PRICE&MYERS

Open University, 1 – 11 Hawley Crescent, Camden, NW1 8NP

Energy Strategy Report

CIBSE LOW CARBON ENERGY ASSESSORS

Date: 01/08/2016
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Executive Summary

This report details the proposed energy strategy for the proposed residential development at the Open University on Hawley Crescent.

The ground, first and second floors are B1 Commercial let to the Open University. The third and fourth floors are residential. The proposed development involves the part demolition of existing residential flats at third and fourth floor and construction of new three storey extension at third fourth and fifth to replace and extend existing residential accommodation.

The development is in the London Borough of Camden.

The proposed development addresses national planning policies on energy; in particular, mitigation of climate change and energy security through energy efficiency enhancements and use of alternative energy technologies. In order to reduce the carbon footprint of the building beyond the requirements of current regulatory and market standards, the development will benefit from the following integrated systems:

- Passive design features (Be Lean)
- Energy efficiency measures (Be Clean)
- Low and zero carbon technologies (Be Green)

The building fabric performance will meet or exceed the Part L 2013 requirements where applicable.

An energy assessment has been carried out based on design information to identify the most appropriate renewable strategy.

The development does not have much external space apart from a green roof and terrace amenity space provided on the fourth and fifth floors. The flat roof will be used to provide additional green roof and also to house 8kWp of PV panels (roughly 25 panels). One Air Source Heat Pump will be provided per apartment to provide heating and hot water, 10 on the fourth floor terrace and 5 in the basement, and a comfort cooling will also be provided sited on the terrace.

The proposed strategy has the potential to provide a 12% improvement over the Building Regulations 2013 minimum target; through passive design measures, energy efficient equipment and renewable technologies.

As the project is a minor development, renewable technologies have been specified to achieve a 9.6% reduction in site wide CO_2 emissions and generate 6.21% of the total energy consumption of the development. Although this does not meet the 20% reduction in site wide CO_2 emissions encouraged by the London Borough of Camden, it incorporates all feasible measures. The reductions show an ambition towards the targets set out in the London Plan and by the London Borough of Camden.

1 Introduction

1.1 Site Analysis

Price & Myers have been commissioned by Castle Haven Row Limited to produce an Energy Strategy Report for the proposed development at the Open University, 1 – 11 Hawley Crescent on behalf of their client.

The existing building is mixed use and is currently 5 storeys with basement car parking. The ground, first and second floors are commercial let to the Open University. The third and fourth floors are residential. The proposed development involves the part demolition of existing residential flats at third and fourth floor and construction of new three storey extension at third fourth and fifth to replace and extend existing residential accommodation. The development is in the London Borough of Camden.

The building has a flat roof, some of which will be used as a green roof for ecological enhancement. The building footprint occupies the majority of the site so there is not much available usable space at ground level.

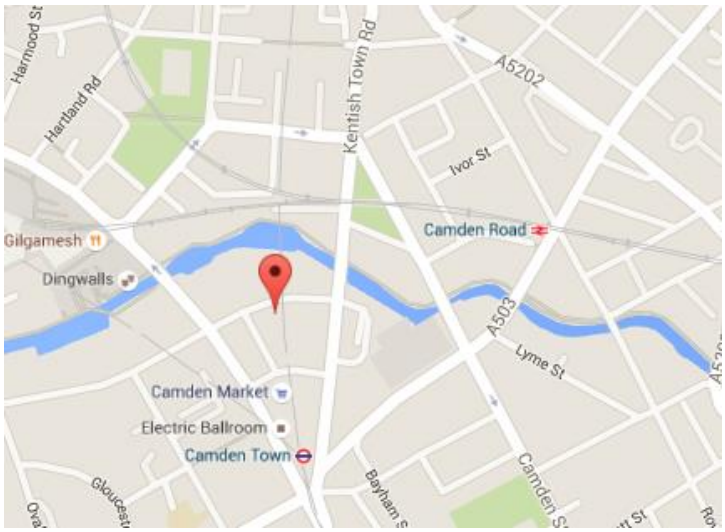


Figure 1 Google Maps extract indicating site location of 1-11 Hawley Crescent

Our assessment has been based on drawings and details provided by Chassay & Last Architects.

1.2 Objectives

This report summarises the work undertaken to support the development of an energy strategy for the scheme. This work has resulted in a strategy that requires design, technical and commercial decisions in order to continue the design development and ultimately select the most appropriate solution for ensuring a low carbon development.

This report outlines the energy strategy for the development, including passive design, energy and CO2 footprint of the proposed scheme, and renewable energy options.

The proposed strategy would allow the scheme to demonstrate compliance with the guidelines set out by the London Borough of Camden and the London Plan in demonstrating a positive commitment to sustainability through providing environmental improvements.

2 Policy

2.1 London Borough of Camden Policies on Energy

Camden Development Policy DP22 – Promoting sustainable design and construction

The Council will promote and measure sustainable design and construction by:

- Expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016;*
- Expecting developments (except new build) of 500 sq m of residential floorspace or above or 5 or more dwellings to achieve "very good" in EcoHomes assessments prior to 2013 and encouraging "excellent" from 2013;
- Expecting non-domestic developments of 500sqm of floorspace or above to achieve "very good" in BREEAM assessments and "excellent" from 2016 and encouraging zero carbon from 2019.

CPG3 Sustainability

The Council adopted CPG3 Sustainability on 6 April 2011 following statutory consultation.

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

*NB since the Code for Sustainable Homes has been withdrawn, this policy no longer applies. The London Borough of Camden will expect the development to demonstrate how it will incorporate sustainable design measures in line with the policies above.

2.2 The London Plan Policies on Energy

The London Plan, March 2015, requires compliance with the following policies relating to climate change:

Policy 5.2: Minimising Carbon Dioxide Emissions

Planning Decisions

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

1. Be Lean: use less energy
2. Be Clean: supply energy efficiently
3. Be Green: use Renewable energy

As this is not a major development, the remaining London Plan policies are not applicable.

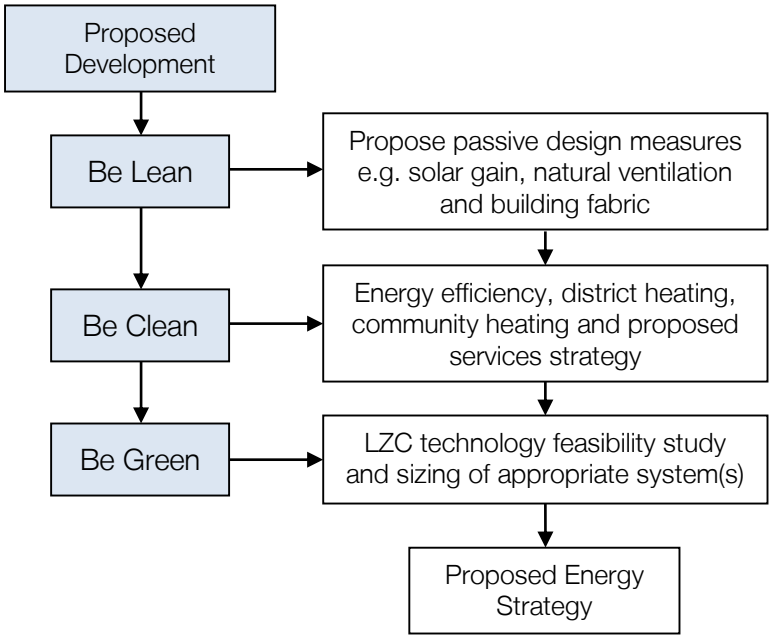
3 Approach

The approach to achieving the planning policy energy objectives has been to consider strategies and technologies to achieve a low energy and carbon footprint for the scheme.

The development will adopt the following energy hierarchy:

- Use less energy through passive design measures (Be Lean)
- Supply and consume energy efficiently (Be Clean)
- Utilise renewable energy sources to reduce carbon emissions (Be Green)

This energy strategy examines the energy performance of the proposed development based on the following methodology:



The performance of the development in terms of energy consumption and carbon emissions is calculated at each stage of the assessment, ensuring that both regulated and unregulated energy is considered when determining the performance of the proposed energy strategy.

3.1 Accredited Energy Assessor

This report has been checked and reviewed by Lucy Smallwood who is an On Construction Domestic Energy Assessor (OCDEA). The energy consumption and carbon emission figures within this report have been calculated using the approved Standard Assessment Procedure for the Energy Rating of Dwellings (SAP), current SAP 2012 version.

4 Energy Targets

The target for the project is a 35% improvement over Building regulations Part L 2013 to meet the London Plan and the London Borough of Camden policy. Table 4-1 details the energy broken down by fuel types and fuel use categories for the site taking into account the regulated and unregulated energy. These are the target energy and carbon calculations before any passive design and energy efficient measures.

Building Regulations Target Emission Rate Breakdown															
Regulated Energy & CO2														Unregulated Energy & CO2	
Type	Gas Demand				Electricity Demand							Total Energy (kWh/yr)	Total CO_2 (kg/yr)		
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Cooling (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Total (kWh/yr)	Electricity CO_2 (kgCO2/yr)			Energy (kWh/yr)	CO2 (kg/yr)
Residential	42,224	33,870	76,094	16,436	0	0	0	1,125	4,761	5,886	3,055	81,980	19,491	29,974	15556

Table 4-1 Estimated regulated and unregulated energy demand and carbon emissions per energy source

The energy consumption calculations for this and all subsequent stages of the assessment include regulated energy (space and water heating, lighting, pumps and fans) derived from outputs of the SAP calculations & dynamic thermal modelling using TAS for the site and unregulated energy (household appliances and equipment) based on the BRE methodology.

5 Be Lean: Passive Design

As part of the Be Lean approach, passive design measures have been considered throughout the pre-planning stage to reduce energy demand.

5.1 Passive design

Passive design measures have been considered where possible throughout the pre-planning stage to reduce energy demand

As an existing building; the orientation along the north-south axis is fixed. However, thermal elements of the proposed residential development will be specified to meet or exceed Building Regulations minimum standards.

5.2 Solar Gain Control and Daylighting

The development has been designed to balance the use of solar gain to reduce reliance on space heating whilst ensuring that the gains do not result in summer overheating. The U-Values of all glazed elements will meet or exceed Building Regulations standards. Windows will be specified to incorporate low emissivity coating to limit overheating, resulting in an efficient balance between passive solar gain and the thermal losses from each room.

The size and orientation of external windows has been considered carefully to incorporate good levels of daylight and reduce lighting demand. Duel aspect layouts have been maximised to enhance the provision of natural daylight. Table 5.1 provides further information on the parameters that will be met by the glazing installed.

The impact of solar gains has been incorporated into the SAP analysis for compliance with Part L and the risk of solar overheating has been concluded to be medium for the 'worst case scenario' units.

Glazing Parameters	Double glazing – windows and glazed doors
U-value	1.4 W/m^{2}K
Light Transmittance	0.7
Frame factor	0.8

Table 5-1 Proposed glazing parameters for the doors and windows

5.3 Ventilation

A natural ventilation strategy will be available in the form of openable windows in all flats. Cross ventilation has been incorporated where feasible by providing all flats with dual aspect layouts.

Due to the location of the dwelling near to surrounding sources of external noise, a natural ventilation strategy will not always be practicable, as windows will need to remain closed at times in order to preserve the sound insulation performance of the building envelope.

An efficient balanced mechanical ventilation heat recovery will therefore be installed to all flats to provide controlled ventilation. As required to comply with Building Regulations, extract ventilation will be installed to serve all wet rooms.

5.4 Thermal Performance

To further improve the passive design of the development, the thermal envelope will be designed to minimise heat loss by specifying low U-values and minimising thermal bridges where possible. Table 5.2 shows the proposed U-values that will be considered for the development and have been assumed for the energy strategy analysis at this stage. The fabric performance values for air tightness and thermal bridging are also detailed.

Element	U-Value - Proposed
External wall	0.14 W/m^{2}K
Corridor wall	0.25 W/m^{2}K
Flat roof	0.11 W/m^{2}K
Terrace	0.11 W/m^{2}K
Heat loss floor (over unheated spaces)	0.22 W/m^{2}K
Windows / Glazed doors	1.1 W/m^{2}K
External door	1.4 W/m^{2}K
Element	**Measure**
Air Tightness	Pressure testing will be carried out to determine air tightness. This will be an assumed: 4 m^3/m^2/h
Thermal Bridging	Independently assessed, designed to be equivalent to accredited detail figures Details to be calculated at the detailed design stage

Table 5-2 Proposed Be Lean passive design measures

The building utilises a Mechanical Ventilation Heat Recovery (MVHR) system. As such, a low air tightness value must be achieved in order to allow the system to work efficiently. Potential air leakage paths must be minimised during design and construction stages to achieve this, for example gaps around service pipes, windows and floor boards.

In order to further improve the thermal performance of the development; Approved Thermal Bridging values have been used rather than default values. In order to achieve the values required; Accredited Construction Details (ACDs) must be used in the design and construction of all thermal junctions. The ACD checklists should be used by the Designer, Constructor and Building Control Body to demonstrate compliance.

5.5 Improvement Over Part L

Based on the performance of the passive design measures proposed in Section 5, as calculated using SAP, Figure 5-1 demonstrates the percentage improvement over the notional baseline levels in each type of use on the development. Table 5.3 confirms that the development can achieve a 2% improvement over Part L before any energy efficiency or low or zero carbon technologies have been considered.

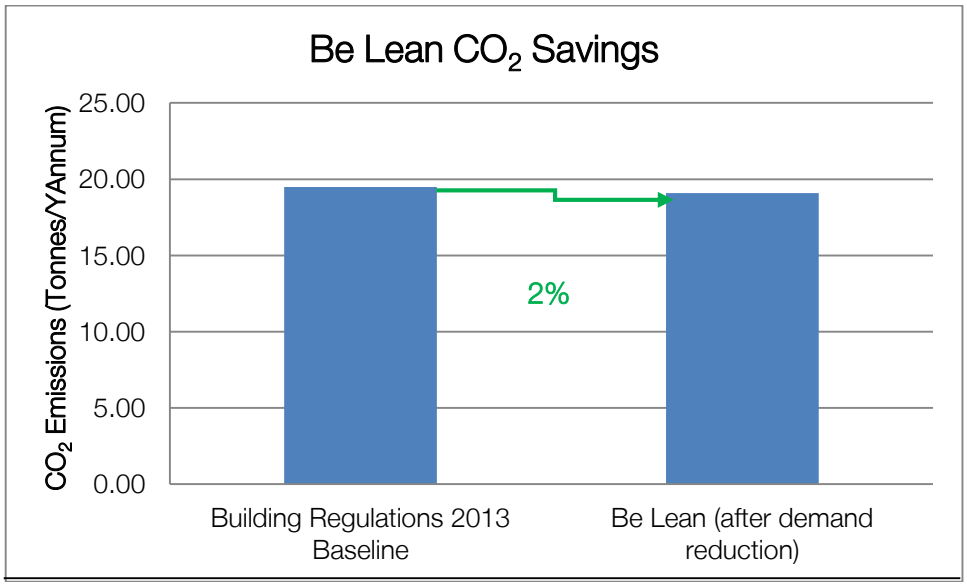


Figure 5-1 Improvement over Building Regulations Part L 2013 with passive design measures

The Be Lean stage has the potential to provide a 2% improvement over the Building Regulations 2013 minimum target; through passive design measures, and the energy use for the Be Lean case is broken down (Table 5-3 and Table 5-4).

Be Lean															
Regulated Energy & CO2														Unregulated Energy & CO2	
	Gas Demand				Electricity Demand							Total Energy (kWh/yr)	Total CO_2 (kg/yr)		
Type	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Cooling (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Total (kWh/yr)	Electricity CO_2 (kgCO2/yr)			Energy (kWh/yr)	CO2 (kg/yr)
Residential	38,912	34,682	73,594	15,896	0	0	0	450	5,711	6,161	3,198	79,755	19,094	29,974	15556

Table 5-3 Estimated regulated and unregulated energy demand and carbon emissions per energy source

Site Wide	CO_2 Emissions (tonnes /annum)	CO_2 Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	19.49		
Be Lean (after demand reduction)	19.09	0.40	2%

Table 5-4 Estimated unregulated energy demand and carbon emissions

6 Be Clean: Energy Efficiency

As part of the Be Clean approach, the use of heat networks, community heating and cooling and energy efficient equipment has been considered for this development.

6.1 District Energy Systems

District energy systems produce steam, hot water or chilled water at a central energy centre. The steam or water is distributed in pre-insulated pipework to individual buildings for space heating, domestic hot water and air conditioning. As a result, individual buildings served by a district energy system don't required their own boilers or chillers.

According to the London Heat Map Study, a potential heat network is located close to the site. The potential Euston Road heat network has been identified shown in Figure 6-1 below.

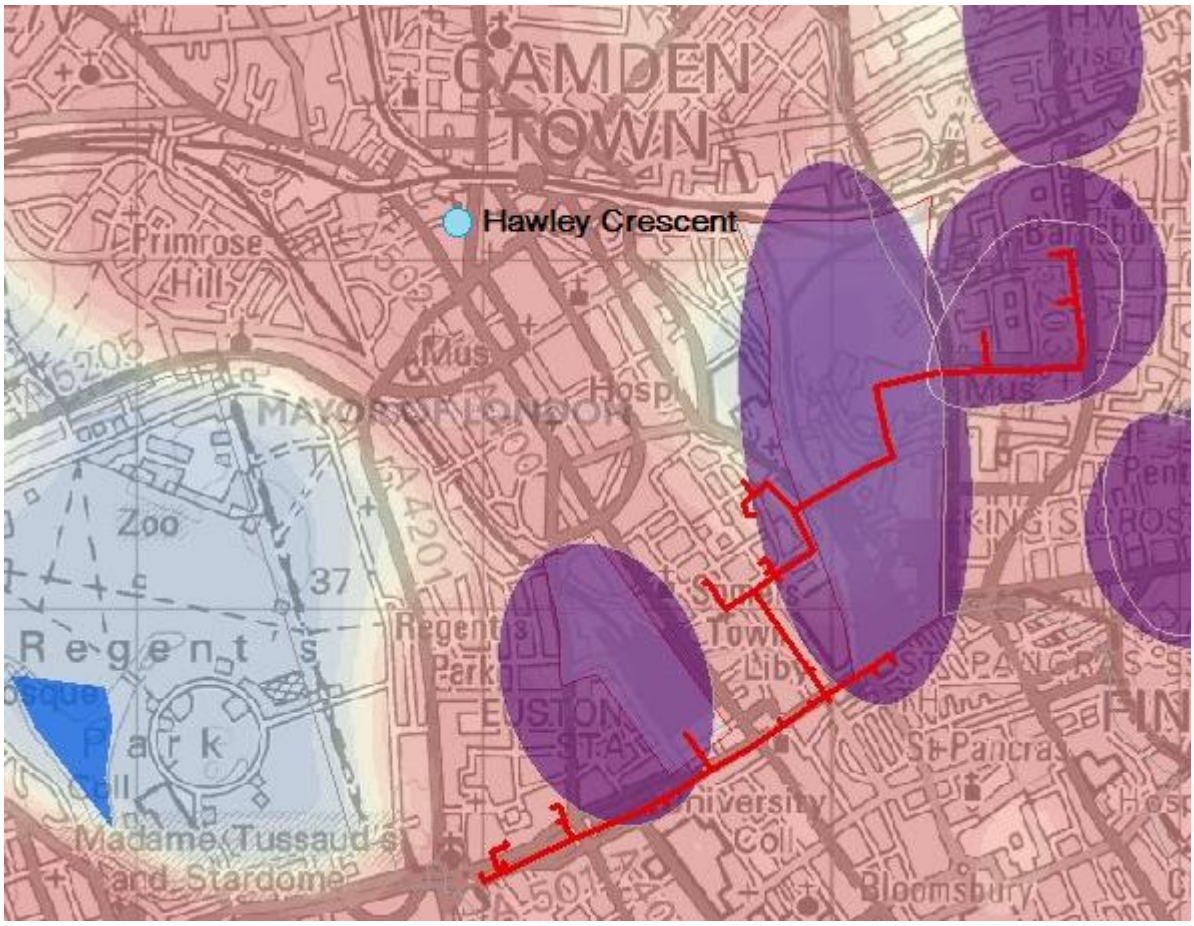


Figure 6-1: London Heat Map

As this network is not yet available, it is not possible to connect at this time. During the detailed design stages of the project, the developer will seek to gain more information on the heat network to ascertain the possibility of connecting in the future.

