.0064	85.3163	88.1476	(72)
Total internal gains													
	341.3964	339.5553	328.2655	310.1195	291.8541	274.1002	262.4633	267.7671	276.9952	295.3304	316.4005	332.0502	(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	
Northeast	1.7800	11.2829	0.6300	0.7000	0.7700	6.1378	(75)
East	4.1600	19.6403	0.6300	0.7000	0.7700	24.9697	(76)
Southeast	1.7800	36.7938	0.6300	0.7000	0.7700	20.0155	(77)
South	2.0800	46.7521	0.6300	0.7000	0.7700	29.7191	(78)
West	3.6700	19.6403	0.6300	0.7000	0.7700	22.0285	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	102.8706	187.1982	282.5676	385.6622	458.0780	464.5544	443.9311	389.5293	318.8006	214.5395	125.5254	86.4706	(83)
Total gains	444.2670	526.7534	610.8332	695.7817	749.9321	738.6546	706.3944	657.2963	595.7958	509.8699	441.9259	418.5208	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.1058	54.2442	54.3805	55.0302	55.1534	55.7347	55.7347	55.8436	55.5093	55.1534	54.9046	54.6469	
alpha	4.6071	4.6163	4.6254	4.6687	4.6769	4.7156	4.7156	4.7229	4.7006	4.6769	4.6603	4.6431	
util living area													
	0.9958	0.9903	0.9744	0.9249	0.8123	0.6347	0.4753	0.5280	0.7799	0.9553	0.9913	0.9968	(86)
MIT	19.6858	19.8772	20.1773	20.5453	20.8221	20.9586	20.9914	20.9862	20.8917	20.5141	20.0295	19.6535	(87)
Th 2	19.8538	19.8564	19.8589	19.8708	19.8730	19.8834	19.8834	19.8853	19.8794	19.8730	19.8685	19.8638	(88)
util rest of house													
	0.9944	0.9870	0.9657	0.8993	0.7538	0.5393	0.3589	0.4072	0.6939	0.9345	0.9878	0.9957	(89)
MIT 2	18.1252	18.4049	18.8383	19.3584	19.7088	19.8578	19.8805	19.8801	19.7991	19.3298	18.6366	18.0850	(90)
Living area fraction									fLA = Living area / (4) =			0.3002	(91)
MIT	18.5936	18.8469	19.2402	19.7147	20.0430	20.1882	20.2139	20.2121	20.1271	19.6853	19.0547	18.5558	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5936	18.8469	19.2402	19.7147	20.0430	20.1882	20.2139	20.2121	20.1271	19.6853	19.0547	18.5558	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9921	0.9830	0.9595	0.8951	0.7635	0.5666	0.3940	0.4436	0.7149	0.9301	0.9842	0.9939	(94)
Useful gains	440.7561	517.8223	586.0747	622.7759	572.5970	418.5057	278.3473	291.5800	425.9349	474.2445	434.9356	415.9545	(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													
	1142.9435	1112.3697	1013.5805	850.2321	654.4482	433.7841	280.5307	295.3362	469.7480	712.6744	942.0089	1136.5459	(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													
	522.4274	399.5359	318.0643	163.7684	60.8973	0.0000	0.0000	0.0000	0.0000	177.3918	365.0928	536.1200	(98)
Space heating												2543.2979	(98)
Space heating per m2											(98) / (4) =	40.8234	(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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2720.1048	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	522.4274	399.5359	318.0643	163.7684	60.8973	0.0000	0.0000	0.0000	0.0000	177.3918	365.0928	536.1200	(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)	558.7459	427.3111	340.1757	175.1534	65.1309	0.0000	0.0000	0.0000	0.0000	189.7239	390.4736	573.3903	(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	162.6691	143.0618	149.5037	132.9899	129.5797	114.7123	109.1491	121.1762	121.4027	137.9534	147.1668	158.4078	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.7076	87.4098	86.7795	85.3702	82.9349	79.8000	79.8000	79.8000	79.8000	85.4856	87.1431	87.8144	(217)
Fuel for water heating, kWh/month	185.4674	163.6679	172.2800	155.7803	156.2426	143.7497	136.7784	151.8499	152.1337	161.3762	168.8794	180.3892	(219)

Water heating fuel used	1928.5947	(219)
Annual totals kWh/year		
Space heating fuel - main system	2720.1048	(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)	281.6528	(232)
Total delivered energy for all uses	5005.3523	(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	2720.1048	0.2160	587.5426	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1928.5947	0.2160	416.5765	(264)
Space and water heating			1004.1191	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	281.6528	0.5190	146.1778	(268)
Total CO2, kg/m2/year			1189.2219	(272)
Emissions per m2 for space and water heating			16.1175	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.3464	(272b)
Emissions per m2 for pumps and fans			0.6248	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.1175 * 1.55) + 2.3464 + 0.6248, rounded to 2 d.p.			27.9500	(273)

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		62.3000 (1b)	x	2.7000 (2b)	=	168.2100	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.3000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	168.2100	(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) =	0.1189	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2689	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2487	(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	0.3171	0.3109	0.3047	0.2736	0.2674	0.2363	0.2363	0.2301	0.2487	0.2674	0.2798	0.2923	(22b)
Effective ac	0.5503	0.5483	0.5464	0.5374	0.5357	0.5279	0.5279	0.5265	0.5309	0.5357	0.5392	0.5427	(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	
Front Door			2.1000	1.0000	2.1000			(26)
Windows (Uw = 1.00)			24.2500	0.9615	23.3173			(27)
External Wall 1	85.4000	24.2500	61.1500	0.1600	9.7840			(29a)
Corridor Wall	29.7600	2.1000	27.6600	0.2257	6.2438			(29a)
Total net area of external elements Aum(A, m2)			115.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.4451			(33)
Party Floor 1			62.3000					(32d)
Party Ceilings 1			62.3000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.9952	(36)
Total fabric heat loss	(33) + (36) =	55.4403	(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	30.5460	30.4376	30.3314	29.8324	29.7390	29.3043	29.3043	29.2239	29.4718	29.7390	29.9279	30.1253	(38)
Heat transfer coeff	85.9863	85.8779	85.7717	85.2727	85.1793	84.7446	84.7446	84.6642	84.9121	85.1793	85.3682	85.5656	(39)
Average = Sum(39)m / 12 =												85.2722	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3802	1.3785	1.3768	1.3687	1.3672	1.3603	1.3603	1.3590	1.3630	1.3672	1.3703	1.3734	(40)
HLP (average)												1.3687	(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	2.0459	(42)
Average daily hot water use (litres/day)	82.7892	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.0681	87.7566	84.4450	81.1334	77.8219	74.5103	74.5103	77.8219	81.1334	84.4450	87.7566	91.0681	(44)
Energy conte	135.0514	118.1168	121.8860	106.2632	101.9620	87.9855	81.5315	93.5586	94.6759	110.3357	120.4400	130.7901	(45)
Energy content (annual)										Total = Sum(45)m =		1302.5967	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage 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	(56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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)
Heat gains from water heating, kWh/month													
	28.6984	25.0998	25.9008	22.5809	21.6669	18.6969	17.3254	19.8812	20.1186	23.4463	25.5935	27.7929	(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	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.9320	14.1506	11.5081	8.7123	6.5126	5.4982	5.9410	7.7223	10.3649	13.1606	15.3604	16.3748	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	178.7081	180.5625	175.8894	165.9409	153.3827	141.5798	133.6947	131.8403	136.5134	146.4619	159.0201	170.8230	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	(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)													
	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	(71)
Water heating gains (Table 5)													
	38.5732	37.3509	34.8129	31.3624	29.1222	25.9679	23.2869	26.7220	27.9426	31.5139	35.5465	37.3560	(72)
Total internal gains													
	286.9011	285.7520	275.8983	259.7036	242.7055	226.7339	216.6105	219.9726	228.5088	244.8243	263.6149	278.2417	(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	
Northeast	3.2000	11.2829	0.4500	0.7000	0.7700	7.8816	(75)
East	7.4900	19.6403	0.4500	0.7000	0.7700	32.1124	(76)
Southeast	3.2000	36.7938	0.4500	0.7000	0.7700	25.7021	(77)
South	3.7500	46.7521	0.4500	0.7000	0.7700	38.2715	(78)
West	6.6100	19.6403	0.4500	0.7000	0.7700	28.3395	(80)