6.2 Community Heating

Community heating involves distributing space and water heating services throughout the development served from a central plant, making use of higher efficiencies available from larger systems.

As this development is relatively small, the installation of a community energy system would not be cost effective. A CHP system would not be viable for such small development due to low peak demand. The potential savings associated with a communal gas heating system would not be significant enough to justify the additional cost. Fabric improvements would have a greater impact and are therefore more cost effective for this development.

6.3 Services Strategy

In addition to the passive design measures identified in Section 4, energy efficient equipment has been proposed where possible to support the services strategy. All lights will be energy efficient (>45 lumens/watt). Efficient gas boilers have been used to model the Be Lean and Be Clean cases. However, it should be noted that gas will not be used in the development, as noted in the Be Green case.

Table 6-1 shows the proposed services strategy and energy efficiency measures for the development.

Services	Measure
Ventilation	MVHR 90% efficient SFP 0.5 w/l/s
Comfort Cooling	VRF split / multi-split system Modulating control
Lighting	100% low energy lighting

Table 6-1 Proposed energy efficient design measures

6.4 Improvement Over Part L

Based on the performance of the passive design and energy efficient measures proposed in Sections 4 and 5, as calculated using SAP 2012, Figure 6-2 demonstrates the percentage improvement these have over the notional baseline levels for the development before any low or zero carbon technologies have been considered.

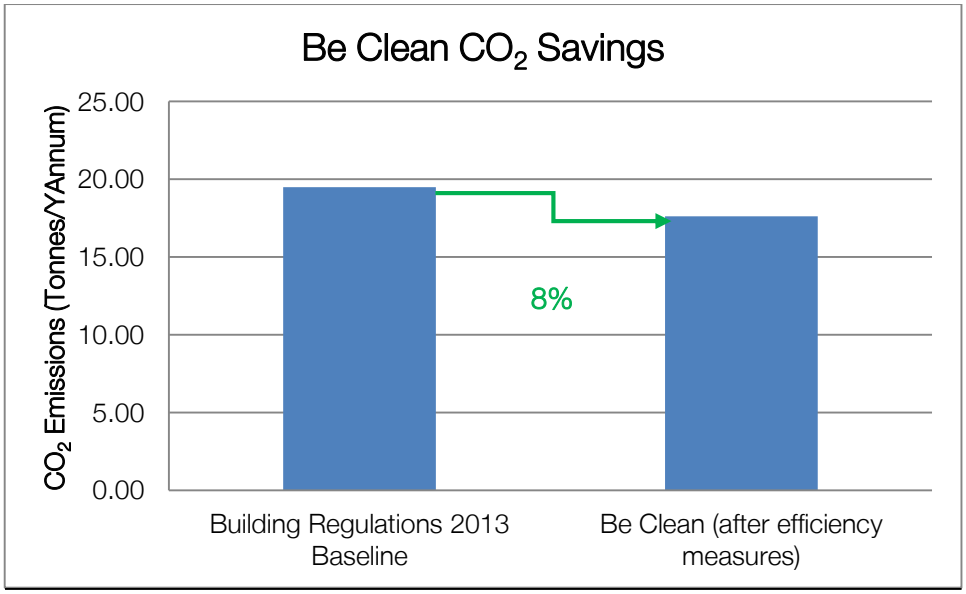


Figure 6-2 Improvement over Building Regulations Part L 2013 before LZCs for residential units

Table 6-1 confirms that the development can achieve 8% improvement over Part L 2013 before any on-site renewables have been considered.

Site Wide	CO_2 Emissions (tonnes /annum)	CO_2 Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	19.49		
Be Lean (after demand reduction)	19.09	0.40	2%
Be Clean (after efficiency measures)	17.61	1.49	8%
Total Cumulative Savings		1.88	10%

Table 6-1 Area Weighted Average % improvement over Part L 2013 at Be Clean Stage

The energy use for the Be Clean case is broken down in Table 6-3.

Be Clean															
Regulated Energy & CO2														Unregulated Energy & CO2	
Type	Gas Demand				Electricity Demand							Total Energy (kWh/yr)	Total CO_2 (kg/yr)		
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Cooling (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Total (kWh/yr)	Electricity CO_2 (kgCO2/yr)			Energy (kWh/yr)	CO2 (kg/yr)
Residential	26,014	34,216	60,230	13,010	0	0	1,487	2,615	4,759	8,861	4,599	69,091	17,608	29,974	15556

Table 6-3 Estimated regulated and unregulated energy demand and carbon emissions per energy source

7 Be Green: Low and Zero Carbon (LZC) Technologies Feasibility Study

The final level of the energy hierarchy is to Be Green, therefore the following table discusses the options for on-site low and zero carbon technologies and their feasibility on this development to contribute to meeting the relevant London Plan and Borough's sustainability targets.

LZC Technologies	Description	Advantages	Disadvantages	Feasibility	
Solar Thermal Collectors	Solar thermal collectors can be used to provide hot water using the irradiation from the sun They can generally provide approx. 50% of the hot water demand	No noise issues associated with Solar thermal collectors No additional land use from the installation of solar thermal collectors Low maintenance and easy to manage Favourable payback periods	The hot water cylinder will need to be larger than a traditional cylinder Needs unobstructed space on roof Low efficiencies Often not compatible with other LZC technologies Saves less carbon when offsetting gas systems	There is a south facing flat roof where solar thermal panels can be installed. However, solar PV is favoured due to greater potential carbon savings.	✗
Solar Photovoltaic Panels (PV)	Solar PV panels provide noiseless, low-maintenance, carbon free electricity	Can have significant impact on carbon emissions by offsetting grid electricity (which has a high carbon footprint) Low maintenance No noise issues No additional land use from the installation of PV panels Bolt on technology that does not need significant amounts of auxiliary equipment Favourable payback periods	Needs unobstructed space on roof Low efficiencies per unit area of PV Often used to supplement landlord's electricity so savings not always transferred to individual properties	There is a large flat roof on which Solar PV panels could be installed to contribute to the electricity demand of the building	✓

CHP (Combined Heat & Power)	CHP systems use an engine driven alternator to generate electricity while using the waste heat from the engine, jacket and exhaust to provide heating and hot water Economic viability relies on at least 4,000 hours running time per annum	Mature technology High CO_2 savings	Cost of the system is relatively high for small schemes Only appropriate for large development with high heat loads	Communal CHP is not viable for such a small development Micro CHP would be technically feasible but is unlikely to save enough carbon to meet the targets with incorporating multiple technologies	✗
Biomass Heating	Solid, liquid or gaseous fuels derived from plant material can provide boiler heat for space and water heating	Potential to reduce large component of the total CO_2 A biomass boiler would supplement a standard gas heating system so some of the cost may be offset through money saved on using smaller traditional boilers	Regular maintenance is required Reliability of fuel access/supply can be a problem The noise generated by a biomass boiler is similar to that of a gas boiler. It is advisable not to locate next to particularly sensitive areas such as bedrooms A plant room and fuel store will be required which may take additional land from the proposed development or surroundings Biomass is often not a favoured technology in new development due to the potential local impacts of NO_x emissions and delivery vehicles for the fuel	This is a small tight site in an urban area and so there is insufficient space for a biomass boiler system Biomass is not considered feasible for this development due to issues with fuel storage, access for delivery vehicles and local NO_x emissions	✗

Wind Turbines	Vertical and horizontal axis wind turbines enable electricity to be generated using the power within the wind	Low noise Bolt on technology that does not need significant amounts of auxiliary equipment	Not suitable for urban environments due to low wind conditions and obstructions High visual impact Noise impact (45-65dB at 3m) High capital cost and only achieve good paybacks in locations with strong wind profiles Requires foundations or vibration supports for building installations (generally not recommended)	This development is in an urban environment and so a wind turbine will not generate much energy	✗
Ground Source Heat Pumps (GSHP)	Utilising horizontal loops or vertical boreholes, GSHP make use of the grounds almost constant temperature to provide heating and/or cooling using a heat exchanger connected to a space/water heating delivery system	Low maintenance and easy to manage High COP (ratio of energy output per energy input) Optimum efficiency with underfloor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through savings on a traditional boiler	The heat pump has a noise level around 35-60dB so some attenuation may be required and it should be sensibly located Relatively high capital cost Requires electricity to run the pump, therefore limited carbon savings in some cases For communal systems a plant room is required which may take additional land from the proposed development/surroundings	GSHP are not a feasible technology for the site since there is a no external space available for installation of boreholes	✗

Air Source Heat Pumps (ASHP)	Air Source Heat Pumps extract latent energy from the external air in a manner similar to ground source heat pumps	ASHP systems are generally cheaper than GSHP as there is no requirement for long lengths of buried piping or boreholes Low maintenance and easy to manage Optimum efficiency with underfloor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through savings on a traditional boiler	The ASHP unit has a noise level around 50-60dB so some attenuation may be required and it should be sensibly located The potential noise from the external unit may mean there is local opposition to their installation Requires electricity to run the pump, therefore limited carbon savings in some cases For communal systems a plant room is required which may take additional land from the proposed development/surroundings	The use of ASHP is technically feasible for the development and there is a screened location where the units could be located with minimal visual impact; on a screen terrace and in the basement.	✓

Table 7-1 Feasibility of LZC technologies for the development

Having reviewed potential LZC technologies for the development it has been identified that the most appropriate system would be ASHP combined with solar PV panels, which would most suitably be installed on the roof space. The chosen system should be accurately sized during the detailed design stages and MCS (Microgeneration Certification Scheme) approved equipment and installers used.

7.1 Summary of CO2 Emission Savings

The most appropriate LZC technology for the development has been identified as solar PV panels and air source heat pumps to meet the London Borough of Camden's target for on-site renewables.

Table 7-2 shows the proposed system size and the estimated energy and carbon emissions savings for this development. Table 7-3 shows the proposed system size and estimated energy and carbon emissions savings and financial feasibility for this development.

Be Green																
Regulated Energy & CO2															Unregulated Energy & CO2	
Type	Gas Demand				Electricity Demand								Total Energy (kWh/yr)	Total CO_2 (kg/yr)		
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Cooling (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	PV (kWh/yr)	Total (kWh/yr)	Electricity CO_2 (kgCO2/yr)			Energy (kWh/yr)	CO2 (kg/yr)
Residential	0	0	0	0	12,757	17,326	1,556	2,615	4,759	-6,150	32,863	17,056	8,930	17,056	29,974	15,556

Table 7-2 Estimated regulated and unregulated energy demand and carbon emissions per energy source

	Energy & CO2				Life Cycle Carbon and Cost Analysis		
Proposed LZC Technologies	Energy Generated (kWh/yr)	% site energy demand met	CO2 saved by system (kgCO2/yr)	% reduction in site CO2 emissions	25 year CO2 saving (kgCO2)	Estimated capital cost	Payback period
Total Solar PV = 8 kWp 8kWp, Horizontal	6,150	6.21%	3,192	9.6%	49,801	£7,000	10 – 15 years

Table 7-3 Energy, carbon and financial performance of the proposed LZC technologies

7.2 Improvement Over Part L with LZC

Figure 7-1 and Table 7-4 demonstrate the percentage improvement over the notional baseline levels for the development incorporating the community heating system for domestic use and air source heat pumps for commercial units. Table 7-1 confirms that the development can achieve 36% improvement over the Part L 2013 target emissions with on-site renewables.

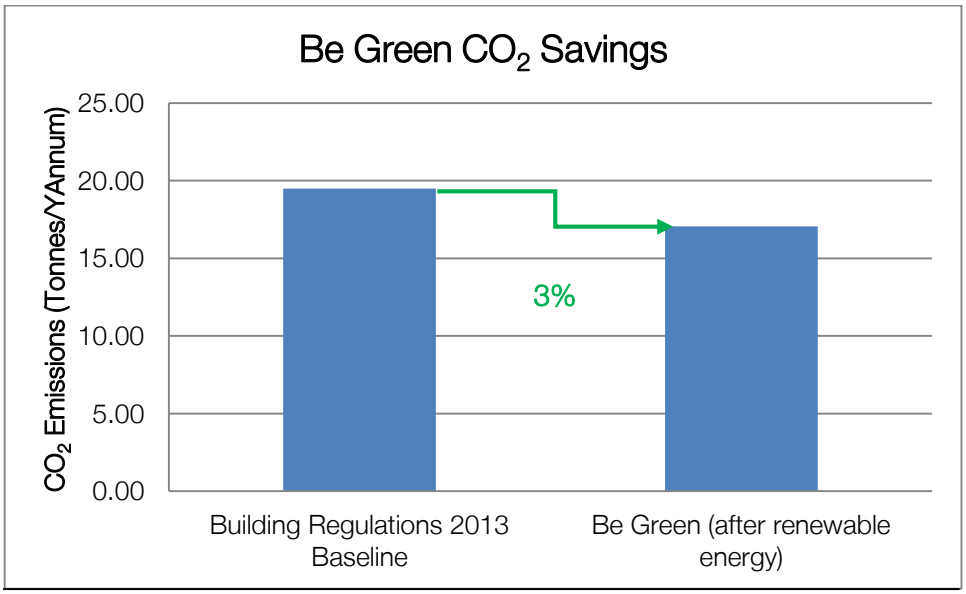


Figure 7-1 Site Wide Improvement over Building Regulations Part L 2013 after LZCs

Site Wide	CO_2 Emissions (tonnes /annum)	CO_2 Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	19.49		
Be Lean (after demand reduction)	19.09	0.40	2%
Be Clean (after efficiency measures)	17.61	1.49	8%
Be Green (after renewable energy)	17.06	0.55	3%
Total Cumulative Savings		2.44	12%

Table 7-4 summarises the carbon savings in the interim strategy after LZCs

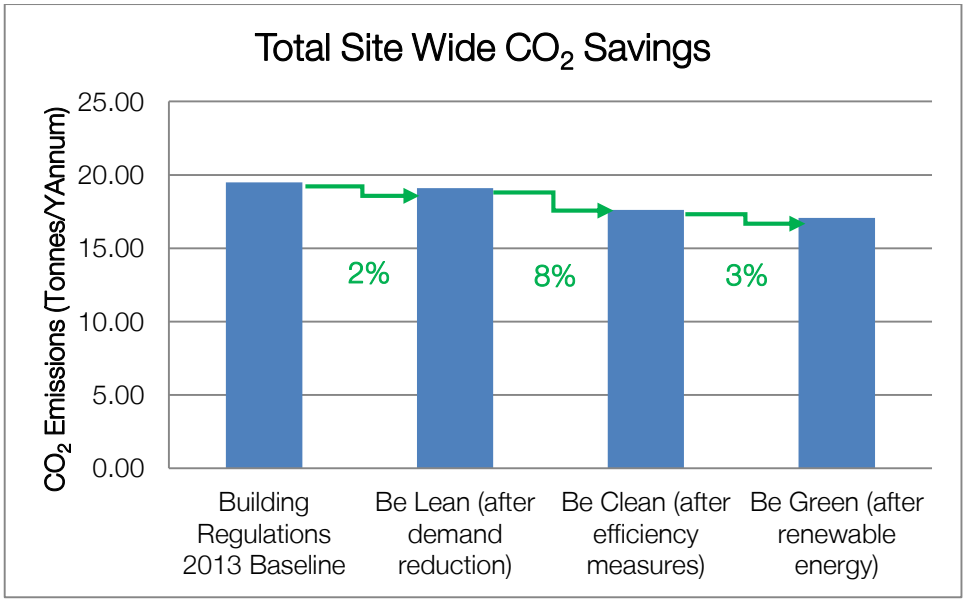


Figure 7-2 Summary of CO2 savings (tonnes CO2/annum) over Building Regulations 2013 baseline

8 Conclusion

Following the Be Lean, Be Clean and Be Green energy hierarchy, passive design measures, energy efficient equipment and LZC technologies have been shown to provide a 12% improvement over the Building Regulations Part L 2013 Target Emissions Rate (TER) and an overall 9.6% saving in carbon emissions from renewables.

The design team have made all reasonable endeavours to achieve the minimum requirements of the London Borough of Camden.

The saving from renewables is lower than the target 20%. However, fabric improvements have been prioritised for the development, which will have a longer lasting impact on energy use than renewable technologies with a finite lifetime. The fabric U-Values exceed Building Regulations. Efficiencies for building services are all particularly high and represent the best that is available on the market. The PV system specified occupies all available roof space. The strategy therefore represents the best possible savings that could be achieved for this development.

The figures within this report are based on preliminary analysis only and further detailed studies will be required at the detailed design stage before specifying any of the proposed systems.

Appendix A

The following tables show figures used in the energy and CO_2 calculations to estimate energy produced and CO_2 savings from LZC technologies. These figures can be used to validate the results.

CO_2 Intensity Values	
Gas Intensity	0.216 kgCO_2/kWh
Electricity Intensity	0.519 kgCO_2/kWh

Energy & Renewable Technology Outputs	
PV energy produced per kWp	768.8 kWh/kWp
PV kWp per m^2 panel	0.2 kWp/m^2
COP of ASHP	2.5
Electricity efficiency	100%
Gas boiler efficiency	90%

Fuel Prices (as of March 2016)	
Natural Gas	4.18 p/kWh
Electricity (Grid)	13.86 p/kWh

Appendix B

The following grants may be available with the use of renewable technologies on this development.