Solar gains	132.3072	240.7592	363.4008	495.9646	589.0724	597.3924	570.8754	500.9302	409.9912	275.9194	161.4436	111.2150	(83)
Total gains	419.2083	526.5112	639.2991	755.6681	831.7778	824.1263	787.4859	720.9028	638.5000	520.7437	425.0585	389.4568	(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	50.3148	50.3784	50.4408	50.7359	50.7916	51.0521	51.0521	51.1006	50.9514	50.7916	50.6792	50.5622	
alpha	4.3543	4.3586	4.3627	4.3824	4.3861	4.4035	4.4035	4.4067	4.3968	4.3861	4.3786	4.3708	
util living area													
	0.9967	0.9907	0.9726	0.9159	0.7939	0.6183	0.4641	0.5232	0.7781	0.9575	0.9928	0.9976	(86)
MIT	19.5269	19.7539	20.0996	20.5076	20.8089	20.9524	20.9892	20.9821	20.8707	20.4384	19.8918	19.4805	(87)
Th 2	19.7785	19.7799	19.7812	19.7874	19.7885	19.7939	19.7939	19.7949	19.7918	19.7885	19.7862	19.7838	(88)
util rest of house													
	0.9955	0.9876	0.9630	0.8873	0.7307	0.5178	0.3417	0.3945	0.6874	0.9369	0.9898	0.9967	(89)
MIT 2	18.4567	18.6830	19.0234	19.4135	19.6707	19.7745	19.7916	19.7905	19.7274	19.3611	18.8264	18.4145	(90)
Living area fraction									fLA = Living area / (4) =			0.3002	(91)
MIT	18.7779	19.0045	19.3464	19.7419	20.0124	20.1280	20.1511	20.1482	20.0706	19.6845	19.1462	18.7345	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7779	19.0045	19.3464	19.7419	20.0124	20.1280	20.1511	20.1482	20.0706	19.6845	19.1462	18.7345	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9942	0.9849	0.9587	0.8860	0.7435	0.5470	0.3787	0.4335	0.7107	0.9347	0.9876	0.9957	(94)
Useful gains	416.7701	518.5373	612.9116	669.5567	618.4397	450.8295	298.2288	312.5032	453.7749	486.7401	419.8038	387.7809	(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													
	1244.9051	1211.2619	1101.8589	924.5184	708.0422	468.4704	300.9335	317.3381	506.9739	773.8085	1028.3587	1243.6533	(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													
	616.1325	465.5110	363.7768	183.5724	66.6643	0.0000	0.0000	0.0000	0.0000	213.5788	438.1595	636.7690	(98)
Space heating												2984.1643	(98)
Space heating per m2											(98) / (4) =	47.8999	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	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	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	796.5996	627.1103	643.4475	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9051	0.9472	0.9269	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	720.9957	594.0275	596.4373	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1039.5158	995.1790	918.5455	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													

	0.0000	0.0000	0.0000	0.0000	0.0000	229.3344	298.4567	239.6485	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												767.4396	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	57.3336	74.6142	59.9121	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												191.8599	(107)
Space cooling per m2												3.0796	(108)
Energy for space heating												47.8999	(99)
Energy for space cooling												3.0796	(108)
Total												50.9795	(109)
Dwelling Fabric Energy Efficiency (DFEE)												51.0	(109)

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

1. Overall dwelling dimensions

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		62.3000 (1b)	x	2.7000 (2b)	=	168.2100	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	62.3000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	168.2100	(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) =	0.1189	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3689	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3412	(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	0.4351	0.4265	0.4180	0.3754	0.3668	0.3242	0.3242	0.3156	0.3412	0.3668	0.3839	0.4009	(22b)
Effective ac	0.5946	0.5910	0.5874	0.5704	0.5673	0.5525	0.5525	0.5498	0.5582	0.5673	0.5737	0.5804	(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)			13.4700	1.3258	17.8580			(27)
External Wall 1	85.4000	13.4700	71.9300	0.1800	12.9474			(29a)
Corridor Wall	29.7600	2.1000	27.6600	0.1800	4.9788			(29a)
Total net area of external elements Aum(A, m2)			115.1600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.8842			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		9.0693	(36)
Total fabric heat loss	(33) + (36) =	46.9535	(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	33.0082	32.8042	32.6043	31.6650	31.4893	30.6713	30.6713	30.5198	30.9864	31.4893	31.8448	32.2164	(38)
Heat transfer coeff	79.9617	79.7577	79.5577	78.6185	78.4428	77.6247	77.6247	77.4732	77.9398	78.4428	78.7983	79.1699	(39)
Average = Sum(39)m / 12 =												78.6176	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2835	1.2802	1.2770	1.2619	1.2591	1.2460	1.2460	1.2436	1.2510	1.2591	1.2648	1.2708	(40)
HLP (average)												1.2619	(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	2.0459	(42)
Average daily hot water use (litres/day)	82.7892	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.0681	87.7566	84.4450	81.1334	77.8219	74.5103	74.5103	77.8219	81.1334	84.4450	87.7566	91.0681	(44)
Energy conte	135.0514	118.1168	121.8860	106.2632	101.9620	87.9855	81.5315	93.5586	94.6759	110.3357	120.4400	130.7901	(45)
Energy content (annual)										Total = Sum(45)m =		1302.5967	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage 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	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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)