Grant	
Feed-in Tariff	By generating your own renewable electricity your energy supplier may pay you money, called a 'Feed-in Tariff' (FIT). Using an MCS certified installer, the system could entitle you to a rate for each unit (kilowatt hour or kWh) of electricity you generate. As well as the FIT, you can sell any excess electricity back to your electricity supplier through an 'Export Tariff'. To qualify, the installation must be less than 5 MW, with the following technologies covered: • Solar photovoltaic (PV) panels • Wind turbines • Water (Hydro) turbines • Anaerobic digestion (biogas energy) • Micro combined heat and power (micro-CHP) https://www.gov.uk/feed-in-tariffs
Renewable Heat Incentive (RHI)	The RHI is a scheme for the non-domestic sector that provides payments to industry, business and public sector organisations that use renewable energy to heat their buildings. Payments are made to the owner of the heat installation over a 20-year period, for the following technologies: • Biomass boilers (including CHP biomass boilers) • Ground source heat pumps (GSHP) • Water source heat pumps • Deep geothermal heat pumps • All solar thermal collectors • Biomethane and biogas There are plans to extend support to the following in 2013: • Air source heat pumps (ASHP) • Biomass direct air heating • Biomass combustion over 200kW There are also plans to launch a domestic RHI scheme in summer 2013. http://www.ofgem.gov.uk/e-serve/RHI/Pages/RHI.aspx
Green Deal	The Green Deal is a Government backed initiative to promote the installation of energy efficiency measures in households in order to reduce energy consumption and bills. There will be no upfront costs, instead consumers will pay through their household energy bills. Consumers can see the Green Deal charge alongside the reductions in energy use which generate savings on their bill. It also means that if they move out (and cease to be the bill payer) the financial obligation remains at the property for the next bill payer: the charge is only paid where/whilst the benefits are enjoyed. https://www.gov.uk/green-deal-energy-saving-measures/how-the-green-deal-works
ECO (Energy Company Obligation)	ECO is a requirement for all large gas and electricity suppliers to fund energy efficiency improvements to dwellings in the UK. Energy suppliers have specific carbon reduction targets to achieve, and therefore must buy ECO 'credits' of CO_2 on a free market, either from installers (and home owners) or from other energy suppliers. Therefore the price of ECO 'credits' is not fixed. The installer (home owner or private renter with owner's permission) can claim back the money for the installation of the improvement measures from the energy suppliers (full payback or partial refund depending on type of

	improvement(s) and value of ECO 'credits'). The scheme can be used to fund a number of domestic energy efficiency improvements. If householders are applying for the Green Deal and are eligible for ECO, they will receive a lower quote from their Green Deal Provider and will benefit from lower repayments. The scheme runs until 31st March 2015, however there are certain Eligibility requirements. See https://www.gov.uk/energy-company-obligation for more information. Energy Companies Obligation - Guidance for suppliers

Appendix C
SAP Calculations

SAP Assumptions

The SAP calculations for the proposed residential development at OU Hawley Crescent have been constructed using the following parameter assumptions;

U-Values

Element	U-Value - Proposed
External wall	0.14 W/m^{2}K
Corridor wall	0.25 W/m^{2}K
Flat roof	0.11 W/m^{2}K
Terrace	0.11 W/m^{2}K
Heat loss floor (over unheated spaces)	0.22 W/m^{2}K
Windows / Glazed doors	1.1 W/m^{2}K
External door	1.4 W/m^{2}K
Element	**Measure**
Air Tightness	Pressure test will be carried out to determine air tightness. This will be an assumed: 4 m^3/m^2/h
Thermal Bridging	Independently assessed, designed to be equivalent to accredited detail figures Details to be calculated at the detailed design stage

Services

Services	Measure
Ventilation	MVHR 90% efficient SFP 0.5 w/l/s Approved installation
Comfort Cooling	VRF split / multi-split system Modulating control
Lighting	100% low energy lighting

Sample Report Ltd
1 Sample Street
Sampletown

Full SAP Calculation Printout

Property Reference: 25299 OU Hawley Crescent A1
Survey Reference: A1 Be Lean
Issued on Date: 01.Aug.2016
Prop Type Ref:

Property: 1-11 Hawley Crescent, London, NW1 8NP

SAP Rating:	82 B	**CO2 Emissions (t/year):**	1.04	**DER:**	21.43 Fail	**TER:**	20.34	**Percentage DER<TER:**	-5.35 %
Environmental:	85 B	**General Requirements Compliance:**	Fail	**DFEE:**	50.07 Pass	**TFEE:**	55.21	**Percentage DFEE<TFEE:**	9.30 %

CfSH Results **Version:** **ENE1 Credits:** N/A **ENE2 Credits:** N/A **ENE7 Credits:** N/A **CfSH Level:** N/A

Surveyor: admin Admin, Tel: 4, Fax: s@l.f Surveyor ID: Admin
Address:
Client:

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 3.05r04
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Build (As Designed)

CALCULATION DETAILS for survey reference no 'A1 Be Lean'
SAP2012 - 9.92 input data (DesignData) -


```
SAP2012 Input Data (Flat)     01/08/2016

FullRefNo:                    A1 Be Lean

Regs Region:                  England
SAP Region:                   Thames Valley
Postcode:                     NW1 8NP
DwellingOrientation:          West
Property Type:                Flat, End-Terrace
Storeys:                      1
Date Built:                   2016
Sheltered Sides:              2
Sunlight Shade:               Average or unknown
Measurements                  Perimeter, Floor Area, Storey Height
    1st Storey:              20.78, 59.85, 2.6
Living Area:                  29.15 m2, fraction: 48.7%
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               8.25, 20.5, 0, Other, Cavity, 0, 0.14, Gross
Corridor wall                 31.62, 33.51, 18, TimberWallTwoLayers, TimberFrame, 0.31, 0.232018561484919, Gross
Party Walls                   Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                  53.02, 20, PartyWallDoublePlaster, FilledWithEdge, 0, 0
External Roofs                Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
    External Roof 1          41.52, 41.52, 0, Other, 0.11
Party Ceilings                Area, Kappa, Construction, Element
    Party Ceilings 1         18.33, 0, Other
Heat Loss Floors              Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
    Heat Loss Floor 1        59.85, 0, Other, Exposed Floor - Solid, 0.31, 0.205953941209511
Description                   Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
    Window                   Manufacturer, Window, Double Low-E Soft 0.1, , , 0.7, , 0.8,
    Door                     Manufacturer, Solid Door, , , , , , ,
Openings                      Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    North elevation          Window, External Wall 1, North, , None, 0, , 0, 0, 0, 7.32,
    SW elevation             Window, External Wall 1, South West, , None, 0, , 0, 0, 0, 4.93,
    Door                     Solid Door, Corridor wall, West, , , , , 0, 0, 0, 1.89,
Conservatory:                 None
Draught Proofing:             100
Draught Lobby:                No
Thermal Bridges
    Bridging:                Calculate Bridges
    Y                        0.047
    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, Yes, 6.8, 0.3, 0.3, 2.04,
    1.                       External wall, E3 Sill, Table K1 - Approved, Yes, 5.9, 0.04, 0.04, 0.24,
    2.                       External wall, E4 Jamb, Table K1 - Approved, Yes, 12.48, 0.05, 0.05, 0.62,
    3.                       External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Approved, Yes, 20.78, 0.07, 0.07, 1.45,
    4.                       External wall, E14 Flat roof, Table K1 - Default, No, 11.33, 0.08, 0.08, 0.91,
    5.                       External wall, E16 Corner (normal), Table K1 - Default, No, 7.8, 0.18, 0.18, 1.40,
    6.                       External wall, E17 Corner (inverted - internal area greater than external area), Table K1 - Default, No, 7.8, 0, 0, 0.00,
    7.                       External wall, E18 Party wall between dwellings, Table K1 - Approved, No, 10.4, 0.06, 0.06, 0.62,
    8.                       Party wall, P3 Party wall - Intermediate floor between dwellings (in blocks of flats), Table K1 - Default, No, 40.8, 0, 0, 0.00,
Pressure Test:                True
Designed q50:                 4
AsBuilt q50:                  15
Property Tested:              False
Mechanical Ventilation        None
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:            2
Passive Vents:                0
Flueless Gas Fires:           0
Cooling System                None
Light Fittings:               10
LEL Fittings:                 8
Percentage of LEL Fittings:   80
External Lights Fitted:       Yes
External LELs Fitted:         Yes
Electricity Tariff:           Standard
Main Heating 1
    Description
    Percentage               100
```

MHS	Mains gas BGW Post 98 Combi condens. with auto ign.
SAP Code	104
Boiler Efficiency Type	Sedbuk 2009
Efficiency	88
Model Name	tbc
Manufacturer	tbc
Controls by PCDF	0
MHS Controls	CBI Time and temperature zone control
Boiler Interlock	Yes
Compensator	0
Delayed Start Stat	Yes
Ctrl SAP Code	2110
Burner Control	Modulating
Flue Type	None or Unknown
Fan Assisted Flue	No
Pumped	Pump in heated space
Heat Pump Age	2013 or later
Heat Emitter	Radiators and Underfloor
Flow Temperature	Normal (> 45°C)
Under Floor Heating	Yes - Pipes in thin screed
Combi boiler type	Standard Combi
Combi keep hot type	None
Main Heating 2	None
Heating Systems Interaction	Each system heats separate parts of dwelling
Smoke Control Area	Unknown
Community Heating	None
Secondary Heating	None
Water Heating	
Type	MainHeating1
WHS	HWP From main heating 1
Low Water Usage	Yes
SAP Code	901
Showers in Property	Non-electric only
Hot Water Cylinder	None
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 60 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:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 20.34 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 21.43 kg/m²Fail
Excess emissions =1.09 kg/m² (5.4%)

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.2 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)50.1 kWh/m²OK

---

2 Fabric U-values

Element	Average	Highest	
External wall	0.21 (max. 0.30)	0.23 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.21 (max. 0.25)	0.21 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.14 (max. 2.00)	1.40 (max. 3.30)	OK

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

---

3 Air permeability
Air permeability at 50 pascals: 4.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc
Combi boiler
Efficiency: 88.0% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage No cylinder

---

6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: No cylinder

Boiler interlock Yes OK

---

7 Low energy lights
Percentage of fixed lights with low-energy fittings:80%
Minimum 75% OK

---

8 Mechanical ventilation
Not applicable

---

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK

Based on:

Overshading:	Average
Windows facing North:	7.32 m², No overhang
Windows facing South West:	4.93 m², No overhang
Air change rate:	6.00 ach
Blinds/curtains:	None

10 Key features

External wall U-value	0.14 W/m²K
Party wall U-value	0.00 W/m²K
Roof U-value	0.11 W/m²K
Window U-value	1.10 W/m²K

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	59.8500 (1b)	x	2.6000 (2b)	=	155.6100 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	155.6100	(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) =	0.1285	(8)
Pressure test		Yes	
Measured/design q50		4.0000	
Infiltration rate		0.3285	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2792	(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	0.3560	0.3491	0.3421	0.3072	0.3002	0.2653	0.2653	0.2583	0.2792	0.3002	0.3142	0.3281	(22b)
Effective ac	0.5634	0.5609	0.5585	0.5472	0.5451	0.5352	0.5352	0.5334	0.5390	0.5451	0.5493	0.5538	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.10)			12.2500	1.0536	12.9071			(27)
Door			1.8900	1.4000	2.6460			(26)
Heat Loss Floor 1			59.8500	0.2060	12.3263			(28b)
External Wall 1	20.5000	12.2500	8.2500	0.1400	1.1550			(29a)
Corridor wall	33.5100	1.8900	31.6200	0.2320	7.3364			(29a)
External Roof 1	41.5200		41.5200	0.1100	4.5672			(30)
Total net area of external elements Aum(A, m2)			155.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.9381			(33)
Party Wall 1			53.0200	0.0000	0.0000			(32)
Party Ceilings 1			18.3300					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.2890	(36)
Total fabric heat loss (33) + (36) =	48.2271	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.9304	28.8040	28.6801	28.0983	27.9894	27.4826	27.4826	27.3888	27.6778	27.9894	28.2096	28.4399	(38)
Heat transfer coeff	77.1575	77.0311	76.9072	76.3253	76.2165	75.7097	75.7097	75.6158	75.9049	76.2165	76.4367	76.6669	(39)
Average = Sum(39)m / 12 =												76.3248	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2892	1.2871	1.2850	1.2753	1.2735	1.2650	1.2650	1.2634	1.2683	1.2735	1.2771	1.2810	(40)
HLP (average)												1.2753	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.9774 (42)
Average daily hot water use (litres/day)	81.1630 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	89.2793	86.0328	82.7863	79.5398	76.2932	73.0467	73.0467	76.2932	79.5398	82.7863	86.0328	89.2793	(44)
Energy conte	132.3986	115.7967	119.4918	104.1759	99.9592	86.2572	79.9300	91.7208	92.8163	108.1684	118.0743	128.2210	(45)
Energy content (annual)										Total = Sum(45)m =		1277.0102	(45)
Distribution loss (46)m = 0.15 x (45)m	19.8598	17.3695	17.9238	15.6264	14.9939	12.9386	11.9895	13.7581	13.9224	16.2253	17.7111	19.2332	(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)
Combi loss	45.4958	39.5987	42.1870	39.2251	38.8782	36.0230	37.2238	38.8782	39.2251	42.1870	42.4271	45.4958	(61)
Total heat required for water heating calculated for each month	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168	(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

177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168 (64)	
								Total per year (kWh/year) = Sum(64)m =			1763.8549 (64)	

Heat gains from water heating, kWh/month

55.3965	48.4021	50.2778	44.4447	42.9560	37.6863	35.8827	40.2167	40.6677	46.5127	49.8665	54.0074 (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	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

18.4615	16.3974	13.3352	10.0956	7.5466	6.3712	6.8843	8.9484	12.0106	15.2502	17.7992	18.9746 (67)	

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

172.5685	174.3592	169.8466	160.2399	148.1132	136.7158	129.1016	127.3109	131.8234	141.4301	153.5569	164.9543 (68)	

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870 (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)

-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956 (71)	

Water heating gains (Table 5)

74.4576	72.0269	67.5777	61.7288	57.7365	52.3421	48.2294	54.0547	56.4829	62.5171	69.2590	72.5906 (72)	

Total internal gains

321.1485	318.4443	306.4204	287.7252	269.0572	251.0898	239.8761	245.9749	255.9777	274.8583	296.2759	312.1804 (73)	

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.3200	10.6334	0.7000	0.8000	0.7700	30.2068 (74)	
Southwest	4.9300	36.7938	0.7000	0.8000	0.7700	70.3952 (79)	

Solar gains	100.6020	177.6358	262.1566	360.8448	439.9438	453.2670	430.0724	368.0272	295.5856	201.2412	121.5812	85.4255	(83)
Total gains	421.7505	496.0801	568.5770	648.5700	709.0009	704.3568	669.9485	614.0021	551.5633	476.0994	417.8571	397.6059	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.8671	53.9555	54.0424	54.4544	54.5322	54.8972	54.8972	54.9654	54.7560	54.5322	54.3751	54.2118	
alpha	4.5911	4.5970	4.6028	4.6303	4.6355	4.6598	4.6598	4.6644	4.6504	4.6355	4.6250	4.6141	
util living area	0.9960	0.9911	0.9774	0.9329	0.8224	0.6452	0.4874	0.5484	0.8011	0.9602	0.9919	0.9969	(86)
MIT	19.9441	20.0815	20.2985	20.5750	20.7968	20.9071	20.9342	20.9291	20.8473	20.5553	20.1960	19.9164	(87)
Th 2	19.8493	19.8510	19.8526	19.8603	19.8617	19.8684	19.8684	19.8696	19.8658	19.8617	19.8588	19.8558	(88)
util rest of house	0.9946	0.9880	0.9695	0.9092	0.7649	0.5482	0.3671	0.4226	0.7169	0.9412	0.9886	0.9959	(89)
MIT 2	18.4511	18.6521	18.9661	19.3584	19.6416	19.7616	19.7806	19.7796	19.7091	19.3414	18.8259	18.4156	(90)
Living area fraction									fLA = Living area / (4) =			0.4871	(91)
MIT	19.1783	19.3483	19.6151	19.9509	20.2042	20.3196	20.3425	20.3395	20.2635	19.9326	19.4932	19.1466	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.0283	19.1983	19.4651	19.8009	20.0542	20.1696	20.1925	20.1895	20.1135	19.7826	19.3432	18.9966	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9933	0.9858	0.9662	0.9077	0.7757	0.5754	0.4023	0.4595	0.7375	0.9395	0.9866	0.9948	(94)
Useful gains	418.9389	489.0296	549.3357	588.7178	549.9561	405.2763	269.5487	282.1155	406.7555	447.2945	412.2429	395.5530	(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	1136.3994	1101.4124	997.1068	832.0185	636.7313	421.6696	271.9848	286.5435	456.4524	699.8688	935.8286	1134.4070	(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

533.7906	411.5213	333.1417	175.1765	64.5607	0.0000	0.0000	0.0000	0.0000	187.9152	376.9817	549.7073	(98)

Space heating 2632.7951 (98)

Space heating per m2 (98) / (4) = 43.9899 (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 %) 88.9000 (206)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

Space heating requirement 2961.5243 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	533.7906	411.5213	333.1417	175.1765	64.5607	0.0000	0.0000	0.0000	0.0000	187.9152	376.9817	549.7073	(98)
Space heating efficiency (main heating system 1)													
	88.9000	88.9000	88.9000	88.9000	88.9000	0.0000	0.0000	0.0000	0.0000	88.9000	88.9000	88.9000	(210)
Space heating fuel (main heating system)													
	600.4393	462.9036	374.7376	197.0489	72.6218	0.0000	0.0000	0.0000	0.0000	211.3782	424.0514	618.3435	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement

	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168 (64)
Efficiency of water heater												78.8000 (216)
(217)m	86.1402	85.8827	85.3266	84.0508	81.7479	78.8000	78.8000	78.8000	78.8000	84.1083	85.6228	86.2455 (217)
Fuel for water heating, kWh/month												
	206.5173	180.9391	189.4824	170.6123	169.8360	155.1780	148.6723	165.7348	167.5652	178.7640	187.4516	201.4212 (219)

Water heating fuel used	2122.1742 (219)
Annual totals kWh/year	
Space heating fuel - main system	2961.5243 (211)
Space heating fuel - secondary	0.0000 (215)
Electricity for pumps and fans:	
central heating pump	30.0000 (230c)
Total electricity for the above, kWh/year	30.0000 (231)
Electricity for lighting (calculated in Appendix L)	326.0363 (232)
Total delivered energy for all uses	5439.7347 (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	2961.5243	0.2160	639.6892	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2122.1742	0.2160	458.3896	(264)
Space and water heating			1098.0789	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	326.0363	0.5190	169.2128	(268)
Total CO2, kg/year			1282.8617	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			21.4300	(273)

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

DER		21.4300	ZC1
Total Floor Area	TFA	59.8500	
Assumed number of occupants	N	1.9774	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.0861	ZC2
CO2 emissions from cooking, equation (L16)		2.7812	ZC3
Total CO2 emissions		41.2974	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		41.2974	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	59.8500 (1b)	x	2.6000 (2b)	=	155.6100 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	155.6100	(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) =	0.1285	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3785	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3217	(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	0.4102	0.4022	0.3941	0.3539	0.3459	0.3057	0.3057	0.2976	0.3217	0.3459	0.3620	0.3781	(22b)
Effective ac	0.5841	0.5809	0.5777	0.5626	0.5598	0.5467	0.5467	0.5443	0.5518	0.5598	0.5655	0.5715	(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			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.40)			12.2500	1.3258	16.2405			(27)
Heat Loss Floor 1			59.8500	0.1300	7.7805			(28b)
External Wall 1	20.5000	12.2500	8.2500	0.1800	1.4850			(29a)
Corridor wall	33.5100	1.8900	31.6200	0.1800	5.6916			(29a)
External Roof 1	41.5200		41.5200	0.1300	5.3976			(30)
Total net area of external elements Aum(A, m2)			155.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.4852			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.2440	(36)
Total fabric heat loss					(33) + (36) =		42.7292	(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	29.9965	29.8287	29.6643	28.8918	28.7473	28.0745	28.0745	27.9499	28.3336	28.7473	29.0397	29.3453	(38)
Heat transfer coeff	72.7258	72.5580	72.3935	71.6210	71.4765	70.8037	70.8037	70.6791	71.0629	71.4765	71.7689	72.0746	(39)
Average = Sum(39)m / 12 =												71.6203	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2151	1.2123	1.2096	1.1967	1.1943	1.1830	1.1830	1.1809	1.1873	1.1943	1.1991	1.2043	(40)
HLP (average)												1.1967	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.9774 (42)
Average daily hot water use (litres/day)		81.1630 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	89.2793	86.0328	82.7863	79.5398	76.2932	73.0467	73.0467	76.2932	79.5398	82.7863	86.0328	89.2793	(44)
Energy conte	132.3986	115.7967	119.4918	104.1759	99.9592	86.2572	79.9300	91.7208	92.8163	108.1684	118.0743	128.2210	(45)
Energy content (annual)										Total = Sum(45)m =		1277.0102	(45)
Distribution loss (46)m = 0.15 x (45)m	19.8598	17.3695	17.9238	15.6264	14.9939	12.9386	11.9895	13.7581	13.9224	16.2253	17.7111	19.2332	(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)
Combi loss	45.4958	39.5987	42.1870	39.2251	38.8782	36.0230	37.2238	38.8782	39.2251	42.1870	42.4271	45.4958	(61)
Total heat required for water heating calculated for each month	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168	(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	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168	(64)
								Total per year (kWh/year) = Sum(64)m =				1763.8549	(64)

Heat gains from water heating, kWh/month

55.3965	48.4021	50.2778	44.4447	42.9560	37.6863	35.8827	40.2167	40.6677	46.5127	49.8665	54.0074 (65)

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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	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

15.4584	13.7300	11.1660	8.4534	6.3190	5.3348	5.7644	7.4928	10.0568	12.7694	14.9038	15.8880	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

172.5685	174.3592	169.8466	160.2399	148.1132	136.7158	129.1016	127.3109	131.8234	141.4301	153.5569	164.9543	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	(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)

-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	(71)

Water heating gains (Table 5)

74.4576	72.0269	67.5777	61.7288	57.7365	52.3421	48.2294	54.0547	56.4829	62.5171	69.2590	72.5906	(72)

Total internal gains

318.1453	315.7769	304.2511	286.0830	267.8296	250.0534	238.7562	244.5192	254.0240	272.3775	293.3805	309.0938	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.3200	10.6334	0.6300	0.7000	0.7700	23.7878	(74)
Southwest	4.9300	36.7938	0.6300	0.7000	0.7700	55.4362	(79)

Solar gains	79.2241	139.8882	206.4483	284.1653	346.4557	356.9478	338.6820	289.8214	232.7737	158.4774	95.7452	67.2726	(83)
Total gains	397.3694	455.6651	510.6994	570.2482	614.2853	607.0012	577.4382	534.3407	486.7976	430.8549	389.1257	376.3664	(84)

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7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.1496	57.2818	57.4119	58.0311	58.1485	58.7010	58.7010	58.8045	58.4870	58.1485	57.9116	57.6660	
alpha	4.8100	4.8188	4.8275	4.8687	4.8766	4.9134	4.9134	4.9203	4.8991	4.8766	4.8608	4.8444	
util living area													
	0.9969	0.9934	0.9839	0.9512	0.8608	0.6918	0.5272	0.5866	0.8335	0.9693	0.9937	0.9976	(86)
MIT	19.7308	19.8898	20.1505	20.4956	20.7884	20.9482	20.9889	20.9818	20.8681	20.4930	20.0499	19.7019	(87)
Th 2	19.9079	19.9101	19.9123	19.9227	19.9246	19.9336	19.9336	19.9353	19.9301	19.9246	19.9207	19.9166	(88)
util rest of house													
	0.9958	0.9912	0.9782	0.9331	0.8111	0.5978	0.4058	0.4616	0.7574	0.9544	0.9911	0.9968	(89)
MIT 2	18.2285	18.4615	18.8405	19.3362	19.7203	19.8999	19.9297	19.9280	19.8260	19.3425	18.7033	18.1924	(90)
Living area fraction									fLA = Living area / (4) =			0.4871	(91)
MIT	18.9602	19.1572	19.4786	19.9009	20.2405	20.4105	20.4456	20.4412	20.3336	19.9029	19.3591	18.9276	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9602	19.1572	19.4786	19.9009	20.2405	20.4105	20.4456	20.4412	20.3336	19.9029	19.3591	18.9276	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9945	0.9891	0.9752	0.9327	0.8272	0.6419	0.4653	0.5228	0.7891	0.9540	0.9893	0.9957	(94)
Useful gains	395.1999	450.7184	498.0503	531.8490	508.1490	389.6093	268.6585	279.3787	384.1170	411.0285	384.9765	374.7630	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1066.1752	1034.4734	939.5629	787.8938	610.4449	411.4036	272.2808	285.6316	442.9750	664.9361	879.8236	1061.4875	(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													
	499.2056	392.2834	328.4854	184.3523	76.1081	0.0000	0.0000	0.0000	0.0000	188.9073	356.2899	510.9230	(98)
Space heating												2536.5549	(98)
Space heating per m2											(98) / (4) =	42.3819	(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 %) 93.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 2715.7976 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	499.2056	392.2834	328.4854	184.3523	76.1081	0.0000	0.0000	0.0000	0.0000	188.9073	356.2899	510.9230	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	534.4813	420.0036	351.6974	197.3793	81.4862	0.0000	0.0000	0.0000	0.0000	202.2562	381.4667	547.0268	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

Water heating requirement

	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168 (64)

Efficiency of water heater 80.3000 (216)

(217)m	87.5082	87.2850	86.7989	85.6847	83.6075	80.3000	80.3000	80.3000	80.3000	85.6269	87.0014	87.6042 (217)

Fuel for water heating, kWh/month

	203.2888	178.0321	186.2682	167.3590	166.0586	152.2793	145.8951	162.6389	164.4351	175.5936	184.4813	198.2974 (219)

Water heating fuel used 2084.6273 (219)

Annual totals kWh/year

Space heating fuel - main system 2715.7976 (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) 272.9997 (232)

Total delivered energy for all uses 5148.4245 (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	2715.7976	0.2160	586.6123 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2084.6273	0.2160	450.2795 (264)
Space and water heating			1036.8918 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	272.9997	0.5190	141.6868 (268)
Total CO2, kg/m2/year			1217.5036 (272)
Emissions per m2 for space and water heating			17.3248 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.3674 (272b)
Emissions per m2 for pumps and fans			0.6504 (272c)
Target Carbon Dioxide Emission Rate (TER) = (17.3248 * 1.00) + 2.3674 + 0.6504, rounded to 2 d.p.			20.3400 (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	59.8500 (1b)	x	2.6000 (2b)	=	155.6100 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	155.6100	(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) =	0.1285 (8)
Pressure test		Yes
Measured/design q50		4.0000
Infiltration rate		0.3285 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2792 (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	0.3560	0.3491	0.3421	0.3072	0.3002	0.2653	0.2653	0.2583	0.2792	0.3002	0.3142	0.3281	(22b)
Effective ac	0.5634	0.5609	0.5585	0.5472	0.5451	0.5352	0.5352	0.5334	0.5390	0.5451	0.5493	0.5538	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.10)			12.2500	1.0536	12.9071			(27)
Door			1.8900	1.4000	2.6460			(26)
Heat Loss Floor 1			59.8500	0.2060	12.3263			(28b)
External Wall 1	20.5000	12.2500	8.2500	0.1400	1.1550			(29a)
Corridor wall	33.5100	1.8900	31.6200	0.2320	7.3364			(29a)
External Roof 1	41.5200		41.5200	0.1100	4.5672			(30)
Total net area of external elements Aum(A, m2)			155.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.9381			(33)
Party Wall 1			53.0200	0.0000	0.0000			(32)
Party Ceilings 1			18.3300					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.2890 (36)
Total fabric heat loss	(33) + (36) =	48.2271 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.9304	28.8040	28.6801	28.0983	27.9894	27.4826	27.4826	27.3888	27.6778	27.9894	28.2096	28.4399	(38)
Heat transfer coeff	77.1575	77.0311	76.9072	76.3253	76.2165	75.7097	75.7097	75.6158	75.9049	76.2165	76.4367	76.6669	(39)
Average = Sum(39)m / 12 =												76.3248	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2892	1.2871	1.2850	1.2753	1.2735	1.2650	1.2650	1.2634	1.2683	1.2735	1.2771	1.2810	(40)
HLP (average)												1.2753	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.9774 (42)
Average daily hot water use (litres/day)	81.1630 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	89.2793	86.0328	82.7863	79.5398	76.2932	73.0467	73.0467	76.2932	79.5398	82.7863	86.0328	89.2793	(44)
Energy conte	132.3986	115.7967	119.4918	104.1759	99.9592	86.2572	79.9300	91.7208	92.8163	108.1684	118.0743	128.2210	(45)
Energy content (annual)										Total = Sum(45)m =		1277.0102	(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	28.1347	24.6068	25.3920	22.1374	21.2413	18.3297	16.9851	19.4907	19.7235	22.9858	25.0908	27.2470	(65)

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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	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	15.3846	13.6645	11.1127	8.4130	6.2888	5.3093	5.7369	7.4570	10.0088	12.7085	14.8327	15.8122	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	172.5685	174.3592	169.8466	160.2399	148.1132	136.7158	129.1016	127.3109	131.8234	141.4301	153.5569	164.9543	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	(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)

	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	(71)

Water heating gains (Table 5)

	37.8155	36.6173	34.1290	30.7463	28.5502	25.4579	22.8295	26.1971	27.3937	30.8949	34.8483	36.6223	(72)

Total internal gains

	278.4294	277.3018	267.7492	252.0602	235.6131	220.1438	210.3288	213.6259	221.8868	237.6943	255.8987	270.0496	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	7.3200	10.6334	0.7000	0.8000	0.7700	30.2068 (74)
Southwest	4.9300	36.7938	0.7000	0.8000	0.7700	70.3952 (79)

Solar gains	100.6020	177.6358	262.1566	360.8448	439.9438	453.2670	430.0724	368.0272	295.5856	201.2412	121.5812	85.4255	(83)
Total gains	379.0314	454.9376	529.9058	612.9049	675.5568	673.4108	640.4012	581.6531	517.4724	438.9355	377.4799	355.4751	(84)

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7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.8671	53.9555	54.0424	54.4544	54.5322	54.8972	54.8972	54.9654	54.7560	54.5322	54.3751	54.2118	
alpha	4.5911	4.5970	4.6028	4.6303	4.6355	4.6598	4.6598	4.6644	4.6504	4.6355	4.6250	4.6141	
util living area	0.9974	0.9937	0.9826	0.9441	0.8417	0.6680	0.5080	0.5749	0.8279	0.9701	0.9946	0.9981	(86)
MIT	19.6066	19.7934	20.0896	20.4708	20.7849	20.9467	20.9880	20.9793	20.8536	20.4370	19.9463	19.5697	(87)
Th 2	19.8493	19.8510	19.8526	19.8603	19.8617	19.8684	19.8684	19.8696	19.8658	19.8617	19.8588	19.8558	(88)
util rest of house	0.9965	0.9915	0.9764	0.9234	0.7870	0.5701	0.3836	0.4449	0.7479	0.9551	0.9924	0.9974	(89)
MIT 2	18.5913	18.7783	19.0723	19.4451	19.7230	19.8454	19.8656	19.8641	19.7880	19.4217	18.9376	18.5596	(90)
Living area fraction										fLA = Living area / (4) =		0.4871	(91)
MIT	19.0858	19.2727	19.5678	19.9447	20.2402	20.3818	20.4123	20.4073	20.3070	19.9162	19.4289	19.0516	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0858	19.2727	19.5678	19.9447	20.2402	20.3818	20.4123	20.4073	20.3070	19.9162	19.4289	19.0516	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9957	0.9901	0.9745	0.9252	0.8069	0.6165	0.4446	0.5087	0.7824	0.9560	0.9912	0.9968	(94)
Useful gains	377.4202	450.4136	516.3672	567.0459	545.1245	415.1813	284.7155	295.9056	404.8533	419.6224	374.1723	354.3371	(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	1140.8359	1107.1464	1005.0043	842.9891	650.9019	437.7360	288.6248	303.0151	471.1431	710.0508	942.3802	1138.6258	(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	567.9813	441.3244	363.5460	198.6791	78.6983	0.0000	0.0000	0.0000	0.0000	216.0787	409.1097	583.5108	(98)

Space heating 2858.9284 (98)

Space heating per m2 (98) / (4) = 47.7682 (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	711.6708	560.2515	574.6802	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8918	0.9395	0.9145	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	634.6497	526.3600	525.5260	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	860.9666	820.9321	753.4072	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	162.9482	219.1617	169.5435	0.0000	0.0000	0.0000	0.0000	(104)

Space cooling 551.6534 (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	40.7370	54.7904	42.3859	0.0000	0.0000	0.0000	0.0000	(107)

Space cooling 137.9134 (107)

Space cooling per m2 2.3043 (108)

Energy for space heating 47.7682 (99)

Energy for space cooling 2.3043 (108)

Total 50.0725 (109)

Dwelling Fabric Energy Efficiency (DFEE) 50.1 (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	59.8500 (1b)	x	2.6000 (2b)	=	155.6100 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	155.6100	(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) =	0.1285	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3785	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3217	(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	0.4102	0.4022	0.3941	0.3539	0.3459	0.3057	0.3057	0.2976	0.3217	0.3459	0.3620	0.3781	(22b)
Effective ac	0.5841	0.5809	0.5777	0.5626	0.5598	0.5467	0.5467	0.5443	0.5518	0.5598	0.5655	0.5715	(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			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.40)			12.2500	1.3258	16.2405			(27)
Heat Loss Floor 1			59.8500	0.1300	7.7805			(28b)
External Wall 1	20.5000	12.2500	8.2500	0.1800	1.4850			(29a)
Corridor wall	33.5100	1.8900	31.6200	0.1800	5.6916			(29a)
External Roof 1	41.5200		41.5200	0.1300	5.3976			(30)
Total net area of external elements Aum(A, m2)			155.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.4852			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.2440	(36)
Total fabric heat loss					(33) + (36) =		42.7292	(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	29.9965	29.8287	29.6643	28.8918	28.7473	28.0745	28.0745	27.9499	28.3336	28.7473	29.0397	29.3453	(38)
Heat transfer coeff	72.7258	72.5580	72.3935	71.6210	71.4765	70.8037	70.8037	70.6791	71.0629	71.4765	71.7689	72.0746	(39)
Average = Sum(39)m / 12 =												71.6203	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2151	1.2123	1.2096	1.1967	1.1943	1.1830	1.1830	1.1809	1.1873	1.1943	1.1991	1.2043	(40)
HLP (average)												1.1967	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.9774 (42)
Average daily hot water use (litres/day)	81.1630 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	89.2793	86.0328	82.7863	79.5398	76.2932	73.0467	73.0467	76.2932	79.5398	82.7863	86.0328	89.2793	(44)
Energy conte	132.3986	115.7967	119.4918	104.1759	99.9592	86.2572	79.9300	91.7208	92.8163	108.1684	118.0743	128.2210	(45)
Energy content (annual)										Total = Sum(45)m =		1277.0102	(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	28.1347	24.6068	25.3920	22.1374	21.2413	18.3297	16.9851	19.4907	19.7235	22.9858	25.0908	27.2470	(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	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.4584	13.7300	11.1660	8.4534	6.3190	5.3348	5.7644	7.4928	10.0568	12.7694	14.9038	15.8880	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	172.5685	174.3592	169.8466	160.2399	148.1132	136.7158	129.1016	127.3109	131.8234	141.4301	153.5569	164.9543	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	(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)													
	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	(71)
Water heating gains (Table 5)													
	37.8155	36.6173	34.1290	30.7463	28.5502	25.4579	22.8295	26.1971	27.3937	30.8949	34.8483	36.6223	(72)
Total internal gains													
	278.5032	277.3673	267.8025	252.1005	235.6432	220.1692	210.3563	213.6616	221.9348	237.7553	255.9698	270.1254	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.3200	10.6334	0.6300	0.7000	0.7700	23.7878	(74)
Southwest	4.9300	36.7938	0.6300	0.7000	0.7700	55.4362	(79)

Solar gains	79.2241	139.8882	206.4483	284.1653	346.4557	356.9478	338.6820	289.8214	232.7737	158.4774	95.7452	67.2726	(83)
Total gains	357.7272	417.2555	474.2508	536.2658	582.0989	577.1170	549.0383	503.4831	454.7084	396.2327	351.7150	337.3980	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.1496	57.2818	57.4119	58.0311	58.1485	58.7010	58.7010	58.8045	58.4870	58.1485	57.9116	57.6660	
alpha	4.8100	4.8188	4.8275	4.8687	4.8766	4.9134	4.9134	4.9203	4.8991	4.8766	4.8608	4.8444	
util living area													
	0.9980	0.9955	0.9880	0.9608	0.8799	0.7176	0.5517	0.6170	0.8602	0.9777	0.9959	0.9985	(86)
MIT	19.6702	19.8320	20.0979	20.4533	20.7625	20.9392	20.9865	20.9774	20.8454	20.4459	19.9933	19.6420	(87)
Th 2	19.9079	19.9101	19.9123	19.9227	19.9246	19.9336	19.9336	19.9353	19.9301	19.9246	19.9207	19.9166	(88)
util rest of house													
	0.9973	0.9939	0.9837	0.9456	0.8339	0.6237	0.4260	0.4882	0.7897	0.9663	0.9942	0.9980	(89)
MIT 2	18.7009	18.8638	19.1292	19.4833	19.7651	19.9060	19.9303	19.9289	19.8440	19.4831	19.0335	18.6797	(90)
Living area fraction										fLA = Living area / (4) =		0.4871	(91)
MIT	19.1730	19.3353	19.6010	19.9557	20.2509	20.4092	20.4447	20.4396	20.3318	19.9521	19.5009	19.1484	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1730	19.3353	19.6010	19.9557	20.2509	20.4092	20.4447	20.4396	20.3318	19.9521	19.5009	19.1484	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9967	0.9928	0.9821	0.9461	0.8494	0.6679	0.4877	0.5515	0.8193	0.9667	0.9933	0.9975	(94)
Useful gains	356.5564	414.2655	465.7470	507.3772	494.4406	385.4469	267.7808	277.6575	372.5525	383.0255	349.3716	336.5609	(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													
	1081.6500	1047.3986	948.4291	791.8233	611.1881	411.3142	272.2210	285.5147	442.8461	668.4520	890.0020	1077.3986	(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													
	539.4697	425.4654	359.1155	204.8012	86.8602	0.0000	0.0000	0.0000	0.0000	212.3573	389.2539	551.1833	(98)
Space heating												2768.5063	(98)
Space heating per m2											(98) / (4) =	46.2574	(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	665.5549	523.9474	537.1613	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8757	0.9308	0.9050	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	582.8230	487.6721	486.1391	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	748.4493	714.1810	662.0872	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	119.2510	168.5226	130.9054	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												418.6790	(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	29.8127	42.1306	32.7264	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												104.6697	(107)
Space cooling per m2												1.7489	(108)
Energy for space heating												46.2574	(99)
Energy for space cooling												1.7489	(108)
Total												48.0063	(109)
Target Fabric Energy Efficiency (TFEE)												55.2	(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	59.8500 (1b)	x	2.6000 (2b)	=	155.6100 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	155.6100	(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) =	0.1285	(8)
Pressure test		Yes	
Measured/design q50		4.0000	
Infiltration rate		0.3285	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2792	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.5000	3.4000	3.4000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8750	0.8500	0.8500	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.3002	0.2862	0.2862	0.2653	0.2723	0.2374	0.2443	0.2374	0.2374	0.2583	0.2513	0.2792	(22b)
Effective ac	0.5451	0.5410	0.5410	0.5352	0.5371	0.5282	0.5299	0.5282	0.5282	0.5334	0.5316	0.5390	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.10)			12.2500	1.0536	12.9071			(27)
Door			1.8900	1.4000	2.6460			(26)
Heat Loss Floor 1			59.8500	0.2060	12.3263			(28b)
External Wall 1	20.5000	12.2500	8.2500	0.1400	1.1550			(29a)
Corridor wall	33.5100	1.8900	31.6200	0.2320	7.3364			(29a)
External Roof 1	41.5200		41.5200	0.1100	4.5672			(30)
Total net area of external elements Aum(A, m2)			155.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.9381			(33)
Party Wall 1			53.0200	0.0000	0.0000			(32)
Party Ceilings 1			18.3300					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.2890	(36)
Total fabric heat loss (33) + (36) =	48.2271	(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	27.9894	27.7792	27.7792	27.4826	27.5790	27.1222	27.2086	27.1222	27.1222	27.3888	27.2974	27.6778	(38)
Heat transfer coeff	76.2165	76.0062	76.0062	75.7097	75.8060	75.3493	75.4356	75.3493	75.3493	75.6158	75.5245	75.9049	(39)
Average = Sum(39)m / 12 =												75.6894	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2735	1.2699	1.2699	1.2650	1.2666	1.2590	1.2604	1.2590	1.2590	1.2634	1.2619	1.2683	(40)
HLP (average)												1.2647	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.9774 (42)
Average daily hot water use (litres/day)	81.1630 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	89.2793	86.0328	82.7863	79.5398	76.2932	73.0467	73.0467	76.2932	79.5398	82.7863	86.0328	89.2793	(44)
Energy conte	132.3986	115.7967	119.4918	104.1759	99.9592	86.2572	79.9300	91.7208	92.8163	108.1684	118.0743	128.2210	(45)
Energy content (annual)										Total = Sum(45)m =		1277.0102	(45)
Distribution loss (46)m = 0.15 x (45)m	19.8598	17.3695	17.9238	15.6264	14.9939	12.9386	11.9895	13.7581	13.9224	16.2253	17.7111	19.2332	(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)
Combi loss	45.4958	39.5987	42.1870	39.2251	38.8782	36.0230	37.2238	38.8782	39.2251	42.1870	42.4271	45.4958	(61)
Total heat required for water heating calculated for each month	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168	(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