Heat gains from water heating, kWh/month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	28.6984	25.0998	25.9008	22.5809	21.6669	18.6969	17.3254	19.8812	20.1186	23.4463	25.5935	27.7929	(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	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	102.2931	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.9484	14.1652	11.5199	8.7213	6.5193	5.5038	5.9471	7.7303	10.3756	13.1741	15.3762	16.3916	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	178.7081	180.5625	175.8894	165.9409	153.3827	141.5798	133.6947	131.8403	136.5134	146.4619	159.0201	170.8230	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	33.2293	(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)													
	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	(71)
Water heating gains (Table 5)													
	38.5732	37.3509	34.8129	31.3624	29.1222	25.9679	23.2869	26.7220	27.9426	31.5139	35.5465	37.3560	(72)
Total internal gains													
	286.9175	285.7665	275.9101	259.7125	242.7122	226.7395	216.6167	219.9805	228.5194	244.8379	263.6307	278.2586	(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	
Northeast	1.7800	11.2829	0.6300	0.7000	0.7700	6.1378	(75)
East	4.1600	19.6403	0.6300	0.7000	0.7700	24.9697	(76)
Southeast	1.7800	36.7938	0.6300	0.7000	0.7700	20.0155	(77)
South	2.0800	46.7521	0.6300	0.7000	0.7700	29.7191	(78)
West	3.6700	19.6403	0.6300	0.7000	0.7700	22.0285	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	102.8706	187.1982	282.5676	385.6622	458.0780	464.5544	443.9311	389.5293	318.8006	214.5395	125.5254	86.4706	(83)
Total gains	389.7881	472.9647	558.4777	645.3748	700.7902	691.2939	660.5478	609.5098	547.3201	459.3774	389.1561	364.7292	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.1058	54.2442	54.3805	55.0302	55.1534	55.7347	55.7347	55.8436	55.5093	55.1534	54.9046	54.6469	
alpha	4.6071	4.6163	4.6254	4.6687	4.6769	4.7156	4.7156	4.7229	4.7006	4.6769	4.6603	4.6431	
util living area													
	0.9976	0.9937	0.9817	0.9409	0.8400	0.6685	0.5057	0.5645	0.8173	0.9690	0.9948	0.9982	(86)
MIT	19.6070	19.8012	20.1081	20.4917	20.7918	20.9486	20.9888	20.9818	20.8661	20.4521	19.9543	19.5752	(87)
Th 2	19.8538	19.8564	19.8589	19.8708	19.8730	19.8834	19.8834	19.8853	19.8794	19.8730	19.8685	19.8638	(88)
util rest of house													
	0.9967	0.9915	0.9751	0.9194	0.7853	0.5716	0.3832	0.4377	0.7361	0.9536	0.9926	0.9976	(89)
MIT 2	18.5952	18.7903	19.0954	19.4732	19.7388	19.8612	19.8808	19.8805	19.8089	19.4454	18.9532	18.5713	(90)
Living area fraction									fLA = Living area / (4) =			0.3002	(91)
MIT	18.8989	19.0937	19.3993	19.7789	20.0549	20.1876	20.2134	20.2111	20.1263	19.7476	19.2537	18.8726	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8989	19.0937	19.3993	19.7789	20.0549	20.1876	20.2134	20.2111	20.1263	19.7476	19.2537	18.8726	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9957	0.9896	0.9718	0.9173	0.7952	0.5995	0.4203	0.4761	0.7562	0.9514	0.9910	0.9968	(94)
Useful gains	388.1262	468.0286	542.7030	592.0276	557.2476	414.4530	277.6236	290.2117	413.9034	437.0745	385.6594	363.5731	(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													
	1167.3526	1132.0602	1026.2423	855.2823	655.3800	433.7358	280.4874	295.2550	469.6849	717.5596	957.6920	1161.6295	(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													
	579.7444	446.2293	359.7533	189.5433	73.0105	0.0000	0.0000	0.0000	0.0000	208.6809	411.8634	593.7539	(98)
Space heating												2862.5791	(98)
Space heating per m2											(98) / (4) =	45.9483	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	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	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	729.6725	574.4230	588.7967	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8940	0.9421	0.9214	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	652.3427	541.1724	542.5379	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	884.2646	846.8178	788.3565	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	166.9838	227.4002	182.8890	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												577.2730	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	41.7459	56.8500	45.7223	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												144.3182 (107)
Space cooling per m2												2.3165 (108)
Energy for space heating												45.9483 (99)
Energy for space cooling												2.3165 (108)
Total												48.2648 (109)
Target Fabric Energy Efficiency (TFEE)												55.5 (109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	62.3000 (1b)	x	2.7000 (2b)	=	168.2100	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 62.3000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	168.2100	(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 q50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1457	0.1388	0.1388	0.1283	0.1283	0.1145	0.1179	0.1110	0.1145	0.1214	0.1214	0.1318	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.9500 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2759	0.2690	0.2690	0.2586	0.2586	0.2447	0.2482	0.2413	0.2447	0.2517	0.2517	0.2621	(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	
Front Door			2.1000	1.0000	2.1000			(26)
Windows (Uw = 1.00)			24.2500	0.9615	23.3173			(27)
External Wall 1	85.4000	24.2500	61.1500	0.1600	9.7840			(29a)
Corridor Wall	29.7600	2.1000	27.6600	0.2257	6.2438			(29a)
Total net area of external elements Aum(A, m2)			115.1600					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	41.4451			(33)
Party Floor 1			62.3000					(32d)
Party Ceilings 1			62.3000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.9952	(36)
Total fabric heat loss	(33) + (36) =	55.4403	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	15.3171	14.9320	14.9320	14.3544	14.3544	13.5842	13.7767	13.3916	13.5842	13.9693	13.9693	14.5469	(38)
Heat transfer coeff	70.7574	70.3723	70.3723	69.7947	69.7947	69.0245	69.2170	68.8319	69.0245	69.4096	69.4096	69.9872	(39)
Average = Sum(39)m / 12 =												69.6663	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1358	1.1296	1.1296	1.1203	1.1203	1.1079	1.1110	1.1048	1.1079	1.1141	1.1141	1.1234	(40)
HLP (average)												1.1182	(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 2.0459 (42)
Average daily hot water use (litres/day) 82.7892 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.0681	87.7566	84.4450	81.1334	77.8219	74.5103	74.5103	77.8219	81.1334	84.4450	87.7566	91.0681	(44)
Energy conte	135.0514	118.1168	121.8860	106.2632	101.9620	87.9855	81.5315	93.5586	94.6759	110.3357	120.4400	130.7901	(45)
Energy content (annual)										Total = Sum(45)m =		1302.5967	(45)
Distribution loss (46)m = 0.15 x (45)m	20.2577	17.7175	18.2829	15.9395	15.2943	13.1978	12.2297	14.0338	14.2014	16.5504	18.0660	19.6185	(46)

Water storage loss:

Store volume 3.0000 (47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0240 (51)

Volume factor from Table 2a 3.4200 (52)

Temperature factor from Table 2b 0.6000 (53)

Enter (49) or (54) in (55) 0.1475 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	4.5734	4.1308	4.5734	4.4259	4.5734	4.4259	4.5734	4.5734	4.4259	4.5734	4.4259	4.5734	(56)
If cylinder contains dedicated solar storage	4.5734	4.1308	4.5734	4.4259	4.5734	4.4259	4.5734	4.5734	4.4259	4.5734	4.4259	4.5734	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	162.8872	143.2589	149.7218	133.2010	129.7978	114.9234	109.3673	121.3944	121.6138	138.1715	147.3779	158.6259	(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	162.8872	143.2589	149.7218	133.2010	129.7978	114.9234	109.3673	121.3944	121.6138	138.1715	147.3779	158.6259	(64)

Total per year (kWh/year) = Sum(64)m = 1630.3410 (64)

RHI water heating demand 1630 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	67.1732	59.3875	62.7957	56.8828	56.1710	50.8055	49.3779	53.3769	53.0301	58.9553	61.5966	65.7564	(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	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.8299	35.3766	28.7701	21.7809	16.2814	13.7455	14.8525	19.3058	25.9122	32.9015	38.4009	40.9369	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.7285	269.4963	262.5215	247.6730	228.9295	211.3132	199.5444	196.7766	203.7514	218.5999	237.3434	254.9597	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	(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)	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	(71)
Water heating gains (Table 5)	90.2866	88.3742	84.4029	79.0039	75.4987	70.5632	66.3681	71.7431	73.6529	79.2410	85.5509	88.3822	(72)
Total internal gains	487.0833	483.4853	465.9328	438.6960	410.9479	385.8601	371.0032	378.0638	393.5547	420.9806	451.5335	474.5171	(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	
Northeast	3.2000	12.9236	0.4500	0.7000	0.7700	9.0277	(75)
East	7.4900	22.3313	0.4500	0.7000	0.7700	36.5124	(76)
Southeast	3.2000	40.4699	0.4500	0.7000	0.7700	28.2700	(77)
South	3.7500	50.9848	0.4500	0.7000	0.7700	41.7365	(78)
West	6.6100	22.3313	0.4500	0.7000	0.7700	32.2225	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	147.7691	242.2342	361.7973	509.8524	590.8352	641.6272	606.3533	543.4568	442.7927	296.5908	184.7814	122.9762	(83)
Total gains	634.8523	725.7195	827.7301	948.5484	1001.7831	1027.4873	977.3566	921.5206	836.3474	717.5714	636.3148	597.4933	(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	61.1440	61.4786	61.4786	61.9874	61.9874	62.6791	62.5047	62.8544	62.6791	62.3313	62.3313	61.8169	
alpha	5.0763	5.0986	5.0986	5.1325	5.1325	5.1786	5.1670	5.1903	5.1786	5.1554	5.1554	5.1211	
util living area	0.9754	0.9532	0.8903	0.7423	0.5447	0.3351	0.2195	0.2389	0.4731	0.7953	0.9449	0.9804	(86)
MIT	20.2355	20.4069	20.6669	20.8929	20.9808	20.9988	20.9999	20.9998	20.9929	20.8759	20.5431	20.2017	(87)
Th 2	19.9717	19.9768	19.9768	19.9843	19.9843	19.9944	19.9918	19.9969	19.9944	19.9893	19.9893	19.9818	(88)
util rest of house	0.9680	0.9402	0.8627	0.6927	0.4803	0.2681	0.1481	0.1641	0.3937	0.7395	0.9270	0.9744	(89)
MIT 2	19.0027	19.2467	19.5978	19.8805	19.9703	19.9939	19.9918	19.9969	19.9907	19.8745	19.4508	18.9626	(90)

Living area fraction fLA = Living area / (4) = 0.3002 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	19.3728	19.5949	19.9187	20.1844	20.2736	20.2955	20.2944	20.2979	20.2915	20.1750	19.7787	19.3345	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3728	19.5949	19.9187	20.1844	20.2736	20.2955	20.2944	20.2979	20.2915	20.1750	19.7787	19.3345	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9626	0.9343	0.8609	0.7030	0.4990	0.2882	0.1696	0.1866	0.4175	0.7505	0.9225	0.9695	(94)
Useful gains	611.0979	678.0590	712.6230	666.8083	499.8940	296.1562	165.7194	171.9132	349.1423	538.5687	587.0269	579.2522	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1009.9028	984.8546	880.9710	717.7945	507.6619	296.4944	165.7338	171.9362	351.4397	595.1904	817.5526	996.2359	(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	296.7108	206.1666	125.2509	36.7101	5.7793	0.0000	0.0000	0.0000	0.0000	42.1265	165.9785	310.2359	(98)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Space heating	1188.9587 (98)
RHI space heating demand	1189 (98)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	62.3000 (1b)	x	2.7000 (2b)	=	168.2100	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 62.3000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	168.2100	(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 q50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 73.9500 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3072	0.3037	0.3002	0.2829	0.2794	0.2621	0.2621	0.2586	0.2690	0.2794	0.2863	0.2933	(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	
Front Door			2.1000	1.0000	2.1000			(26)
Windows (Uw = 1.00)			24.2500	0.9615	23.3173			(27)
External Wall 1	85.4000	24.2500	61.1500	0.1600	9.7840			(29a)
Corridor Wall	29.7600	2.1000	27.6600	0.2257	6.2438			(29a)
Total net area of external elements Aum(A, m2)			115.1600					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		41.4451			(33)
Party Floor 1			62.3000					(32d)
Party Ceilings 1			62.3000					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.9952	(36)
Total fabric heat loss	(33) + (36) =	55.4403	(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	17.0500	16.8575	16.6649	15.7022	15.5096	14.5469	14.5469	14.3544	14.9320	15.5096	15.8947	16.2798	(38)
Heat transfer coeff	72.4903	72.2978	72.1052	71.1425	70.9499	69.9872	69.9872	69.7947	70.3723	70.9499	71.3350	71.7201	(39)
Average = Sum(39)m / 12 =												71.0944	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1636	1.1605	1.1574	1.1419	1.1388	1.1234	1.1234	1.1203	1.1296	1.1388	1.1450	1.1512	(40)
HLP (average)												1.1412	(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 2.0459 (42)
Average daily hot water use (litres/day) 82.7892 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	91.0681	87.7566	84.4450	81.1334	77.8219	74.5103	74.5103	77.8219	81.1334	84.4450	87.7566	91.0681	(44)
Energy conte	135.0514	118.1168	121.8860	106.2632	101.9620	87.9855	81.5315	93.5586	94.6759	110.3357	120.4400	130.7901	(45)
Energy content (annual)										Total = Sum(45)m =		1302.5967	(45)
Distribution loss (46)m = 0.15 x (45)m	20.2577	17.7175	18.2829	15.9395	15.2943	13.1978	12.2297	14.0338	14.2014	16.5504	18.0660	19.6185	(46)

Water storage loss:

Store volume	3.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0240	(51)
Volume factor from Table 2a	3.4200	(52)
Temperature factor from Table 2b	0.6000	(53)
Enter (49) or (54) in (55)	0.1475	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	4.5734	4.1308	4.5734	4.4259	4.5734	4.4259	4.5734	4.5734	4.4259	4.5734	4.4259	4.5734	(56)
If cylinder contains dedicated solar storage	4.5734	4.1308	4.5734	4.4259	4.5734	4.4259	4.5734	4.5734	4.4259	4.5734	4.4259	4.5734	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	162.8872	143.2589	149.7218	133.2010	129.7978	114.9234	109.3673	121.3944	121.6138	138.1715	147.3779	158.6259	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	162.8872	143.2589	149.7218	133.2010	129.7978	114.9234	109.3673	121.3944	121.6138	138.1715	147.3779	158.6259	(64)
Total per year (kWh/year) = Sum(64)m =												1630.3410	(64)
Heat gains from water heating, kWh/month	67.1732	59.3875	62.7957	56.8828	56.1710	50.8055	49.3779	53.3769	53.0301	58.9553	61.5966	65.7564	(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	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.8299	35.3766	28.7701	21.7809	16.2814	13.7455	14.8525	19.3058	25.9122	32.9015	38.4009	40.9369	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.7285	269.4963	262.5215	247.6730	228.9295	211.3132	199.5444	196.7766	203.7514	218.5999	237.3434	254.9597	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	(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)	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	(71)
Water heating gains (Table 5)	90.2866	88.3742	84.4029	79.0039	75.4987	70.5632	66.3681	71.7431	73.6529	79.2410	85.5509	88.3822	(72)
Total internal gains	487.0833	483.4853	465.9328	438.6960	410.9479	385.8601	371.0032	378.0638	393.5547	420.9806	451.5335	474.5171	(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	
Northeast	3.2000	11.2829	0.4500	0.7000	0.7700	7.8816	(75)
East	7.4900	19.6403	0.4500	0.7000	0.7700	32.1124	(76)
Southeast	3.2000	36.7938	0.4500	0.7000	0.7700	25.7021	(77)
South	3.7500	46.7521	0.4500	0.7000	0.7700	38.2715	(78)
West	6.6100	19.6403	0.4500	0.7000	0.7700	28.3395	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	132.3072	240.7592	363.4008	495.9646	589.0724	597.3924	570.8754	500.9302	409.9912	275.9194	161.4436	111.2150	(83)
Total gains	619.3905	724.2445	829.3336	934.6606	1000.0202	983.2525	941.8786	878.9940	803.5460	696.9000	612.9771	585.7321	(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	59.6823	59.8412	60.0010	60.8130	60.9780	61.8169	61.8169	61.9874	61.4786	60.9780	60.6489	60.3232	
alpha	4.9788	4.9894	5.0001	5.0542	5.0652	5.1211	5.1211	5.1325	5.0986	5.0652	5.0433	5.0215	
util living area	0.9823	0.9624	0.9135	0.7987	0.6301	0.4511	0.3262	0.3639	0.5851	0.8580	0.9643	0.9861	(86)
MIT	20.0945	20.2974	20.5666	20.8274	20.9551	20.9934	20.9990	20.9982	20.9766	20.7886	20.3957	20.0545	(87)
Th 2	19.9493	19.9517	19.9542	19.9667	19.9692	19.9818	19.9818	19.9843	19.9768	19.9692	19.9642	19.9592	(88)
util rest of house	0.9771	0.9519	0.8913	0.7560	0.5697	0.3813	0.2511	0.2843	0.5061	0.8148	0.9525	0.9819	(89)
MIT 2	18.7836	19.0730	19.4451	19.7882	19.9317	19.9780	19.9814	19.9837	19.9614	19.7548	19.2265	18.7338	(90)
Living area fraction									fLA = Living area / (4) =			0.3002	(91)
MIT	19.1771	19.4405	19.7817	20.1002	20.2389	20.2828	20.2869	20.2882	20.2662	20.0651	19.5775	19.1303	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1771	19.4405	19.7817	20.1002	20.2389	20.2828	20.2869	20.2882	20.2662	20.0651	19.5775	19.1303	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9721	0.9457	0.8871	0.7619	0.5860	0.4021	0.2737	0.3082	0.5290	0.8193	0.9470	0.9775	(94)
Useful gains	602.0912	684.9197	735.7259	712.1099	586.0263	395.4128	257.7862	270.9248	425.0948	570.9521	580.4765	572.5574	(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	1078.4461	1051.2453	957.6803	796.8068	605.8361	397.7202	258.0335	271.3754	433.9270	671.5502	890.0794	1070.7999	(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	354.4081	246.1708	165.1341	60.9818	14.7385	0.0000	0.0000	0.0000	0.0000	74.8450	222.9141	370.6924	(98)
Space heating												1509.8848	(98)