	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168 (64)
									Total per year (kWh/year) = Sum(64)m =			1763.8549 (64)
RHI water heating demand												1764 (64)
Heat gains from water heating, kWh/month												
	55.3965	48.4021	50.2778	44.4447	42.9560	37.6863	35.8827	40.2167	40.6677	46.5127	49.8665	54.0074 (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	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	46.1538	40.9934	33.3381	25.2391	18.8665	15.9279	17.2107	22.3711	30.0264	38.1254	44.4980	47.4366	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5649	260.2376	253.5024	239.1641	221.0645	204.0534	192.6889	190.0162	196.7514	211.0897	229.1894	246.2004	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	(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)													
	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	(71)
Water heating gains (Table 5)													
	74.4576	72.0269	67.5777	61.7288	57.7365	52.3421	48.2294	54.0547	56.4829	62.5171	69.2590	72.5906	(72)
Total internal gains													
	469.5659	464.6474	445.8077	417.5215	389.0570	363.7129	349.5185	357.8316	374.6502	403.1218	434.3359	457.6172	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	7.3200	11.5683	0.7000	0.8000	0.7700	32.8626 (74)
Southwest	4.9300	39.0225	0.7000	0.8000	0.7700	74.6591 (79)

Solar gains	107.5218	171.0326	255.0993	365.2187	435.0620	479.0060	453.1853	399.0462	316.8212	212.1159	134.3037	89.5721 (83)
Total gains	577.0877	635.6800	700.9070	782.7402	824.1190	842.7189	802.7038	756.8777	691.4714	615.2377	568.6395	547.1892 (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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.5322	54.6830	54.6830	54.8972	54.8274	55.1598	55.0967	55.1598	55.1598	54.9654	55.0318	54.7560	
alpha	4.6355	4.6455	4.6455	4.6598	4.6552	4.6773	4.6731	4.6773	4.6773	4.6644	4.6688	4.6504	
util living area													
	0.9807	0.9688	0.9294	0.8257	0.6398	0.3904	0.2254	0.2585	0.5487	0.8499	0.9605	0.9842	(86)
MIT	20.2420	20.3466	20.5627	20.7792	20.9029	20.9391	20.9418	20.9417	20.9277	20.7862	20.4830	20.2154	(87)
Th 2	19.8617	19.8645	19.8645	19.8684	19.8671	19.8731	19.8720	19.8731	19.8731	19.8696	19.8708	19.8658	(88)
util rest of house													
	0.9744	0.9587	0.9067	0.7756	0.5568	0.2920	0.1195	0.1466	0.4383	0.7925	0.9454	0.9789	(89)
MIT 2	18.8915	19.0423	19.3426	19.6234	19.7544	19.7873	19.7870	19.7882	19.7817	19.6412	19.2432	18.8570	(90)
Living area fraction									fLA = Living area / (4) =			0.4871	(91)
MIT	19.5492	19.6775	19.9368	20.1863	20.3138	20.3483	20.3495	20.3500	20.3399	20.1989	19.8470	19.5186	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.3992	19.5275	19.7868	20.0363	20.1638	20.1983	20.1995	20.2000	20.1899	20.0489	19.6970	19.3686	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9711	0.9551	0.9048	0.7838	0.5795	0.3206	0.1503	0.1792	0.4703	0.8028	0.9426	0.9759	(94)
Useful gains	560.3992	607.1265	634.2126	613.4802	477.5993	270.2102	120.6412	135.5947	325.2053	493.9060	535.9925	533.9876	(95)
Ext temp.	5.6000	6.1000	8.1000	10.6000	13.6000	16.6000	18.6000	18.4000	15.8000	12.3000	8.5000	5.6000	(96)
Heat loss rate W													
	1051.7296	1020.5774	888.2734	714.4210	497.5752	271.1256	120.6558	135.6305	330.7729	585.9389	845.6512	1045.1070	(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													
	365.5498	277.8390	189.0213	72.6774	14.8620	0.0000	0.0000	0.0000	0.0000	68.4725	222.9543	380.2728	(98)
Space heating												1591.6491	(98)
RHI space heating demand												1592	(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	59.8500 (1b)	x	2.6000 (2b)	=	155.6100 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	155.6100	(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) =	0.1285	(8)
Pressure test		Yes	
Measured/design q50		4.0000	
Infiltration rate		0.3285	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2792	(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	0.3560	0.3491	0.3421	0.3072	0.3002	0.2653	0.2653	0.2583	0.2792	0.3002	0.3142	0.3281	(22b)
Effective ac	0.5634	0.5609	0.5585	0.5472	0.5451	0.5352	0.5352	0.5334	0.5390	0.5451	0.5493	0.5538	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.10)			12.2500	1.0536	12.9071			(27)
Door			1.8900	1.4000	2.6460			(26)
Heat Loss Floor 1			59.8500	0.2060	12.3263			(28b)
External Wall 1	20.5000	12.2500	8.2500	0.1400	1.1550			(29a)
Corridor wall	33.5100	1.8900	31.6200	0.2320	7.3364			(29a)
External Roof 1	41.5200		41.5200	0.1100	4.5672			(30)
Total net area of external elements Aum(A, m2)			155.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.9381			(33)
Party Wall 1			53.0200	0.0000	0.0000			(32)
Party Ceilings 1			18.3300					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.2890	(36)
Total fabric heat loss (33) + (36) =	48.2271	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.9304	28.8040	28.6801	28.0983	27.9894	27.4826	27.4826	27.3888	27.6778	27.9894	28.2096	28.4399	(38)
Heat transfer coeff	77.1575	77.0311	76.9072	76.3253	76.2165	75.7097	75.7097	75.6158	75.9049	76.2165	76.4367	76.6669	(39)
Average = Sum(39)m / 12 =												76.3248	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2892	1.2871	1.2850	1.2753	1.2735	1.2650	1.2650	1.2634	1.2683	1.2735	1.2771	1.2810	(40)
HLP (average)												1.2753	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.9774 (42)
Average daily hot water use (litres/day)	81.1630 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	89.2793	86.0328	82.7863	79.5398	76.2932	73.0467	73.0467	76.2932	79.5398	82.7863	86.0328	89.2793	(44)
Energy conte	132.3986	115.7967	119.4918	104.1759	99.9592	86.2572	79.9300	91.7208	92.8163	108.1684	118.0743	128.2210	(45)
Energy content (annual)										Total = Sum(45)m =		1277.0102	(45)
Distribution loss (46)m = 0.15 x (45)m	19.8598	17.3695	17.9238	15.6264	14.9939	12.9386	11.9895	13.7581	13.9224	16.2253	17.7111	19.2332	(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)
Combi loss	45.4958	39.5987	42.1870	39.2251	38.8782	36.0230	37.2238	38.8782	39.2251	42.1870	42.4271	45.4958	(61)
Total heat required for water heating calculated for each month	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168	(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

	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168 (64)
										Total per year (kWh/year) = Sum(64)m =		1763.8549 (64)
Heat gains from water heating, kWh/month												
	55.3965	48.4021	50.2778	44.4447	42.9560	37.6863	35.8827	40.2167	40.6677	46.5127	49.8665	54.0074 (65)

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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	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	46.1538	40.9934	33.3381	25.2391	18.8665	15.9279	17.2107	22.3711	30.0264	38.1254	44.4980	47.4366	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	257.5649	260.2376	253.5024	239.1641	221.0645	204.0534	192.6889	190.0162	196.7514	211.0897	229.1894	246.2004	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	(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)

	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	(71)

Water heating gains (Table 5)

	74.4576	72.0269	67.5777	61.7288	57.7365	52.3421	48.2294	54.0547	56.4829	62.5171	69.2590	72.5906	(72)
Total internal gains													
	469.5659	464.6474	445.8077	417.5215	389.0570	363.7129	349.5185	357.8316	374.6502	403.1218	434.3359	457.6172	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.3200	10.6334	0.7000	0.8000	0.7700	30.2068	(74)
Southwest	4.9300	36.7938	0.7000	0.8000	0.7700	70.3952	(79)

Solar gains	100.6020	177.6358	262.1566	360.8448	439.9438	453.2670	430.0724	368.0272	295.5856	201.2412	121.5812	85.4255	(83)
Total gains	570.1679	642.2832	707.9643	778.3663	829.0008	816.9799	779.5909	725.8588	670.2358	604.3630	555.9170	543.0427	(84)

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7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.8671	53.9555	54.0424	54.4544	54.5322	54.8972	54.8972	54.9654	54.7560	54.5322	54.3751	54.2118	
alpha	4.5911	4.5970	4.6028	4.6303	4.6355	4.6598	4.6598	4.6644	4.6504	4.6355	4.6250	4.6141	
util living area													
	0.9867	0.9760	0.9511	0.8848	0.7527	0.5708	0.4226	0.4710	0.7093	0.9137	0.9755	0.9892	(86)
MIT	20.1077	20.2368	20.4336	20.6712	20.8439	20.9208	20.9376	20.9350	20.8860	20.6648	20.3431	20.0782	(87)
Th 2	19.8493	19.8510	19.8526	19.8603	19.8617	19.8684	19.8684	19.8696	19.8658	19.8617	19.8588	19.8558	(88)
util rest of house													
	0.9825	0.9686	0.9360	0.8507	0.6887	0.4792	0.3164	0.3594	0.6187	0.8799	0.9666	0.9857	(89)
MIT 2	18.6877	18.8740	19.1535	19.4806	19.6898	19.7707	19.7818	19.7820	19.7416	19.4825	19.0352	18.6502	(90)
Living area fraction									fLA = Living area / (4) =			0.4871	(91)
MIT	19.3793	19.5378	19.7770	20.0605	20.2519	20.3309	20.3447	20.3436	20.2990	20.0583	19.6722	19.3457	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.2293	19.3878	19.6270	19.9105	20.1019	20.1809	20.1947	20.1936	20.1490	19.9083	19.5222	19.1957	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9796	0.9649	0.9324	0.8524	0.7032	0.5053	0.3474	0.3920	0.6429	0.8816	0.9633	0.9832	(94)
Useful gains	558.5343	619.7538	660.1158	663.4666	582.9304	412.8479	270.8381	284.5585	430.9136	532.7828	535.5367	533.9085	(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													
	1151.9064	1116.0073	1009.5579	840.3799	640.3634	422.5260	272.1554	286.8542	459.1465	709.4491	949.5137	1149.6730	(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													
	441.4689	333.4823	259.9849	127.3775	42.7302	0.0000	0.0000	0.0000	0.0000	131.4397	298.0635	458.1288	(98)
Space heating												2092.6758	(98)
Space heating per m2											(98) / (4) =	34.9653	(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 %)	88.9000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	2353.9660 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	441.4689	333.4823	259.9849	127.3775	42.7302	0.0000	0.0000	0.0000	0.0000	131.4397	298.0635	458.1288	(98)
Space heating efficiency (main heating system 1)													
	88.9000	88.9000	88.9000	88.9000	88.9000	0.0000	0.0000	0.0000	0.0000	88.9000	88.9000	88.9000	(210)
Space heating fuel (main heating system)													
	496.5904	375.1207	292.4465	143.2818	48.0655	0.0000	0.0000	0.0000	0.0000	147.8511	335.2795	515.3305	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement

	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168 (64)
Efficiency of water heater												78.8000 (216)
(217)m	85.7434	85.4199	84.7356	83.2492	80.9648	78.8000	78.8000	78.8000	78.8000	83.2095	85.0831	85.8739 (217)
Fuel for water heating, kWh/month												
	207.4729	181.9194	190.8038	172.2551	171.4788	155.1780	148.6723	165.7348	167.5652	180.6951	188.6409	202.2929 (219)
Water heating fuel used												2132.7091 (219)

Annual totals kWh/year
Space heating fuel - main system 2353.9660 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
Total electricity for the above, kWh/year 30.0000 (231)
Electricity for lighting (calculated in Appendix L) 326.0363 (232)
Total delivered energy for all uses 4842.7114 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2353.9660	3.4800	81.9180	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2132.7091	3.4800	74.2183	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	326.0363	13.1900	43.0042	(250)
Additional standing charges			120.0000	(251)
Total energy cost			323.0975	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 1.2942 (257)
SAP value 81.9454
SAP rating (Section 12) 82 (258)
SAP band B

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	2353.9660	0.2160	508.4567	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2132.7091	0.2160	460.6652	(264)
Space and water heating			969.1218	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	326.0363	0.5190	169.2128	(268)
Total kg/year			1153.9047	(272)
CO2 emissions per m2			19.2800	(273)
EI value			85.2529	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency 3.48 × (1 + 0.29 × 0.25) / 0.8890 = 4.198, stars = 4
Main heating environmental impact 0.216 × (1 + 0.29 × 0.25) / 0.8890 = 0.2606, stars = 4
Water heating energy efficiency 3.48 / 0.8246 = 4.220, stars = 4
Water heating environmental impact 0.216 / 0.8246 = 0.2620, stars = 4

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	59.8500 (1b)	x	2.6000 (2b)	=	155.6100 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	155.6100	(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) =	0.1285	(8)
Pressure test		Yes	
Measured/design q50		4.0000	
Infiltration rate		0.3285	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2792	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.5000	3.4000	3.4000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8750	0.8500	0.8500	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.3002	0.2862	0.2862	0.2653	0.2723	0.2374	0.2443	0.2374	0.2374	0.2583	0.2513	0.2792	(22b)
Effective ac	0.5451	0.5410	0.5410	0.5352	0.5371	0.5282	0.5299	0.5282	0.5282	0.5334	0.5316	0.5390	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.10)			12.2500	1.0536	12.9071			(27)
Door			1.8900	1.4000	2.6460			(26)
Heat Loss Floor 1			59.8500	0.2060	12.3263			(28b)
External Wall 1	20.5000	12.2500	8.2500	0.1400	1.1550			(29a)
Corridor wall	33.5100	1.8900	31.6200	0.2320	7.3364			(29a)
External Roof 1	41.5200		41.5200	0.1100	4.5672			(30)
Total net area of external elements Aum(A, m2)			155.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.9381			(33)
Party Wall 1			53.0200	0.0000	0.0000			(32)
Party Ceilings 1			18.3300					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	7.2890	(36)
Total fabric heat loss (33) + (36) =	48.2271	(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	27.9894	27.7792	27.7792	27.4826	27.5790	27.1222	27.2086	27.1222	27.1222	27.3888	27.2974	27.6778	(38)
Heat transfer coeff	76.2165	76.0062	76.0062	75.7097	75.8060	75.3493	75.4356	75.3493	75.3493	75.6158	75.5245	75.9049	(39)
Average = Sum(39)m / 12 =												75.6894	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2735	1.2699	1.2699	1.2650	1.2666	1.2590	1.2604	1.2590	1.2590	1.2634	1.2619	1.2683	(40)
HLP (average)												1.2647	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.9774 (42)
Average daily hot water use (litres/day)	81.1630 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	89.2793	86.0328	82.7863	79.5398	76.2932	73.0467	73.0467	76.2932	79.5398	82.7863	86.0328	89.2793	(44)
Energy conte	132.3986	115.7967	119.4918	104.1759	99.9592	86.2572	79.9300	91.7208	92.8163	108.1684	118.0743	128.2210	(45)
Energy content (annual)										Total = Sum(45)m =		1277.0102	(45)
Distribution loss (46)m = 0.15 x (45)m	19.8598	17.3695	17.9238	15.6264	14.9939	12.9386	11.9895	13.7581	13.9224	16.2253	17.7111	19.2332	(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)
Combi loss	45.4958	39.5987	42.1870	39.2251	38.8782	36.0230	37.2238	38.8782	39.2251	42.1870	42.4271	45.4958	(61)
Total heat required for water heating calculated for each month	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168	(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

177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168 (64)
								Total per year (kWh/year) = Sum(64)m =			1763.8549 (64)

Heat gains from water heating, kWh/month

55.3965	48.4021	50.2778	44.4447	42.9560	37.6863	35.8827	40.2167	40.6677	46.5127	49.8665	54.0074 (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	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

46.1538	40.9934	33.3381	25.2391	18.8665	15.9279	17.2107	22.3711	30.0264	38.1254	44.4980	47.4366 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

257.5649	260.2376	253.5024	239.1641	221.0645	204.0534	192.6889	190.0162	196.7514	211.0897	229.1894	246.2004 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417 (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)

-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956 (71)

Water heating gains (Table 5)

74.4576	72.0269	67.5777	61.7288	57.7365	52.3421	48.2294	54.0547	56.4829	62.5171	69.2590	72.5906 (72)

Total internal gains

469.5659	464.6474	445.8077	417.5215	389.0570	363.7129	349.5185	357.8316	374.6502	403.1218	434.3359	457.6172 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.3200	11.5683	0.7000	0.8000	0.7700	32.8626 (74)	
Southwest	4.9300	39.0225	0.7000	0.8000	0.7700	74.6591 (79)	