Space heating per m2	(98) / (4) =	24.2357	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	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	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	657.8797	517.9053	530.4394	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9680	0.9856	0.9784	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	636.8557	510.4310	519.0078	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1084.1110	1038.2602	963.5666	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	322.0238	392.7049	330.7517	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1045.4805	(104)
Cooled fraction									fC = cooled area / (4) =			0.4875	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	39.2450	47.8589	40.3087	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												127.4127	(107)
Space cooling per m2												2.0451	(108)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	1509.8848	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	1585.3790	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	1630.3410	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	1711.8580	(310a)
Electricity used for heat distribution	32.9724	(313)
Cooling System Energy Efficiency Ratio	12.1770	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	10.4634	(315)
Annual totals kWh/year		
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)		
mechanical ventilation fans (SFP = 0.8250)	169.3034	(330a)
Total electricity for the above, kWh/year	169.3034	(331)
Electricity for lighting (calculated in Appendix L)	281.3633	(332)
Total delivered energy for all uses	3758.3671	(338)

10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating from Heat pump	1585.3790	4.2400	67.2201	(340a)
Space heating - secondary	0.0000	0.0000	0.0000	(341)
Water heating from Heat pump	1711.8580	4.2400	72.5828	(342a)
Space cooling	10.4634	13.1900	1.3801	(348)
Mechanical ventilation fans	169.3034	13.1900	22.3311	(349)
Pumps and fans for heating	0.0000	0.0000	0.0000	(349)
Energy for lighting	281.3633	13.1900	37.1118	(350)
Additional standing charges			120.0000	(351)
Total energy cost			320.6259	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12):		0.4200	(356)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.2550	(357)
SAP value		82.4926	
SAP rating (Section 12)		82	(358)
SAP band		B	

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			500.0000	(367a)
Space heating from Heat pump	659.4474	0.5190	342.2532	(367)
Electrical energy for heat distribution	32.9724	0.5190	17.1127	(372)
Total CO2 associated with community systems			359.3659	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			359.3659	(376)
Space cooling	10.4634	0.5190	5.4305	(377)

Pumps and fans	169.3034	0.5190	87.8684 (378)
Energy for lighting	281.3633	0.5190	146.0276 (379)
Total kg/year			598.6924 (383)
CO2 emissions per m2			9.6100 (384)
EI value			92.5233 (384a)
EI rating			93 (385)
EI band			A

Calculation of stars for heating and DHW

Space heating energy efficiency 1.00 × 4.240 × 1.05
= 4.452, stars = 4
Space heating environmental impact 1.00 × 0.519 × 1.05 / 5.0000
= 0.1090, stars = 5
Water heating energy efficiency 4.452, stars = 4
Water heating environmental impact 0.1090, stars = 5

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SAP 2012 WORKSHEET FOR New Build (As Designed)   (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY      09 Jan 2014
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-----------------------------------------------------------------------------------------------------
1. Overall dwelling dimensions
-----------------------------------------------------------------------------------------------------
                                                                           Area         Storey height                Volume
                                                                           (m2)               (m)                     (m3)
Ground floor                                                            62.3000 (1b)    x       2.7000 (2b)    =    168.2100 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)             62.3000                                                   (4)
Dwelling volume                                                               (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    168.2100 (5)


-----------------------------------------------------------------------------------------------------
2. Ventilation rate
-----------------------------------------------------------------------------------------------------
                                                      main          secondary            other             total        m3 per hour
                                                    heating          heating
Number of chimneys                                      0      +          0      +          0      =          0 * 40 =       0.0000 (6a)
Number of open flues                                    0      +          0      +          0      =          0 * 20 =       0.0000 (6b)
Number of intermittent fans                                                                                   0 * 10 =       0.0000 (7a)
Number of passive vents                                                                                       0 * 10 =       0.0000 (7b)
Number of flueless gas fires                                                                                  0 * 40 =       0.0000 (7c)

                                                                                                           Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(7a)+(7b)+(7c) =                          0.0000 / (5) =       0.0000 (8)
Pressure test                                                                                                                 Yes
Measured/design q50                                                                                                        3.0000
Infiltration rate                                                                                                          0.1500 (18)
Number of sides sheltered                                                                                                       1 (19)

Shelter factor                                                                          (20) = 1  -  [0.075 x (19)]  =       0.9250 (20)
Infiltration rate adjusted to include shelter factor                                          (21) = (18) x (20)  =       0.1388 (21)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Wind speed     4.2000     4.0000     4.0000     3.7000     3.7000     3.3000     3.4000     3.2000     3.3000     3.5000     3.5000     3.8000 (22)
Wind factor    1.0500     1.0000     1.0000     0.9250     0.9250     0.8250     0.8500     0.8000     0.8250     0.8750     0.8750     0.9500 (22a)
Adj infilt rate
               0.1457     0.1388     0.1388     0.1283     0.1283     0.1145     0.1179     0.1110     0.1145     0.1214     0.1214     0.1318 (22b)
 Balanced mechanical ventilation with heat recovery
If mechanical ventilation:                                                                                                 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =                              73.9500 (23c)

Effective ac   0.2759     0.2690     0.2690     0.2586     0.2586     0.2447     0.2482     0.2413     0.2447     0.2517     0.2517     0.2621 (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
Front Door                                                                        2.1000         1.0000         2.1000                                (26)
Windows (Uw = 1.00)                                                              24.2500         0.9615        23.3173                                (27)
External Wall 1                                   85.4000        24.2500         61.1500         0.1600         9.7840                                (29a)
Corridor Wall                                     29.7600         2.1000         27.6600         0.2257         6.2438                                (29a)
Total net area of external elements Aum(A, m2)                                  115.1600                                                              (31)
Fabric heat loss, W/K = Sum (A x U)                                         (26)...(30) + (32) =      41.4451                                         (33)
Party Floor 1                                                                    62.3000                                                              (32d)
Party Ceilings 1                                                                 62.3000                                                              (32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                    250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                            13.9952 (36)
Total fabric heat loss                                                                                          (33) + (36) =       55.4403 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m         15.3171    14.9320    14.9320    14.3544    14.3544    13.5842    13.7767    13.3916    13.5842    13.9693    13.9693    14.5469 (38)
Heat transfer coeff
              70.7574    70.3723    70.3723    69.7947    69.7947    69.0245    69.2170    68.8319    69.0245    69.4096    69.4096    69.9872 (39)
Average = Sum(39)m / 12 =                                                                                                           69.6663 (39)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP            1.1358     1.1296     1.1296     1.1203     1.1203     1.1079     1.1110     1.1048     1.1079     1.1141     1.1141     1.1234 (40)
HLP (average)                                                                                                                        1.1182 (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                                                                                                                    2.0459 (42)
Average daily hot water use (litres/day)                                                                                            82.7892 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
              91.0681    87.7566    84.4450    81.1334    77.8219    74.5103    74.5103    77.8219    81.1334    84.4450    87.7566    91.0681 (44)
Energy conte 135.0514   118.1168   121.8860   106.2632   101.9620    87.9855    81.5315    93.5586    94.6759   110.3357   120.4400   130.7901 (45)
Energy content (annual)                                                                                   Total = Sum(45)m =     1302.5967 (45)
Distribution loss  (46)m = 0.15 x (45)m
              20.2577    17.7175    18.2829    15.9395    15.2943    13.1978    12.2297    14.0338    14.2014    16.5504    18.0660    19.6185 (46)
```

Water storage loss:

Store volume	3.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0240	(51)
Volume factor from Table 2a	3.4200	(52)
Temperature factor from Table 2b	0.6000	(53)
Enter (49) or (54) in (55)	0.1475	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	4.5734	4.1308	4.5734	4.4259	4.5734	4.4259	4.5734	4.5734	4.4259	4.5734	4.4259	4.5734	(56)
If cylinder contains dedicated solar storage	4.5734	4.1308	4.5734	4.4259	4.5734	4.4259	4.5734	4.5734	4.4259	4.5734	4.4259	4.5734	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	162.8872	143.2589	149.7218	133.2010	129.7978	114.9234	109.3673	121.3944	121.6138	138.1715	147.3779	158.6259	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h	162.8872	143.2589	149.7218	133.2010	129.7978	114.9234	109.3673	121.3944	121.6138	138.1715	147.3779	158.6259	(64)
Total per year (kWh/year) = Sum(64)m =												1630.3410	(64)
Heat gains from water heating, kWh/month	67.1732	59.3875	62.7957	56.8828	56.1710	50.8055	49.3779	53.3769	53.0301	58.9553	61.5966	65.7564	(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	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	122.7517	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.8299	35.3766	28.7701	21.7809	16.2814	13.7455	14.8525	19.3058	25.9122	32.9015	38.4009	40.9369	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	266.7285	269.4963	262.5215	247.6730	228.9295	211.3132	199.5444	196.7766	203.7514	218.5999	237.3434	254.9597	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	49.3210	(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)	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	-81.8345	(71)
Water heating gains (Table 5)	90.2866	88.3742	84.4029	79.0039	75.4987	70.5632	66.3681	71.7431	73.6529	79.2410	85.5509	88.3822	(72)
Total internal gains	487.0833	483.4853	465.9328	438.6960	410.9479	385.8601	371.0032	378.0638	393.5547	420.9806	451.5335	474.5171	(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	
Northeast	3.2000	12.9236	0.4500	0.7000	0.7700	9.0277	(75)
East	7.4900	22.3313	0.4500	0.7000	0.7700	36.5124	(76)
Southeast	3.2000	40.4699	0.4500	0.7000	0.7700	28.2700	(77)
South	3.7500	50.9848	0.4500	0.7000	0.7700	41.7365	(78)
West	6.6100	22.3313	0.4500	0.7000	0.7700	32.2225	(80)

Solar gains	147.7691	242.2342	361.7973	509.8524	590.8352	641.6272	606.3533	543.4568	442.7927	296.5908	184.7814	122.9762	(83)
Total gains	634.8523	725.7195	827.7301	948.5484	1001.7831	1027.4873	977.3566	921.5206	836.3474	717.5714	636.3148	597.4933	(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	61.1440	61.4786	61.4786	61.9874	61.9874	62.6791	62.5047	62.8544	62.6791	62.3313	62.3313	61.8169	
alpha	5.0763	5.0986	5.0986	5.1325	5.1325	5.1786	5.1670	5.1903	5.1786	5.1554	5.1554	5.1211	
util living area	0.9754	0.9532	0.8903	0.7423	0.5447	0.3351	0.2195	0.2389	0.4731	0.7953	0.9449	0.9804	(86)
MIT	20.2355	20.4069	20.6669	20.8929	20.9808	20.9988	20.9999	20.9998	20.9929	20.8759	20.5431	20.2017	(87)
Th 2	19.9717	19.9768	19.9768	19.9843	19.9843	19.9944	19.9918	19.9969	19.9944	19.9893	19.9893	19.9818	(88)
util rest of house	0.9680	0.9402	0.8627	0.6927	0.4803	0.2681	0.1481	0.1641	0.3937	0.7395	0.9270	0.9744	(89)
MIT 2	19.0027	19.2467	19.5978	19.8805	19.9703	19.9939	19.9918	19.9969	19.9907	19.8745	19.4508	18.9626	(90)
Living area fraction									fLA = Living area / (4) =			0.3002	(91)
MIT	19.3728	19.5949	19.9187	20.1844	20.2736	20.2955	20.2944	20.2979	20.2915	20.1750	19.7787	19.3345	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3728	19.5949	19.9187	20.1844	20.2736	20.2955	20.2944	20.2979	20.2915	20.1750	19.7787	19.3345	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9626	0.9343	0.8609	0.7030	0.4990	0.2882	0.1696	0.1866	0.4175	0.7505	0.9225	0.9695	(94)