Solar gains	107.5218	171.0326	255.0993	365.2187	435.0620	479.0060	453.1853	399.0462	316.8212	212.1159	134.3037	89.5721 (83)
Total gains	577.0877	635.6800	700.9070	782.7402	824.1190	842.7189	802.7038	756.8777	691.4714	615.2377	568.6395	547.1892 (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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.5322	54.6830	54.6830	54.8972	54.8274	55.1598	55.0967	55.1598	55.1598	54.9654	55.0318	54.7560	
alpha	4.6355	4.6455	4.6455	4.6598	4.6552	4.6773	4.6731	4.6773	4.6773	4.6644	4.6688	4.6504	
util living area	0.9807	0.9688	0.9294	0.8257	0.6398	0.3904	0.2254	0.2585	0.5487	0.8499	0.9605	0.9842 (86)	
MIT	20.2420	20.3466	20.5627	20.7792	20.9029	20.9391	20.9418	20.9417	20.9277	20.7862	20.4830	20.2154 (87)	
Th 2	19.8617	19.8645	19.8645	19.8684	19.8671	19.8731	19.8720	19.8731	19.8731	19.8696	19.8708	19.8658 (88)	
util rest of house	0.9744	0.9587	0.9067	0.7756	0.5568	0.2920	0.1195	0.1466	0.4383	0.7925	0.9454	0.9789 (89)	
MIT 2	18.8915	19.0423	19.3426	19.6234	19.7544	19.7873	19.7870	19.7882	19.7817	19.6412	19.2432	18.8570 (90)	
Living area fraction									fLA = Living area / (4) =			0.4871 (91)	
MIT	19.5492	19.6775	19.9368	20.1863	20.3138	20.3483	20.3495	20.3500	20.3399	20.1989	19.8470	19.5186 (92)	
Temperature adjustment												-0.1500	
adjusted MIT	19.3992	19.5275	19.7868	20.0363	20.1638	20.1983	20.1995	20.2000	20.1899	20.0489	19.6970	19.3686 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9711	0.9551	0.9048	0.7838	0.5795	0.3206	0.1503	0.1792	0.4703	0.8028	0.9426	0.9759 (94)	
Useful gains	560.3992	607.1265	634.2126	613.4802	477.5993	270.2102	120.6412	135.5947	325.2053	493.9060	535.9925	533.9876 (95)	
Ext temp.	5.6000	6.1000	8.1000	10.6000	13.6000	16.6000	18.6000	18.4000	15.8000	12.3000	8.5000	5.6000 (96)	
Heat loss rate W	1051.7296	1020.5774	888.2734	714.4210	497.5752	271.1256	120.6558	135.6305	330.7729	585.9389	845.6512	1045.1070 (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	365.5498	277.8390	189.0213	72.6774	14.8620	0.0000	0.0000	0.0000	0.0000	68.4725	222.9543	380.2728 (98)	
Space heating												1591.6491 (98)	
Space heating per m2											(98) / (4) =	26.5940 (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 %)	88.9000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	1790.3815 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	365.5498	277.8390	189.0213	72.6774	14.8620	0.0000	0.0000	0.0000	0.0000	68.4725	222.9543	380.2728 (98)	
Space heating efficiency (main heating system 1)	88.9000	88.9000	88.9000	88.9000	88.9000	0.0000	0.0000	0.0000	0.0000	88.9000	88.9000	88.9000 (210)	
Space heating fuel (main heating system)	411.1922	312.5299	212.6223	81.7518	16.7177	0.0000	0.0000	0.0000	0.0000	77.0219	250.7922	427.7535 (211)	
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)	

Water heating
Water heating requirement

	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168 (64)
Efficiency of water heater												78.8000 (216)
(217)m	85.3202	84.9926	83.9400	81.9308	79.6753	78.8000	78.8000	78.8000	78.8000	81.7046	84.3735	85.4650 (217)
Fuel for water heating, kWh/month												
	208.5020	182.8340	192.6123	175.0269	174.2541	155.1780	148.6723	165.7348	167.5652	184.0233	190.2273	203.2607 (219)

Water heating fuel used 2147.8909 (219)
Annual totals kWh/year
Space heating fuel - main system 1790.3815 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
Total electricity for the above, kWh/year 30.0000 (231)
Electricity for lighting (calculated in Appendix L) 326.0363 (232)
Total delivered energy for all uses 4294.3087 (238)

10a. Fuel costs - using BEDF prices (395)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1790.3815	4.2800	76.6283 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2147.8909	4.2800	91.9297 (247)
Pumps and fans for heating	30.0000	15.4400	4.6320 (249)
Energy for lighting	326.0363	15.4400	50.3400 (250)
Additional standing charges			92.0000 (251)
Total energy cost			315.5301 (255)

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	1790.3815	0.2160	386.7224 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2147.8909	0.2160	463.9444 (264)
Space and water heating			850.6668 (265)
Pumps and fans	30.0000	0.5190	15.5700 (267)
Energy for lighting	326.0363	0.5190	169.2128 (268)
Total kg/year			1035.4497 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	1790.3815	1.2200	2184.2654 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2147.8909	1.2200	2620.4269 (264)
Space and water heating			4804.6923 (265)
Pumps and fans	30.0000	3.0700	92.1000 (267)
Energy for lighting	326.0363	3.0700	1000.9315 (268)
Primary energy kWh/year			5897.7238 (272)
Primary energy kWh/m2/year			98.5418 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 82
Current environmental impact rating: B 85

(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)			

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

Potential energy efficiency rating: B 82
Potential environmental impact rating: B 85

Fuel prices for cost data on this page from database revision number 395 TEST (24 Jun 2016)
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	£55	£55	£0
Mains gas	£261	£261	£0
Space heating	£173	£173	£0
Water heating	£92	£92	£0
Lighting	£50	£50	£0
Total cost of fuels	£316	£316	£0
Total cost of uses	£315	£315	£0
Delivered energy	72 kWh/m²	72 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.0 tonnes	1.0 tonnes	0.0 tonnes
CO2 emissions per m²	17 kg/m²	17 kg/m²	0 kg/m²
Primary energy	99 kWh/m²	99 kWh/m²	0 kWh/m²

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

No improvements selected / applicable

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	West
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	308.11 (P1)
Transmission heat loss coefficient	48.23 (37)
Summer heat loss coefficient	356.33 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	1.000	0.90	1.000	0.900 (P8)
South 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	7.3200	81.1852	0.7000	0.8000	0.9000	269.5634
South West	4.9300	119.9223	0.7000	0.8000	0.9000	268.1761
total:						537.7395

	Jun	Jul	Aug	
Solar gains	573	538	469	(P3)
Internal gains	361	347	355	
Total summer gains	934	884	824	(P5)
Summer gain/loss ratio	2.62	2.48	2.31	(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	18.87	20.63	20.36	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight

Sample Report Ltd
1 Sample Street
Sampletown

Full SAP Calculation Printout

Property Reference: 25299 OU Hawley Crescent A1
Survey Reference: A1 Be Clean
Property: 1-11 Hawley Crescent, London, NW1 8NP

Issued on Date: 01.Aug.2016
Prop Type Ref:

SAP Rating:	83 B	**CO2 Emissions (t/year):**	0.94	**DER:**	19.56 Pass	**TER:**	20.34	**Percentage DER<TER:**	3.85 %
Environmental:	87 B	**General Requirements Compliance:**	Pass	**DFEE:**	51.35 Pass	**TFEE:**	55.21	**Percentage DFEE<TFEE:**	6.98 %

CfSH Results **Version:** **ENE1 Credits:** N/A **ENE2 Credits:** N/A **ENE7 Credits:** N/A **CfSH Level:** N/A

Surveyor: admin Admin, Tel: 4, Fax: s@l.f Surveyor ID: Admin
Address:
Client:

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 3.05r04
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Build (As Designed)

CALCULATION DETAILS for survey reference no 'A1 Be Clean'
SAP2012 - 9.92 input data (DesignData) -

SAP2012 Input Data (Flat)	01/08/2016
FullRefNo:	A1 Be Clean
Regs Region:	England
SAP Region:	Thames Valley
Postcode:	NW1 8NP
DwellingOrientation:	West
Property Type:	Flat, End-Terrace
Storeys:	1
Date Built:	2016
Sheltered Sides:	2
Sunlight Shade:	Average or unknown
Measurements	Perimeter, Floor Area, Storey Height
1st Storey:	20.78, 59.85, 2.6
Living Area:	29.15 m2, fraction: 48.7%
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	8.25, 20.5, 0, Other, Cavity, 0, 0.14, Gross
Corridor wall	31.62, 33.51, 18, TimberWallTwoLayers, TimberFrame, 0.31, 0.232018561484919, Gross
Party Walls	Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1	53.02, 20, PartyWallDoublePlaster, FilledWithEdge, 0, 0
External Roofs	Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
External Roof 1	41.52, 41.52, 0, Other, 0.11
Party Ceilings	Area, Kappa, Construction, Element
Party Ceilings 1	18.33, 0, Other
Heat Loss Floors	Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
Heat Loss Floor 1	59.85, 0, Other, Exposed Floor - Solid, 0.31, 0.205953941209511
Description	Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
Window	Manufacturer, Window, Double Low-E Soft 0.1, , , 0.7, , 0.8,
Door	Manufacturer, Solid Door, , , , , , ,
Openings	Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
North elevation	Window, External Wall 1, North, , None, 0, , 0, 0, 0, 7.32,
SW elevation	Window, External Wall 1, South West, , None, 0, , 0, 0, 0, 4.93,
Door	Solid Door, Corridor wall, West, , , , , 0, 0, 0, 1.89,
Conservatory:	None
Draught Proofing:	100
Draught Lobby:	No
Thermal Bridges	
Bridging:	Calculate Bridges
Y	0.056
List of Bridges	Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
0.	External wall, E1 Steel lintel with perforated steel base plate, Table K1 - Approved, Yes, 6.8, 0.5, 0.5, 3.40,
1.	External wall, E3 Sill, Table K1 - Approved, Yes, 5.9, 0.04, 0.04, 0.24,
2.	External wall, E4 Jamb, Table K1 - Approved, Yes, 12.48, 0.05, 0.05, 0.62,
3.	External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Approved, Yes, 20.78, 0.07, 0.07, 1.45,
4.	External wall, E14 Flat roof, Table K1 - Default, No, 11.33, 0.08, 0.08, 0.91,
5.	External wall, E16 Corner (normal), Table K1 - Default, No, 7.8, 0.18, 0.18, 1.40,
6.	External wall, E17 Corner (inverted - internal area greater than external area), Table K1 - Default, No, 7.8, 0, 0, 0.00,
7.	External wall, E18 Party wall between dwellings, Table K1 - Approved, No, 10.4, 0.06, 0.06, 0.62,
8.	Party wall, P3 Party wall - Intermediate floor between dwellings (in blocks of flats), Table K1 - Default, No, 40.8, 0, 0, 0.00,
Pressure Test:	True
Designed q50:	4
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	Data Sheet
Type	Balanced mechanical ventilation with heat recovery
HR Duct Insulated	Yes
ManufacturerSFP	0.5
DuctType	Rigid
HR Efficiency	90
Wet Rooms	1
Brand Model	tbc
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              59.85
    Data Source              SAP table
    Type                     Split or Multi-Split
    Class                    A
    Control                  Modulating
Light Fittings:               10
LEL Fittings:                 10
Percentage of LEL Fittings:   100
External Lights Fitted:       Yes
External LELs Fitted:         Yes
Electricity Tariff:           Standard
Main Heating 1
    Description
    Percentage               100
    MHS                      Mains gas BGW Post 98 Combi condens. with auto ign.
    SAP Code                 104
    Boiler Efficiency Type   Sedbuk 2009
    Efficiency               90
    Model Name               tbc
    Manufacturer             tbc
    Controls by PCDF         0
    MHS Controls             CBI Time and temperature zone control
    Boiler Interlock         Yes
    Compensator              0
    Delayed Start Stat       Yes
    Ctrl SAP Code            2110
    Burner Control           Modulating
    Flue Type                None or Unknown
    Fan Assisted Flue        No
    Pumped                   Pump in heated space
    Heat Pump Age            2013 or later
    Heat Emitter             Radiators and Underfloor
    Flow Temperature         Normal (> 45°C)
    Under Floor Heating      Yes - Pipes in thin screed
    Combi boiler type        Standard Combi
    Combi keep hot type      None
Main Heating 2                None
Heating Systems Interaction   Each system heats separate parts of dwelling
Smoke Control Area            Unknown
Community Heating             None
Secondary Heating             None
Water Heating
    Type                     MainHeating1
    WHS                      HWP From main heating 1
    Low Water Usage          Yes
    SAP Code                 901
    Showers in Property      Non-electric only
    Hot Water Cylinder       None
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
-------------------------------------------------------------------------------------------------------

DWELLING AS DESIGNED

Mid-floor flat, total floor area 60 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:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 20.34 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 19.56 kg/m²OK
-------------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.2 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)51.4 kWh/m²OK
-------------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                 Highest
External wall   0.21 (max. 0.30)        0.23 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)         -                        OK
Floor           0.21 (max. 0.25)        0.21 (max. 0.70)          OK
Roof            0.11 (max. 0.20)        0.11 (max. 0.35)          OK
Openings        1.14 (max. 2.00)        1.40 (max. 3.30)          OK
-------------------------------------------------------------------------------------------------------
2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction
-------------------------------------------------------------------------------------------------------
3 Air permeability
Air permeability at 50 pascals:         4.00 (design value)
Maximum                                 10.0                                              OK
-------------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                    Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc
Combi boiler
Efficiency: 90.0% SEDBUK2009
Minimum: 88.0%                                  OK