Useful gains	611.0979	678.0590	712.6230	666.8083	499.8940	296.1562	165.7194	171.9132	349.1423	538.5687	587.0269	579.2522	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1009.9028	984.8546	880.9710	717.7945	507.6619	296.4944	165.7338	171.9362	351.4397	595.1904	817.5526	996.2359	(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	296.7108	206.1666	125.2509	36.7101	5.7793	0.0000	0.0000	0.0000	0.0000	42.1265	165.9785	310.2359	(98)
Space heating												1188.9587	(98)

Space heating per m2	(98) / (4) =	19.0844 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	552.1957	422.2238	426.7579	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9876	0.9952	0.9935	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	545.3413	420.2077	423.9679	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1135.8139	1079.7279	1013.2730	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	425.1403	490.6830	438.4430	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1354.2664	(104)
Cooled fraction									fC = cooled area / (4) =			0.4875	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	51.8118	59.7995	53.4330	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												165.0444	(107)
Space cooling per m2												2.6492	(108)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Heat pump	1.0000	(303a)
Fraction of total space heat from community Heat pump	1.0000	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating	1.0000	(305)
Factor for control and charging method (Table 4c(3)) for community water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0500	(306)
Space heating:		
Annual space heating requirement	1188.9587	(98)
Space heat from Heat pump = (98) x 1.00 x 1.00 x 1.05	1248.4066	(307a)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)	0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	(309)
Water heating		
Annual water heating requirement	1630.3410	(64)
Water heat from Heat pump = (64) x 1.00 x 1.00 x 1.05	1711.8580	(310a)
Electricity used for heat distribution	29.6026	(313)
Cooling System Energy Efficiency Ratio	12.1770	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	13.5538	(315)
Annual totals kWh/year		
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.8250)		
mechanical ventilation fans (SFP = 0.8250)	169.3034	(330a)
Total electricity for the above, kWh/year	169.3034	(331)
Electricity for lighting (calculated in Appendix L)	281.3633	(332)
Total delivered energy for all uses	3424.4851	(338)

10b. Fuel costs - using BEDF prices (424)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating from Heat pump	1248.4066	4.8900	61.0471	(340a)
Space heating - secondary	0.0000	0.0000	0.0000	(341)
Water heating from Heat pump	1711.8580	4.8900	83.7099	(342a)
Space cooling	13.5538	16.1200	2.1849	(348)
Mechanical ventilation fans	169.3034	16.1200	27.2917	(349)
Pumps and fans for heating	0.0000	0.0000	0.0000	(349)
Energy for lighting	281.3633	16.1200	45.3558	(350)
Additional standing charges			87.0000	(351)
Total energy cost			306.5893	(355)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Heat pump			500.0000	(367a)
Space heating from Heat pump	592.0529	0.5190	307.2755	(367)
Electrical energy for heat distribution	29.6026	0.5190	15.3638	(372)
Total CO2 associated with community systems			322.6392	(373)
(negative value allowed since DFEE <= TFEE)				
Space and water heating			322.6392	(376)
Space cooling	13.5538	0.5190	7.0344	(377)
Pumps and fans	169.3034	0.5190	87.8684	(378)
Energy for lighting	281.3633	0.5190	146.0276	(379)
Total kg/year			563.5697	(383)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year

Efficiency of heat source Heat pump			500.0000 (367a)
Space heating from Heat pump	592.0529	3.0700	1817.6025 (367)
Electrical energy for heat distribution	29.6026	3.0700	90.8801 (372)
Total CO2 associated with community systems (negative value allowed since DFEE <= TFEE)			1908.4826 (373)
Space and water heating			1908.4826 (376)
Space cooling	13.5538	3.0700	41.6101 (377)
Pumps and fans	169.3034	3.0700	519.7613 (378)
Energy for lighting	281.3633	3.0700	863.7854 (379)
Primary energy kWh/year			3333.6394 (383)
Primary energy kWh/m2/year			53.5095 (384)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 82
Current environmental impact rating: A 93

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Not applicable
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Not applicable
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures: SAP change Cost change CO2 change
(none)

	Typical annual savings	Energy efficiency	Environmental impact
Recommended measures			
(none)			
Total Savings	£0	0.00 kg/m²	

Potential energy efficiency rating: B 82
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 424 TEST (27 Feb 2018)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£75	£75	£0
Community scheme	£232	£232	£0
Space heating	£175	£175	£0
Space cooling	£2	£2	£0
Water heating	£84	£84	£0
Lighting	£45	£45	£0
Total cost of fuels	£307	£307	£0
Total cost of uses	£306	£306	£0
Delivered energy	55 kWh/m²	55 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.6 tonnes	0.6 tonnes	0.0 tonnes
CO2 emissions per m²	9 kg/m²	9 kg/m²	0 kg/m²
Primary energy	54 kWh/m²	54 kWh/m²	0 kWh/m²

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SAP 2012 WORKSHEET FOR New Build (As Designed)    (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING      09 Jan 2014
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No improvements selected / applicable



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SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

No improvements selected / applicable

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	EndTerrace Flat
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	250.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	333.06	(P1)
Transmission heat loss coefficient	55.44	(37)
Summer heat loss coefficient	388.50	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
East	0.000	1.000	None
South East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
South East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	3.2000	98.8453	0.4500	0.7000	0.9000	80.7052
East	7.4900	117.5071	0.4500	0.7000	0.9000	224.5646
South East	3.2000	119.9223	0.4500	0.7000	0.9000	97.9142
South	3.7500	112.2060	0.4500	0.7000	0.9000	107.3601
West	6.6100	117.5071	0.4500	0.7000	0.9000	198.1805
total:						708.7247

	Jun	Jul	Aug	
Solar gains	750	709	635	(P3)
Internal gains	386	371	378	
Total summer gains	1136	1080	1013	(P5)
Summer gain/loss ratio	2.92	2.78	2.61	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	19.17	20.93	20.66	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

Block Compliance

Block Reference	000142	Issued on Date	25/09/2018
Block Name	St Johns Wood - For Planning		
Surveyor	Jessica Finnigan, Tel: .	Surveyor ID	Admin
Client	Almax, 5006835		

Block Compliance Report - DER

Block Reference: 000142		Block Name: St Johns Wood - For Planning		
Property-Survey Reference	Multiplier	Floor Area (m²)	DER (kgCO2/m²)	TER (kgCO2/m²)
Unit 2-Centralised ASHP	3	90.3	9.38	25.01
Unit 3-Centralised ASHP	3	62.3	10.44	27.95
Unit 5-Centralised ASHP	1	141.5	10.58	27.04
Unit 4-Centralised ASHP	1	149.7	10.69	26.03
Unit 1-Centralised ASHP	1	165.7	9.46	24.01
Totals:	9	914.7	50.55	130.04
Average DER = 10.01 kgCO2/m²			PASS	
Average TER = 25.91 kgCO2/m²				

Block Compliance Report - DFEE

Block Reference: 000142		Block Name: St Johns Wood - For Planning		
Property-Survey Reference	Multiplier	Floor Area (m²)	DFEE (kWh/m²/yr)	TFEE (kWh/m²/yr)
Unit 2-Centralised ASHP	3	90.3	48.17	53.62
Unit 3-Centralised ASHP	3	62.3	50.98	55.50
Unit 5-Centralised ASHP	1	141.5	63.84	70.11
Unit 4-Centralised ASHP	1	149.7	61.59	67.68
Unit 1-Centralised ASHP	1	165.7	56.59	62.39
Totals:	9	914.7	281.17	309.30
Average DFEE = 54.89 kWh/m²/yr			PASS	
Average TFEE = 60.44 kWh/m²/yr				

APPENDIX 3 –ASHP EFFICIENCY DATA

Mitsubishi Electric Aug-15
City Multi YLM
Seasonal Efficiency

Model Range		Complete System Efficiency (typical) SEER	Complete System Efficiency (typical) SCOP	Outdoor Unit Only Efficiency SEER	Outdoor Unit Only Efficiency SCOP	Complete System Annual Efficiency Examples: 20% H, 80% C NEW OFFICE	60% H, 40% C OLD OFFICE	50% H, 50% C NEW HOTEL	70% H, 30% C OLD HOTEL	10% H, 90% C RETAIL	System includes
Heat Pump High COP	PUHY-EP200YLM-A	9.02	5.53	10.99	6.08	8.32	6.93	7.28	6.58	8.67	5 x PLFY-P40VBM
	PUHY-EP250YLM-A	9.02	6.00	11.39	6.79	8.42	7.21	7.51	6.91	8.72	7 x PLFY-P40VBM
	PUHY-EP300YLM-A	7.75	6.00	9.27	6.77	7.40	6.70	6.88	6.53	7.58	8 x PLFY-P40VBM
	PUHY-EP350YLM-A	7.16	5.90	8.36	6.64	6.91	6.40	6.53	6.28	7.03	9 x PLFY-P40VBM
	PUHY-EP400YLM-A	6.97	4.79	8.19	5.25	6.53	5.66	5.88	5.44	6.75	10 x PLFY-P40VBM
	PUHY-EP450YLM-A	7.03	4.85	7.96	5.23	6.59	5.72	5.94	5.50	6.81	9 x PLFY-P50VBM
	PUHY-EP500YLM-A	7.28	4.90	8.30	5.30	6.80	5.85	6.09	5.61	7.04	10 x PLFY-P50VBM
	PUHY-EP550YSLM-A	8.75	6.07	10.22	6.65	8.21	7.14	7.41	6.87	8.48	11 x PLFY-P50VBM
	PUHY-EP600YSLM-A	7.45	6.08	8.43	6.68	7.18	6.63	6.77	6.49	7.31	12 x PLFY-P50VBM
	PUHY-EP650YSLM-A	8.48	5.40	9.82	5.82	7.86	6.63	6.94	6.32	8.17	13 x PLFY-P50VBM
	PUHY-EP700YSLM-A	8.29	5.61	9.57	6.07	7.75	6.68	6.95	6.41	8.02	14 x PLFY-P50VBM
	PUHY-EP750YSLM-A	8.79	6.41	10.31	7.06	8.31	7.36	7.60	7.12	8.55	15 x PLFY-P50VBM
	PUHY-EP800YSLM-A	7.53	6.40	8.59	7.08	7.30	6.85	6.97	6.74	7.42	16 x PLFY-P50VBM
	PUHY-EP850YSLM-A	7.68	6.03	8.79	6.68	7.35	6.69	6.86	6.53	7.52	14 x PLFY-P63VBM
	PUHY-EP900YSLM-A	7.58	6.02	8.68	6.68	7.27	6.64	6.80	6.49	7.42	15 x PLFY-P63VBM
Y Series Heat Pump - Standard	PUHY-P200YKB-A1	8.12	5.08	9.65	5.57	7.51	5.99	8.83	4.46	1.50	5 x PLFY-P40VBM
	PUHY-P250YKB-A1	8.36	5.65	10.31	6.38	7.82	6.58	9.52	5.10	1.56	7 x PLFY-P40VBM
	PUHY-P300YKB-A1	7.15	5.63	8.42	6.32	6.85	6.19	8.00	5.06	1.37	8 x PLFY-P40VBM
	PUHY-P350YKB-A1	6.66	5.61	7.69	6.31	6.45	6.03	7.41	5.05	1.29	9 x PLFY-P40VBM
	PUHY-P400YKB-A1	6.04	4.65	6.94	5.04	5.76	5.11	6.56	4.03	1.15	10 x PLFY-P40VBM
	PUHY-P450YKB-A1	6.47	4.64	7.27	4.98	6.10	5.17	6.81	3.98	1.22	9 x PLFY-P50VBM
	PUHY-P500YKB-A1	6.83	4.77	7.82	5.14	6.42	5.38	7.28	4.11	1.28	10 x PLFY-P50VBM
	PUHY-P550YSKB-A1	8.39	5.70	9.77	6.23	7.85	6.51	9.06	4.98	1.57	11 x PLFY-P50VBM
	PUHY-P600YSKB-A1	6.69	5.69	7.47	6.23	6.49	6.05	7.22	4.98	1.30	12 x PLFY-P50VBM
	PUHY-P650YSKB-A1	6.94	4.83	7.81	5.19	6.52	5.43	7.29	4.15	1.30	13 x PLFY-P50VBM
	PUHY-P700YSKB-A1	6.47	5.05	7.23	5.45	6.19	5.49	6.87	4.36	1.24	14 x PLFY-P50VBM
	PUHY-P750YSKB-A1	7.61	5.48	8.91	5.98	7.18	6.17	8.32	4.78	1.44	15 x PLFY-P50VBM
	PUHY-P800YSKB-A1	5.93	5.44	6.56	5.96	5.83	5.66	6.44	4.77	1.17	16 x PLFY-P50VBM
	PUHY-P850YSKB-A1	6.01	4.95	6.67	5.41	5.80	5.29	6.42	4.33	1.16	14 x PLFY-P63VBM
	PUHY-P900YSKB-A1	6.08	4.89	6.76	5.35	5.84	5.26	6.48	4.28	1.17	15 x PLFY-P63VBM
	PUHY-P950YSKB-A1	6.71	5.39	7.50	5.92	6.45	5.81	7.18	4.74	1.29	15 x PLFY-P63VBM
	PUHY-P1000YSKB-A1	6.67	5.32	7.46	5.84	6.40	5.75	7.14	4.67	1.28	16 x PLFY-P63VBM
	PUHY-P1050YSKB-A1	6.65	5.66	7.45	6.28	6.45	6.02	7.22	5.02	1.29	17 x PLFY-P63VBM
	PUHY-P1100YSKB-A1	6.40	5.44	7.11	5.98	6.21	5.77	6.88	4.78	1.24	17 x PLFY-P63VBM
	PUHY-P1150YSKB-A1	6.44	5.33	7.16	5.85	6.22	5.70	6.90	4.68	1.24	18 x PLFY-P63VBM
	PUHY-P1200YSKB-A1	5.85	4.56	6.52	4.90	5.59	4.95	6.20	3.92	1.12	19 x PLFY-P63VBM
	PUHY-P1250YSKB-A1	6.44	4.54	7.22	4.88	6.06	5.08	6.75	3.90	1.21	20 x PLFY-P63VBM
Heat Recovery High COP	PURY-EP200YLM-A	8.21	5.06	11.17	5.73	7.58	6.32	6.64	6.01	7.90	5 x PLFY-P40VBM + CMB-105G1
	PURY-EP250YLM-A	8.20	5.36	11.88	6.33	7.63	6.50	6.78	6.21	7.92	7 x PLFY-P40VBM + CMB-108GA1
	PURY-EP300YLM-A	6.79	5.41	8.91	6.39	6.51	5.96	6.10	5.82	6.65	8 x PLFY-P40VBM + CMB-108GA1
	PURY-EP350YLM-A	6.56	5.38	8.42	6.30	6.32	5.85	5.97	5.73	6.44	9 x PLFY-P40VBM + CMB-1010GA1
	PURY-EP400YLM-A	6.85	4.59	8.79	5.14	6.40	5.49	5.72	5.27	6.62	10 x PLFY-P40VBM + CMB-1010GA1
	PURY-EP450YLM-A	7.05	4.93	8.72	5.41	6.63	5.78	5.99	5.57	6.84	9 x PLFY-P50VBM + CMB-1010GA1
	PURY-EP500YLM-A	6.79	4.97	8.23	5.45	6.43	5.70	5.88	5.52	6.61	10 x PLFY-P50VBM + CMB-1010GA1
	PURY-EP550YSLM-A	7.88	5.60	10.12	6.33	7.42	6.51	6.74	6.28	7.65	11 x PLFY-P50VBM + CMB-1013GA1
	PURY-EP600YSLM-A	7.06	5.63	8.66	6.33	6.77	6.20	6.35	6.06	6.92	12 x PLFY-P50VBM + CMB-1013GA1
	PURY-EP650YSLM-A	6.87	5.47	8.34	6.12	6.59	6.03	6.17	5.89	6.73	13 x PLFY-P50VBM + CMB-1013GA1
	PURY-EP700YSLM-A	6.70	5.75	8.18	6.52	6.51	6.13	6.23	6.04	6.61	14 x PLFY-P50VBM + CMB-1016HA1
	PURY-EP750YSLM-A	6.80	4.91	8.35	5.40	6.42	5.67	5.86	5.48	6.61	15 x PLFY-P50VBM + CMB-1016HA1
	PURY-EP800YSLM-A	6.88	4.78	8.40	5.23	6.46	5.62	5.83	5.41	6.67	16 x PLFY-P50VBM + CMB-1016HA1

	PURY-EP850YSLM-A	7.14	4.83	8.75	5.30		6.68	5.75	5.99	5.52	6.91		14 x PLFY-P63VBM + CMB-1016HA1
	PURY-EP900YSLM-A	7.19	4.93	8.82	5.43		6.74	5.83	6.06	5.61	6.96		15 x PLFY-P63VBM + CMB-1016HA1
	PURY-P200YLM-A1	7.54	4.96	9.79	5.58		7.02	5.93	8.95	4.46	1.40		5 x PLFY-P40VBM + CMB-105G1
	PURY-P250YLM-A1	7.02	5.32	9.36	6.21		6.68	6.13	8.73	4.97	1.34		7 x PLFY-P40VBM + CMB-108GA1
	PURY-P300YLM-A1	6.09	5.18	7.60	6.11		5.91	5.66	7.30	4.89	1.18		8 x PLFY-P40VBM + CMB-108GA1
	PURY-P350YLM-A1	5.76	5.29	7.04	6.26		5.67	5.64	6.88	5.01	1.13		9 x PLFY-P40VBM + CMB-1010GA1
	PURY-P400YLM-A1	6.64	4.35	8.36	4.91		6.18	5.15	7.67	3.93	1.24		10 x PLFY-P40VBM + CMB-1010GA1
	PURY-P450YLM-A1	6.25	4.80	7.45	5.26		5.96	5.33	7.01	4.21	1.19		9 x PLFY-P50VBM + CMB-1010GA1
	PURY-P500YLM-A1	6.15	4.82	7.23	5.33		5.88	5.30	6.85	4.26	1.18		10 x PLFY-P50VBM + CMB-1010GA1
R2 Series	PURY-P400YSLM-A1	7.07	5.19	8.99	5.93		6.69	5.95	8.38	4.74	1.34		10 x PLFY-P40VBM + CMB-1010GA1
Heat	PURY-P450YSLM-A1	7.26	5.54	8.92	6.18		6.92	6.22	8.37	4.94	1.38		9 x PLFY-P50VBM + CMB-1010GA1
Recovery -	PURY-P500YSLM-A1	7.16	5.90	8.69	6.62		6.91	6.46	8.28	5.30	1.38		10 x PLFY-P50VBM + CMB-1010GA1
Standard	PURY-P550YSLM-A1	6.67	5.43	8.03	6.13		6.42	5.95	7.65	4.90	1.28		11 x PLFY-P50VBM + CMB-1013GA1
	PURY-P600YSLM-A1	6.30	5.36	7.45	6.06		6.11	5.78	7.17	4.85	1.22		12 x PLFY-P50VBM + CMB-1013GA1
	PURY-P650YSLM-A1	6.13	5.30	7.21	5.98		5.96	5.68	6.96	4.78	1.19		13 x PLFY-P50VBM + CMB-1013GA1
	PURY-P700YSLM-A1	5.83	5.67	6.84	6.48		5.80	5.90	6.77	5.18	1.16		14 x PLFY-P50VBM + CMB-1016HA1
	PURY-P750YSLM-A1	6.28	4.77	7.48	5.26		5.98	5.31	7.04	4.21	1.20		15 x PLFY-P50VBM + CMB-1016HA1
	PURY-P800YSLM-A1	6.33	4.54	7.55	5.00		5.97	5.14	7.04	4.00	1.19		16 x PLFY-P50VBM + CMB-1016HA1
	PURY-P850YSLM-A1	6.74	4.65	8.11	5.11		6.32	5.34	7.51	4.09	1.26		14 x PLFY-P63VBM + CMB-1016HA1
	PURY-P900YSLM-A1	6.35	4.80	7.51	5.27		6.04	5.34	7.06	4.22	1.21		15 x PLFY-P63VBM + CMB-1016HA1

NOTE:

Complete System Efficiency (typical) - this includes for power input of the outdoor unit, outdoor standby power, indoor units, BC controller

Outdoor Unit Only Efficiency - this includes for power input of the outdoor unit, outdoor standby power ONLY