Secondary heating system:               None
-------------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                       No cylinder
-------------------------------------------------------------------------------------------------------
```

6 Controls		
Space heating controls:	Time and temperature zone control	OK
Hot water controls:	No cylinder	
Boiler interlock	Yes	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:	0.50	
Maximum	1.5	OK
MVHR efficiency:	90%	
Minimum:	70%	OK
9 Summertime temperature		
Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing North:	7.32 m², No overhang	
Windows facing South West:	4.93 m², No overhang	
Air change rate:	6.00 ach	
Blinds/curtains:	None	
10 Key features		
External wall U-value	0.14 W/m²K	
Party wall U-value	0.00 W/m²K	
Roof U-value	0.11 W/m²K	
Window U-value	1.10 W/m²K	

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	59.8500 (1b)	x	2.6000 (2b)	=	155.6100 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	155.6100	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998	(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) = 76.5000 (23c)

Effective ac	0.3343	0.3300	0.3258	0.3045	0.3003	0.2790	0.2790	0.2748	0.2875	0.3003	0.3088	0.3173	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.10)			12.2500	1.0536	12.9071			(27)
Door			1.8900	1.4000	2.6460			(26)
Heat Loss Floor 1			59.8500	0.2060	12.3263			(28b)
External Wall 1	20.5000	12.2500	8.2500	0.1400	1.1550			(29a)
Corridor wall	33.5100	1.8900	31.6200	0.2320	7.3364			(29a)
External Roof 1	41.5200		41.5200	0.1100	4.5672			(30)
Total net area of external elements Aum(A, m2)			155.3800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.9381			(33)
Party Wall 1			53.0200	0.0000	0.0000			(32)
Party Ceilings 1			18.3300					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.6490 (36)
Total fabric heat loss	(33) + (36) =	49.5871 (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	17.1642	16.9459	16.7277	15.6365	15.4182	14.3270	14.3270	14.1088	14.7635	15.4182	15.8547	16.2912	(38)
Heat transfer coeff	66.7512	66.5330	66.3147	65.2235	65.0053	63.9141	63.9141	63.6958	64.3506	65.0053	65.4418	65.8783	(39)

Average = Sum(39)m / 12 = 65.1690 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1153	1.1117	1.1080	1.0898	1.0861	1.0679	1.0679	1.0643	1.0752	1.0861	1.0934	1.1007	(40)
HLP (average)												1.0889	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.9774 (42)
Average daily hot water use (litres/day)	81.1630 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	89.2793	86.0328	82.7863	79.5398	76.2932	73.0467	73.0467	76.2932	79.5398	82.7863	86.0328	89.2793	(44)
Energy conte	132.3986	115.7967	119.4918	104.1759	99.9592	86.2572	79.9300	91.7208	92.8163	108.1684	118.0743	128.2210	(45)
Energy content (annual)										Total = Sum(45)m =		1277.0102	(45)
Distribution loss (46)m = 0.15 x (45)m	19.8598	17.3695	17.9238	15.6264	14.9939	12.9386	11.9895	13.7581	13.9224	16.2253	17.7111	19.2332	(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)
Combi loss	45.4958	39.5987	42.1870	39.2251	38.8782	36.0230	37.2238	38.8782	39.2251	42.1870	42.4271	45.4958	(61)

Total heat required for water heating calculated for each month

	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168 (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												
	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168 (64)
									Total per year (kWh/year) = Sum(64)m =			1763.8549 (64)
Heat gains from water heating, kWh/month												
	55.3965	48.4021	50.2778	44.4447	42.9560	37.6863	35.8827	40.2167	40.6677	46.5127	49.8665	54.0074 (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	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.3846	13.6645	11.1127	8.4130	6.2888	5.3093	5.7369	7.4570	10.0088	12.7085	14.8327	15.8122	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	172.5685	174.3592	169.8466	160.2399	148.1132	136.7158	129.1016	127.3109	131.8234	141.4301	153.5569	164.9543	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	(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)													
	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	(71)
Water heating gains (Table 5)													
	74.4576	72.0269	67.5777	61.7288	57.7365	52.3421	48.2294	54.0547	56.4829	62.5171	69.2590	72.5906	(72)
Total internal gains													
	318.0716	315.7114	304.1978	286.0426	267.7994	250.0280	238.7287	244.4835	253.9760	272.3166	293.3094	309.0180	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.3200	10.6334	0.7000	0.8000	0.7700	30.2068	(74)
Southwest	4.9300	36.7938	0.7000	0.8000	0.7700	70.3952	(79)

Solar gains	100.6020	177.6358	262.1566	360.8448	439.9438	453.2670	430.0724	368.0272	295.5856	201.2412	121.5812	85.4255 (83)
Total gains	418.6736	493.3472	566.3544	646.8874	707.7432	703.2950	668.8011	612.5107	549.5616	473.5577	414.8906	394.4435 (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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	62.2648	62.4690	62.6746	63.7232	63.9371	65.0287	65.0287	65.2515	64.5876	63.9371	63.5107	63.0899	
alpha	5.1510	5.1646	5.1783	5.2482	5.2625	5.3352	5.3352	5.3501	5.3058	5.2625	5.2340	5.2060	
util living area													
	0.9960	0.9901	0.9724	0.9107	0.7676	0.5677	0.4181	0.4735	0.7403	0.9484	0.9910	0.9970	(86)
MIT	20.1209	20.2568	20.4604	20.7102	20.8754	20.9374	20.9472	20.9457	20.9044	20.6782	20.3553	20.1005	(87)
Th 2	19.9884	19.9913	19.9943	20.0092	20.0122	20.0271	20.0271	20.0301	20.0211	20.0122	20.0062	20.0002	(88)
util rest of house													
	0.9946	0.9869	0.9635	0.8835	0.7100	0.4874	0.3269	0.3762	0.6595	0.9265	0.9875	0.9960	(89)
MIT 2	18.8169	19.0165	19.3109	19.6667	19.8705	19.9454	19.9519	19.9544	19.9137	19.6348	19.1728	18.7967	(90)
Living area fraction										fLA = Living area / (4) =		0.4871	(91)
MIT	19.4520	19.6206	19.8708	20.1749	20.3600	20.4285	20.4366	20.4372	20.3962	20.1430	19.7488	19.4317	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.3020	19.4706	19.7208	20.0249	20.2100	20.2785	20.2866	20.2872	20.2462	19.9930	19.5988	19.2817	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9935	0.9848	0.9605	0.8840	0.7223	0.5086	0.3514	0.4023	0.6794	0.9260	0.9857	0.9951	(94)
Useful gains	415.9325	485.8306	543.9877	571.8698	511.1744	357.7097	235.0439	246.4348	373.3748	438.5268	408.9477	392.4980	(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													
	1001.4036	969.4264	876.7314	725.6071	553.1920	362.9386	235.6286	247.5980	395.5135	610.5925	817.9406	993.5592	(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													
	435.5905	324.9764	247.5613	110.6909	31.2611	0.0000	0.0000	0.0000	0.0000	128.0169	294.4748	447.1895	(98)
Space heating												2019.7614	(98)
Space heating per m2											(98) / (4) =	33.7471	(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	600.7923	472.9641	484.0883	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9561	0.9797	0.9691	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	574.3910	463.3665	469.1502	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	887.8508	846.3321	781.2647	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	225.6910	284.9264	232.2132	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												742.8306	(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	56.4228	71.2316	58.0533	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												185.7077	(107)

Space cooling per m2 3.1029 (108)

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 %) 90.9000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 2221.9597 (211)
Cooling System Energy Efficiency Ratio (see Table 10c) 4.3200 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	435.5905	324.9764	247.5613	110.6909	31.2611	0.0000	0.0000	0.0000	0.0000	128.0169	294.4748	447.1895	(98)
Space heating efficiency (main heating system 1)													
	90.9000	90.9000	90.9000	90.9000	90.9000	0.0000	0.0000	0.0000	0.0000	90.9000	90.9000	90.9000	(210)
Space heating fuel (main heating system)													
	479.1975	357.5098	272.3447	121.7722	34.3906	0.0000	0.0000	0.0000	0.0000	140.8326	323.9547	491.9576	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement

	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168	(64)
Efficiency of water heater												80.8000	(216)
(217)m	87.7204	87.3672	86.6223	84.9100	82.4844	80.8000	80.8000	80.8000	80.8000	85.1510	87.0610	87.8284	(217)
Fuel for water heating, kWh/month													
	202.7970	177.8646	186.6481	168.8859	168.3197	151.3369	144.9923	161.6325	163.4175	176.5750	184.3552	197.7911	(219)
Water heating fuel used												2084.6159	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	13.0608	16.4888	13.4383	0.0000	0.0000	0.0000	0.0000	(221)
Cooling												42.9879	(221)

Annual totals kWh/year
Space heating fuel - main system 2221.9597 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6250)
mechanical ventilation fans (SFP = 0.6250) 118.6526 (230a)
central heating pump 30.0000 (230c)
Total electricity for the above, kWh/year 148.6526 (231)
Electricity for lighting (calculated in Appendix L) 271.6969 (232)
Total delivered energy for all uses 4769.9131 (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	2221.9597	0.2160	479.9433	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2084.6159	0.2160	450.2770	(264)
Space and water heating			930.2203	(265)
Space cooling	42.9879	0.5190	22.3107	(266)
Pumps and fans	148.6526	0.5190	77.1507	(267)
Energy for lighting	271.6969	0.5190	141.0107	(268)
Total CO2, kg/year			1170.6925	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			19.5600	(273)

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

DER		19.5600	ZC1
Total Floor Area	TFA	59.8500	
Assumed number of occupants	N	1.9774	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.0861	ZC2
CO2 emissions from cooking, equation (L16)		2.7812	ZC3
Total CO2 emissions		39.4274	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		39.4274	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	59.8500 (1b)	x	2.6000 (2b)	=	155.6100 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	155.6100	(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) =	0.1285	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3785	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3217	(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	0.4102	0.4022	0.3941	0.3539	0.3459	0.3057	0.3057	0.2976	0.3217	0.3459	0.3620	0.3781	(22b)
Effective ac	0.5841	0.5809	0.5777	0.5626	0.5598	0.5467	0.5467	0.5443	0.5518	0.5598	0.5655	0.5715	(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			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.40)			12.2500	1.3258	16.2405			(27)
Heat Loss Floor 1			59.8500	0.1300	7.7805			(28b)
External Wall 1	20.5000	12.2500	8.2500	0.1800	1.4850			(29a)
Corridor wall	33.5100	1.8900	31.6200	0.1800	5.6916			(29a)
External Roof 1	41.5200		41.5200	0.1300	5.3976			(30)
Total net area of external elements Aum(A, m2)			155.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.4852			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		4.2440 (36)
Total fabric heat loss	(33) + (36) =	42.7292 (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	29.9965	29.8287	29.6643	28.8918	28.7473	28.0745	28.0745	27.9499	28.3336	28.7473	29.0397	29.3453	(38)
Heat transfer coeff	72.7258	72.5580	72.3935	71.6210	71.4765	70.8037	70.8037	70.6791	71.0629	71.4765	71.7689	72.0746	(39)
Average = Sum(39)m / 12 =												71.6203	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2151	1.2123	1.2096	1.1967	1.1943	1.1830	1.1830	1.1809	1.1873	1.1943	1.1991	1.2043	(40)
HLP (average)												1.1967	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.9774 (42)
Average daily hot water use (litres/day)	81.1630 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	89.2793	86.0328	82.7863	79.5398	76.2932	73.0467	73.0467	76.2932	79.5398	82.7863	86.0328	89.2793	(44)
Energy conte	132.3986	115.7967	119.4918	104.1759	99.9592	86.2572	79.9300	91.7208	92.8163	108.1684	118.0743	128.2210	(45)
Energy content (annual)										Total = Sum(45)m =		1277.0102	(45)
Distribution loss (46)m = 0.15 x (45)m	19.8598	17.3695	17.9238	15.6264	14.9939	12.9386	11.9895	13.7581	13.9224	16.2253	17.7111	19.2332	(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)
Combi loss	45.4958	39.5987	42.1870	39.2251	38.8782	36.0230	37.2238	38.8782	39.2251	42.1870	42.4271	45.4958	(61)
Total heat required for water heating calculated for each month	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168	(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	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168	(64)
								Total per year (kWh/year) = Sum(64)m =				1763.8549	(64)

Heat gains from water heating, kWh/month

	55.3965	48.4021	50.2778	44.4447	42.9560	37.6863	35.8827	40.2167	40.6677	46.5127	49.8665	54.0074 (65)

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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	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	15.4584	13.7300	11.1660	8.4534	6.3190	5.3348	5.7644	7.4928	10.0568	12.7694	14.9038	15.8880	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	172.5685	174.3592	169.8466	160.2399	148.1132	136.7158	129.1016	127.3109	131.8234	141.4301	153.5569	164.9543	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	(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)

	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	(71)

Water heating gains (Table 5)

	74.4576	72.0269	67.5777	61.7288	57.7365	52.3421	48.2294	54.0547	56.4829	62.5171	69.2590	72.5906	(72)

Total internal gains

	318.1453	315.7769	304.2511	286.0830	267.8296	250.0534	238.7562	244.5192	254.0240	272.3775	293.3805	309.0938	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.3200	10.6334	0.6300	0.7000	0.7700	23.7878	(74)
Southwest	4.9300	36.7938	0.6300	0.7000	0.7700	55.4362	(79)

Solar gains	79.2241	139.8882	206.4483	284.1653	346.4557	356.9478	338.6820	289.8214	232.7737	158.4774	95.7452	67.2726	(83)
Total gains	397.3694	455.6651	510.6994	570.2482	614.2853	607.0012	577.4382	534.3407	486.7976	430.8549	389.1257	376.3664	(84)

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7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.1496	57.2818	57.4119	58.0311	58.1485	58.7010	58.7010	58.8045	58.4870	58.1485	57.9116	57.6660	
alpha	4.8100	4.8188	4.8275	4.8687	4.8766	4.9134	4.9134	4.9203	4.8991	4.8766	4.8608	4.8444	
util living area													
	0.9969	0.9934	0.9839	0.9512	0.8608	0.6918	0.5272	0.5866	0.8335	0.9693	0.9937	0.9976	(86)
MIT	19.7308	19.8898	20.1505	20.4956	20.7884	20.9482	20.9889	20.9818	20.8681	20.4930	20.0499	19.7019	(87)
Th 2	19.9079	19.9101	19.9123	19.9227	19.9246	19.9336	19.9336	19.9353	19.9301	19.9246	19.9207	19.9166	(88)
util rest of house													
	0.9958	0.9912	0.9782	0.9331	0.8111	0.5978	0.4058	0.4616	0.7574	0.9544	0.9911	0.9968	(89)
MIT 2	18.2285	18.4615	18.8405	19.3362	19.7203	19.8999	19.9297	19.9280	19.8260	19.3425	18.7033	18.1924	(90)
Living area fraction									fLA = Living area / (4) =			0.4871	(91)
MIT	18.9602	19.1572	19.4786	19.9009	20.2405	20.4105	20.4456	20.4412	20.3336	19.9029	19.3591	18.9276	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9602	19.1572	19.4786	19.9009	20.2405	20.4105	20.4456	20.4412	20.3336	19.9029	19.3591	18.9276	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9945	0.9891	0.9752	0.9327	0.8272	0.6419	0.4653	0.5228	0.7891	0.9540	0.9893	0.9957	(94)
Useful gains	395.1999	450.7184	498.0503	531.8490	508.1490	389.6093	268.6585	279.3787	384.1170	411.0285	384.9765	374.7630	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1066.1752	1034.4734	939.5629	787.8938	610.4449	411.4036	272.2808	285.6316	442.9750	664.9361	879.8236	1061.4875	(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													
	499.2056	392.2834	328.4854	184.3523	76.1081	0.0000	0.0000	0.0000	0.0000	188.9073	356.2899	510.9230	(98)
Space heating												2536.5549	(98)
Space heating per m2											(98) / (4) =	42.3819	(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 %) 93.4000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 2715.7976 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	499.2056	392.2834	328.4854	184.3523	76.1081	0.0000	0.0000	0.0000	0.0000	188.9073	356.2899	510.9230	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	534.4813	420.0036	351.6974	197.3793	81.4862	0.0000	0.0000	0.0000	0.0000	202.2562	381.4667	547.0268	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating

Water heating requirement												
	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168 (64)
Efficiency of water heater												80.3000 (216)
(217)m	87.5082	87.2850	86.7989	85.6847	83.6075	80.3000	80.3000	80.3000	80.3000	85.6269	87.0014	87.6042 (217)
Fuel for water heating, kWh/month												
	203.2888	178.0321	186.2682	167.3590	166.0586	152.2793	145.8951	162.6389	164.4351	175.5936	184.4813	198.2974 (219)
Water heating fuel used												2084.6273 (219)
Annual totals kWh/year												
Space heating fuel - main system												2715.7976 (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)												272.9997 (232)
Total delivered energy for all uses												5148.4245 (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	2715.7976	0.2160	586.6123 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2084.6273	0.2160	450.2795 (264)
Space and water heating			1036.8918 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	272.9997	0.5190	141.6868 (268)
Total CO2, kg/m2/year			1217.5036 (272)
Emissions per m2 for space and water heating			17.3248 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.3674 (272b)
Emissions per m2 for pumps and fans			0.6504 (272c)
Target Carbon Dioxide Emission Rate (TER) = (17.3248 * 1.00) + 2.3674 + 0.6504, rounded to 2 d.p.			20.3400 (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	59.8500 (1b)	x	2.6000 (2b)	=	155.6100 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	155.6100	(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) =	0.1285	(8)
Pressure test		Yes	
Measured/design q50		4.0000	
Infiltration rate		0.3285	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2792	(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	0.3560	0.3491	0.3421	0.3072	0.3002	0.2653	0.2653	0.2583	0.2792	0.3002	0.3142	0.3281	(22b)
Effective ac	0.5634	0.5609	0.5585	0.5472	0.5451	0.5352	0.5352	0.5334	0.5390	0.5451	0.5493	0.5538	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.10)			12.2500	1.0536	12.9071			(27)
Door			1.8900	1.4000	2.6460			(26)
Heat Loss Floor 1			59.8500	0.2060	12.3263			(28b)
External Wall 1	20.5000	12.2500	8.2500	0.1400	1.1550			(29a)
Corridor wall	33.5100	1.8900	31.6200	0.2320	7.3364			(29a)
External Roof 1	41.5200		41.5200	0.1100	4.5672			(30)
Total net area of external elements Aum(A, m2)			155.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.9381			(33)
Party Wall 1			53.0200	0.0000	0.0000			(32)
Party Ceilings 1			18.3300					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.6490	(36)
Total fabric heat loss (33) + (36) =	49.5871	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	28.9304	28.8040	28.6801	28.0983	27.9894	27.4826	27.4826	27.3888	27.6778	27.9894	28.2096	28.4399	(38)
Heat transfer coeff	78.5175	78.3911	78.2672	77.6853	77.5765	77.0697	77.0697	76.9758	77.2649	77.5765	77.7967	78.0269	(39)
Average = Sum(39)m / 12 =												77.6848	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3119	1.3098	1.3077	1.2980	1.2962	1.2877	1.2877	1.2861	1.2910	1.2962	1.2999	1.3037	(40)
HLP (average)												1.2980	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.9774 (42)
Average daily hot water use (litres/day)	81.1630 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	89.2793	86.0328	82.7863	79.5398	76.2932	73.0467	73.0467	76.2932	79.5398	82.7863	86.0328	89.2793	(44)
Energy conte	132.3986	115.7967	119.4918	104.1759	99.9592	86.2572	79.9300	91.7208	92.8163	108.1684	118.0743	128.2210	(45)
Energy content (annual)										Total = Sum(45)m =		1277.0102	(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	28.1347	24.6068	25.3920	22.1374	21.2413	18.3297	16.9851	19.4907	19.7235	22.9858	25.0908	27.2470	(65)

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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	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.3846	13.6645	11.1127	8.4130	6.2888	5.3093	5.7369	7.4570	10.0088	12.7085	14.8327	15.8122	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	172.5685	174.3592	169.8466	160.2399	148.1132	136.7158	129.1016	127.3109	131.8234	141.4301	153.5569	164.9543	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	(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)													
	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	(71)
Water heating gains (Table 5)													
	37.8155	36.6173	34.1290	30.7463	28.5502	25.4579	22.8295	26.1971	27.3937	30.8949	34.8483	36.6223	(72)
Total internal gains													
	278.4294	277.3018	267.7492	252.0602	235.6131	220.1438	210.3288	213.6259	221.8868	237.6943	255.8987	270.0496	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	7.3200	10.6334	0.7000	0.8000	0.7700	30.2068 (74)
Southwest	4.9300	36.7938	0.7000	0.8000	0.7700	70.3952 (79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	100.6020	177.6358	262.1566	360.8448	439.9438	453.2670	430.0724	368.0272	295.5856	201.2412	121.5812	85.4255	(83)
Total gains	379.0314	454.9376	529.9058	612.9049	675.5568	673.4108	640.4012	581.6531	517.4724	438.9355	377.4799	355.4751	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.9341	53.0194	53.1033	53.5011	53.5762	53.9285	53.9285	53.9942	53.7922	53.5762	53.4245	53.2669	
alpha	4.5289	4.5346	4.5402	4.5667	4.5717	4.5952	4.5952	4.5996	4.5861	4.5717	4.5616	4.5511	
util living area													
	0.9974	0.9937	0.9830	0.9456	0.8464	0.6756	0.5157	0.5829	0.8330	0.9708	0.9946	0.9981	(86)
MIT	19.5776	19.7649	20.0634	20.4493	20.7712	20.9414	20.9865	20.9769	20.8438	20.4181	19.9217	19.5406	(87)
Th 2	19.8315	19.8332	19.8348	19.8424	19.8438	19.8505	19.8505	19.8517	19.8479	19.8438	19.8409	19.8379	(88)
util rest of house													
	0.9965	0.9915	0.9768	0.9253	0.7920	0.5764	0.3880	0.4500	0.7531	0.9560	0.9924	0.9974	(89)
MIT 2	18.5484	18.7360	19.0323	19.4100	19.6960	19.8252	19.8473	19.8456	19.7647	19.3891	18.8991	18.5166	(90)
Living area fraction										fLA = Living area / (4) =		0.4871	(91)
MIT	19.0497	19.2371	19.5345	19.9162	20.2197	20.3689	20.4021	20.3966	20.2903	19.8903	19.3972	19.0153	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0497	19.2371	19.5345	19.9162	20.2197	20.3689	20.4021	20.3966	20.2903	19.8903	19.3972	19.0153	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9957	0.9901	0.9748	0.9268	0.8114	0.6233	0.4507	0.5152	0.7872	0.9568	0.9912	0.9968	(94)
Useful gains	377.4076	450.4247	516.5381	568.0319	548.1635	419.7505	288.5990	299.6768	407.3692	419.9562	374.1753	354.3243	(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													
	1158.1088	1123.9027	1020.1756	855.7967	660.9259	444.6045	293.0300	307.6433	478.2929	720.7101	956.6785	1155.9961	(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													
	580.8417	452.5772	374.7063	207.1907	83.8952	0.0000	0.0000	0.0000	0.0000	223.7609	419.4023	596.4438	(98)
Space heating												2938.8182	(98)
Space heating per m2											(98) / (4) =	49.1031	(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	724.4548	570.3155	585.0162	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8842	0.9342	0.9078	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	640.5641	532.7742	531.0918	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	860.9666	820.9321	753.4072	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	158.6898	214.3895	165.4026	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												538.4820	(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	39.6725	53.5974	41.3507	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												134.6205	(107)
Space cooling per m2												2.2493	(108)
Energy for space heating												49.1031	(99)
Energy for space cooling												2.2493	(108)
Total												51.3524	(109)
Dwelling Fabric Energy Efficiency (DFEE)												51.4	(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	59.8500 (1b)	x	2.6000 (2b)	=	155.6100 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	155.6100	(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) =	0.1285	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3785	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3217	(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	0.4102	0.4022	0.3941	0.3539	0.3459	0.3057	0.3057	0.2976	0.3217	0.3459	0.3620	0.3781	(22b)
Effective ac	0.5841	0.5809	0.5777	0.5626	0.5598	0.5467	0.5467	0.5443	0.5518	0.5598	0.5655	0.5715	(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			1.8900	1.0000	1.8900			(26)
TER Opening Type (Uw = 1.40)			12.2500	1.3258	16.2405			(27)
Heat Loss Floor 1			59.8500	0.1300	7.7805			(28b)
External Wall 1	20.5000	12.2500	8.2500	0.1800	1.4850			(29a)
Corridor wall	33.5100	1.8900	31.6200	0.1800	5.6916			(29a)
External Roof 1	41.5200		41.5200	0.1300	5.3976			(30)
Total net area of external elements Aum(A, m2)			155.3800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		38.4852			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.2440	(36)
Total fabric heat loss					(33) + (36) =		42.7292	(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	29.9965	29.8287	29.6643	28.8918	28.7473	28.0745	28.0745	27.9499	28.3336	28.7473	29.0397	29.3453	(38)
Heat transfer coeff	72.7258	72.5580	72.3935	71.6210	71.4765	70.8037	70.8037	70.6791	71.0629	71.4765	71.7689	72.0746	(39)
Average = Sum(39)m / 12 =												71.6203	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2151	1.2123	1.2096	1.1967	1.1943	1.1830	1.1830	1.1809	1.1873	1.1943	1.1991	1.2043	(40)
HLP (average)												1.1967	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.9774 (42)
Average daily hot water use (litres/day)		81.1630 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	89.2793	86.0328	82.7863	79.5398	76.2932	73.0467	73.0467	76.2932	79.5398	82.7863	86.0328	89.2793	(44)
Energy conte	132.3986	115.7967	119.4918	104.1759	99.9592	86.2572	79.9300	91.7208	92.8163	108.1684	118.0743	128.2210	(45)
Energy content (annual)										Total = Sum(45)m =		1277.0102	(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	28.1347	24.6068	25.3920	22.1374	21.2413	18.3297	16.9851	19.4907	19.7235	22.9858	25.0908	27.2470	(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	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	98.8695	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.4584	13.7300	11.1660	8.4534	6.3190	5.3348	5.7644	7.4928	10.0568	12.7694	14.9038	15.8880	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	172.5685	174.3592	169.8466	160.2399	148.1132	136.7158	129.1016	127.3109	131.8234	141.4301	153.5569	164.9543	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	32.8870	(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)													
	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	(71)
Water heating gains (Table 5)													
	37.8155	36.6173	34.1290	30.7463	28.5502	25.4579	22.8295	26.1971	27.3937	30.8949	34.8483	36.6223	(72)
Total internal gains													
	278.5032	277.3673	267.8025	252.1005	235.6432	220.1692	210.3563	213.6616	221.9348	237.7553	255.9698	270.1254	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.3200	10.6334	0.6300	0.7000	0.7700	23.7878	(74)
Southwest	4.9300	36.7938	0.6300	0.7000	0.7700	55.4362	(79)

Solar gains	79.2241	139.8882	206.4483	284.1653	346.4557	356.9478	338.6820	289.8214	232.7737	158.4774	95.7452	67.2726	(83)
Total gains	357.7272	417.2555	474.2508	536.2658	582.0989	577.1170	549.0383	503.4831	454.7084	396.2327	351.7150	337.3980	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.1496	57.2818	57.4119	58.0311	58.1485	58.7010	58.7010	58.8045	58.4870	58.1485	57.9116	57.6660	
alpha	4.8100	4.8188	4.8275	4.8687	4.8766	4.9134	4.9134	4.9203	4.8991	4.8766	4.8608	4.8444	
util living area													
	0.9980	0.9955	0.9880	0.9608	0.8799	0.7176	0.5517	0.6170	0.8602	0.9777	0.9959	0.9985	(86)
MIT	19.6702	19.8320	20.0979	20.4533	20.7625	20.9392	20.9865	20.9774	20.8454	20.4459	19.9933	19.6420	(87)
Th 2	19.9079	19.9101	19.9123	19.9227	19.9246	19.9336	19.9336	19.9353	19.9301	19.9246	19.9207	19.9166	(88)
util rest of house													
	0.9973	0.9939	0.9837	0.9456	0.8339	0.6237	0.4260	0.4882	0.7897	0.9663	0.9942	0.9980	(89)
MIT 2	18.7009	18.8638	19.1292	19.4833	19.7651	19.9060	19.9303	19.9289	19.8440	19.4831	19.0335	18.6797	(90)
Living area fraction										fLA = Living area / (4) =		0.4871	(91)
MIT	19.1730	19.3353	19.6010	19.9557	20.2509	20.4092	20.4447	20.4396	20.3318	19.9521	19.5009	19.1484	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1730	19.3353	19.6010	19.9557	20.2509	20.4092	20.4447	20.4396	20.3318	19.9521	19.5009	19.1484	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9967	0.9928	0.9821	0.9461	0.8494	0.6679	0.4877	0.5515	0.8193	0.9667	0.9933	0.9975	(94)
Useful gains	356.5564	414.2655	465.7470	507.3772	494.4406	385.4469	267.7808	277.6575	372.5525	383.0255	349.3716	336.5609	(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													
	1081.6500	1047.3986	948.4291	791.8233	611.1881	411.3142	272.2210	285.5147	442.8461	668.4520	890.0020	1077.3986	(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													
	539.4697	425.4654	359.1155	204.8012	86.8602	0.0000	0.0000	0.0000	0.0000	212.3573	389.2539	551.1833	(98)
Space heating												2768.5063	(98)
Space heating per m2											(98) / (4) =	46.2574	(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	665.5549	523.9474	537.1613	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8757	0.9308	0.9050	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	582.8230	487.6721	486.1391	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	748.4493	714.1810	662.0872	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	119.2510	168.5226	130.9054	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												418.6790	(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	29.8127	42.1306	32.7264	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												104.6697	(107)
Space cooling per m2												1.7489	(108)
Energy for space heating												46.2574	(99)
Energy for space cooling												1.7489	(108)
Total												48.0063	(109)
Target Fabric Energy Efficiency (TFEE)												55.2	(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	59.8500 (1b)	x	2.6000 (2b)	=	155.6100 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	155.6100	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.5000	3.4000	3.4000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8750	0.8500	0.8500	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.1828	0.1743	0.1743	0.1615	0.1658	0.1445	0.1488	0.1445	0.1445	0.1573	0.1530	0.1700	(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) = 76.5000 (23c)

Effective ac	0.3003	0.2918	0.2918	0.2790	0.2833	0.2620	0.2663	0.2620	0.2620	0.2748	0.2705	0.2875	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.10)			12.2500	1.0536	12.9071			(27)
Door			1.8900	1.4000	2.6460			(26)
Heat Loss Floor 1			59.8500	0.2060	12.3263			(28b)
External Wall 1	20.5000	12.2500	8.2500	0.1400	1.1550			(29a)
Corridor wall	33.5100	1.8900	31.6200	0.2320	7.3364			(29a)
External Roof 1	41.5200		41.5200	0.1100	4.5672			(30)
Total net area of external elements Aum(A, m2)			155.3800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.9381			(33)
Party Wall 1			53.0200	0.0000	0.0000			(32)
Party Ceilings 1			18.3300					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.6490 (36)
Total fabric heat loss	(33) + (36) =	49.5871 (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	15.4182	14.9817	14.9817	14.3270	14.5453	13.4540	13.6723	13.4540	13.4540	14.1088	13.8905	14.7635	(38)
Heat transfer coeff	65.0053	64.5688	64.5688	63.9141	64.1323	63.0411	63.2593	63.0411	63.0411	63.6958	63.4776	64.3506	(39)

Average = Sum(39)m / 12 = 63.8413 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0861	1.0788	1.0788	1.0679	1.0716	1.0533	1.0570	1.0533	1.0533	1.0643	1.0606	1.0752	(40)
HLP (average)												1.0667	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.9774 (42)
Average daily hot water use (litres/day)	81.1630 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	89.2793	86.0328	82.7863	79.5398	76.2932	73.0467	73.0467	76.2932	79.5398	82.7863	86.0328	89.2793	(44)
Energy conte	132.3986	115.7967	119.4918	104.1759	99.9592	86.2572	79.9300	91.7208	92.8163	108.1684	118.0743	128.2210	(45)
Energy content (annual)										Total = Sum(45)m =		1277.0102	(45)
Distribution loss (46)m = 0.15 x (45)m	19.8598	17.3695	17.9238	15.6264	14.9939	12.9386	11.9895	13.7581	13.9224	16.2253	17.7111	19.2332	(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)
Combi loss	45.4958	39.5987	42.1870	39.2251	38.8782	36.0230	37.2238	38.8782	39.2251	42.1870	42.4271	45.4958	(61)
Total heat required for water heating calculated for each month													

	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168 (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												
	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168 (64)
									Total per year (kWh/year) = Sum(64)m =			1763.8549 (64)
RHI water heating demand												1764 (64)
Heat gains from water heating, kWh/month												
	55.3965	48.4021	50.2778	44.4447	42.9560	37.6863	35.8827	40.2167	40.6677	46.5127	49.8665	54.0074 (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	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	38.4615	34.1612	27.7817	21.0326	15.7221	13.2732	14.3422	18.6425	25.0220	31.7712	37.0816	39.5305	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5649	260.2376	253.5024	239.1641	221.0645	204.0534	192.6889	190.0162	196.7514	211.0897	229.1894	246.2004	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	(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)													
	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	(71)
Water heating gains (Table 5)													
	74.4576	72.0269	67.5777	61.7288	57.7365	52.3421	48.2294	54.0547	56.4829	62.5171	69.2590	72.5906	(72)
Total internal gains													
	461.8736	457.8152	440.2514	413.3150	385.9126	361.0582	346.6501	354.1030	369.6458	396.7676	426.9195	449.7111	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.3200	11.5683	0.7000	0.8000	0.7700	32.8626	(74)
Southwest	4.9300	39.0225	0.7000	0.8000	0.7700	74.6591	(79)

Solar gains	107.5218	171.0326	255.0993	365.2187	435.0620	479.0060	453.1853	399.0462	316.8212	212.1159	134.3037	89.5721 (83)
Total gains	569.3954	628.8478	695.3507	778.5336	820.9746	840.0643	799.8354	753.1492	686.4670	608.8835	561.2232	539.2832 (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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	63.9371	64.3693	64.3693	65.0287	64.8074	65.9292	65.7018	65.9292	65.9292	65.2515	65.4759	64.5876	
alpha	5.2625	5.2913	5.2913	5.3352	5.3205	5.3953	5.3801	5.3953	5.3953	5.3501	5.3651	5.3058	
util living area													
	0.9772	0.9608	0.9064	0.7689	0.5644	0.3296	0.1898	0.2176	0.4729	0.8003	0.9487	0.9815	(86)
MIT	20.4189	20.5220	20.7070	20.8701	20.9356	20.9491	20.9495	20.9496	20.9458	20.8693	20.6371	20.3980	(87)
Th 2	20.0122	20.0181	20.0181	20.0271	20.0241	20.0391	20.0361	20.0391	20.0391	20.0301	20.0331	20.0211	(88)
util rest of house													
	0.9701	0.9492	0.8804	0.7184	0.4954	0.2580	0.1136	0.1372	0.3878	0.7416	0.9313	0.9757	(89)
MIT 2	19.2661	19.4160	19.6682	19.8769	19.9401	19.9652	19.9622	19.9654	19.9636	19.8842	19.5920	19.2439	(90)
Living area fraction										fLA = Living area / (4) =		0.4871	(91)
MIT	19.8276	19.9547	20.1742	20.3607	20.4249	20.4444	20.4431	20.4448	20.4420	20.3640	20.1010	19.8060	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.6776	19.8047	20.0242	20.2107	20.2749	20.2944	20.2931	20.2948	20.2920	20.2140	19.9510	19.6560	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9672	0.9463	0.8806	0.7285	0.5135	0.2770	0.1339	0.1586	0.4105	0.7536	0.9295	0.9730	(94)
Useful gains	550.7270	595.0507	612.3308	567.1612	421.5643	232.7334	107.0996	119.4427	281.7754	458.8810	521.6646	524.7195	(95)
Ext temp.	5.6000	6.1000	8.1000	10.6000	13.6000	16.6000	18.6000	18.4000	15.8000	12.3000	8.5000	5.6000	(96)
Heat loss rate W													
	915.1156	884.8930	769.9288	614.2563	428.0799	232.8995	107.1014	119.4476	283.1808	504.0899	726.8804	904.5126	(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													
	271.1051	194.7740	117.2529	33.9084	4.8476	0.0000	0.0000	0.0000	0.0000	33.6354	147.7554	282.5660	(98)
Space heating												1085.8449	(98)
RHI space heating demand												1086	(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	59.8500 (1b)	x	2.6000 (2b)	=	155.6100 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	155.6100	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(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	0.2168	0.2125	0.2083	0.1870	0.1828	0.1615	0.1615	0.1573	0.1700	0.1828	0.1913	0.1998	(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) = 76.5000 (23c)

Effective ac	0.3343	0.3300	0.3258	0.3045	0.3003	0.2790	0.2790	0.2748	0.2875	0.3003	0.3088	0.3173	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.10)			12.2500	1.0536	12.9071			(27)
Door			1.8900	1.4000	2.6460			(26)
Heat Loss Floor 1			59.8500	0.2060	12.3263			(28b)
External Wall 1	20.5000	12.2500	8.2500	0.1400	1.1550			(29a)
Corridor wall	33.5100	1.8900	31.6200	0.2320	7.3364			(29a)
External Roof 1	41.5200		41.5200	0.1100	4.5672			(30)
Total net area of external elements Aum(A, m2)			155.3800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.9381			(33)
Party Wall 1			53.0200	0.0000	0.0000			(32)
Party Ceilings 1			18.3300					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.6490 (36)
Total fabric heat loss	(33) + (36) =	49.5871 (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	17.1642	16.9459	16.7277	15.6365	15.4182	14.3270	14.3270	14.1088	14.7635	15.4182	15.8547	16.2912	(38)
Heat transfer coeff	66.7512	66.5330	66.3147	65.2235	65.0053	63.9141	63.9141	63.6958	64.3506	65.0053	65.4418	65.8783	(39)

Average = Sum(39)m / 12 = 65.1690 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1153	1.1117	1.1080	1.0898	1.0861	1.0679	1.0679	1.0643	1.0752	1.0861	1.0934	1.1007	(40)
HLP (average)												1.0889	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.9774 (42)
Average daily hot water use (litres/day)	81.1630 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	89.2793	86.0328	82.7863	79.5398	76.2932	73.0467	73.0467	76.2932	79.5398	82.7863	86.0328	89.2793	(44)
Energy conte	132.3986	115.7967	119.4918	104.1759	99.9592	86.2572	79.9300	91.7208	92.8163	108.1684	118.0743	128.2210	(45)
Energy content (annual)										Total = Sum(45)m =		1277.0102	(45)
Distribution loss (46)m = 0.15 x (45)m	19.8598	17.3695	17.9238	15.6264	14.9939	12.9386	11.9895	13.7581	13.9224	16.2253	17.7111	19.2332	(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)
Combi loss	45.4958	39.5987	42.1870	39.2251	38.8782	36.0230	37.2238	38.8782	39.2251	42.1870	42.4271	45.4958	(61)

Total heat required for water heating calculated for each month

	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168	(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													
	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168	(64)
								Total per year (kWh/year) = Sum(64)m =				1763.8549	(64)
Heat gains from water heating, kWh/month													
	55.3965	48.4021	50.2778	44.4447	42.9560	37.6863	35.8827	40.2167	40.6677	46.5127	49.8665	54.0074	(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	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	38.4615	34.1612	27.7817	21.0326	15.7221	13.2732	14.3422	18.6425	25.0220	31.7712	37.0816	39.5305	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5649	260.2376	253.5024	239.1641	221.0645	204.0534	192.6889	190.0162	196.7514	211.0897	229.1894	246.2004	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	(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)													
	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	(71)
Water heating gains (Table 5)													
	74.4576	72.0269	67.5777	61.7288	57.7365	52.3421	48.2294	54.0547	56.4829	62.5171	69.2590	72.5906	(72)
Total internal gains													
	461.8736	457.8152	440.2514	413.3150	385.9126	361.0582	346.6501	354.1030	369.6458	396.7676	426.9195	449.7111	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.3200	10.6334	0.7000	0.8000	0.7700	30.2068	(74)
Southwest	4.9300	36.7938	0.7000	0.8000	0.7700	70.3952	(79)

Solar gains	100.6020	177.6358	262.1566	360.8448	439.9438	453.2670	430.0724	368.0272	295.5856	201.2412	121.5812	85.4255	(83)
Total gains	562.4756	635.4510	702.4079	774.1598	825.8564	814.3252	776.7225	722.1303	665.2314	598.0087	548.5007	535.1366	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	62.2648	62.4690	62.6746	63.7232	63.9371	65.0287	65.0287	65.2515	64.5876	63.9371	63.5107	63.0899	
alpha	5.1510	5.1646	5.1783	5.2482	5.2625	5.3352	5.3352	5.3501	5.3058	5.2625	5.2340	5.2060	
util living area													
	0.9852	0.9714	0.9381	0.8479	0.6878	0.4959	0.3610	0.4038	0.6393	0.8871	0.9706	0.9881	(86)
MIT	20.2833	20.4095	20.5887	20.7903	20.9049	20.9428	20.9481	20.9476	20.9264	20.7751	20.4995	20.2615	(87)
Th 2	19.9884	19.9913	19.9943	20.0092	20.0122	20.0271	20.0271	20.0301	20.0211	20.0122	20.0062	20.0002	(88)
util rest of house													
	0.9807	0.9632	0.9209	0.8109	0.6282	0.4234	0.2818	0.3197	0.5597	0.8498	0.9607	0.9845	(89)
MIT 2	19.0515	19.2339	19.4867	19.7647	19.8990	19.9489	19.9522	19.9551	19.9309	19.7558	19.3770	19.0298	(90)
Living area fraction									fLA = Living area / (4) =			0.4871	(91)
MIT	19.6515	19.8065	20.0234	20.2642	20.3889	20.4330	20.4373	20.4385	20.4158	20.2522	19.9237	19.6297	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.5015	19.6565	19.8734	20.1142	20.2389	20.2830	20.2873	20.2885	20.2658	20.1022	19.7737	19.4797	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9781	0.9600	0.9185	0.8152	0.6424	0.4427	0.3031	0.3423	0.5803	0.8536	0.9579	0.9822	(94)
Useful gains	550.1468	610.0082	645.1818	631.0847	530.5461	360.4965	235.3871	247.1497	386.0404	510.4652	525.4165	525.6027	(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													
	1014.7155	981.7929	886.8540	731.4295	555.0744	363.2229	235.6703	247.6814	396.7722	617.6950	829.3905	1006.5982	(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													
	345.6391	249.8394	179.8041	72.2482	18.2491	0.0000	0.0000	0.0000	0.0000	79.7789	218.8613	357.8607	(98)
Space heating												1522.2807	(98)
Space heating per m2											(98) / (4) =	25.4349	(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	600.7923	472.9641	484.0883	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9561	0.9797	0.9691	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	574.3910	463.3665	469.1502	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	887.8508	846.3321	781.2647	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	225.6910	284.9264	232.2132	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												742.8306	(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	56.4228	71.2316	58.0533	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												185.7077	(107)

Space cooling per m2 3.1029 (108)

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 %) 90.9000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 1674.6763 (211)
Cooling System Energy Efficiency Ratio (see Table 10c) 4.3200 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	345.6391	249.8394	179.8041	72.2482	18.2491	0.0000	0.0000	0.0000	0.0000	79.7789	218.8613	357.8607	(98)
Space heating efficiency (main heating system 1)													
	90.9000	90.9000	90.9000	90.9000	90.9000	0.0000	0.0000	0.0000	0.0000	90.9000	90.9000	90.9000	(210)
Space heating fuel (main heating system)													
	380.2410	274.8508	197.8043	79.4810	20.0760	0.0000	0.0000	0.0000	0.0000	87.7656	240.7715	393.6861	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement

	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168	(64)
Efficiency of water heater												80.8000	(216)
(217)m	87.1964	86.7421	85.8209	83.9241	81.8566	80.8000	80.8000	80.8000	80.8000	84.0369	86.3342	87.3325	(217)
Fuel for water heating, kWh/month													
	204.0158	179.1464	188.3909	170.8698	169.6105	151.3369	144.9923	161.6325	163.4175	178.9158	185.9071	198.9142	(219)
Water heating fuel used												2097.1498	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	13.0608	16.4888	13.4383	0.0000	0.0000	0.0000	0.0000	(221)
Cooling												42.9879	(221)

Annual totals kWh/year
Space heating fuel - main system 1674.6763 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6250)
mechanical ventilation fans (SFP = 0.6250) 118.6526 (230a)
central heating pump 30.0000 (230c)
Total electricity for the above, kWh/year 148.6526 (231)
Electricity for lighting (calculated in Appendix L) 271.6969 (232)
Total delivered energy for all uses 4235.1635 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1674.6763	3.4800	58.2787	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2097.1498	3.4800	72.9808	(247)
Space cooling	42.9879	13.1900	5.6701	(248)
Mechanical ventilation fans	118.6526	13.1900	15.6503	(249)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	271.6969	13.1900	35.8368	(250)
Additional standing charges			120.0000	(251)
Total energy cost			312.3738	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 1.2513 (257)
SAP value 82.5446
SAP rating (Section 12) 83 (258)
SAP band B

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	1674.6763	0.2160	361.7301	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2097.1498	0.2160	452.9844	(264)
Space and water heating			814.7144	(265)
Space cooling	42.9879	0.5190	22.3107	(266)
Pumps and fans	148.6526	0.5190	77.1507	(267)
Energy for lighting	271.6969	0.5190	141.0107	(268)
Total kg/year			1055.1866	(272)
CO2 emissions per m2			17.6300	(273)
EI value			86.5145	
EI rating			87	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency 3.48 × (1 + 0.29 × 0.25) / 0.9090 = 4.106, stars = 4
Main heating environmental impact 0.216 × (1 + 0.29 × 0.25) / 0.9090 = 0.2549, stars = 4
Water heating energy efficiency 3.48 / 0.8387 = 4.149, stars = 4
Water heating environmental impact 0.216 / 0.8387 = 0.2575, stars = 4

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	59.8500 (1b)	x	2.6000 (2b)	=	155.6100 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.8500					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	155.6100	(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		4.0000	
Infiltration rate		0.2000	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1700	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.5000	3.4000	3.4000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8750	0.8500	0.8500	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.1828	0.1743	0.1743	0.1615	0.1658	0.1445	0.1488	0.1445	0.1445	0.1573	0.1530	0.1700	(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) = 76.5000 (23c)

Effective ac	0.3003	0.2918	0.2918	0.2790	0.2833	0.2620	0.2663	0.2620	0.2620	0.2748	0.2705	0.2875	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Window (Uw = 1.10)			12.2500	1.0536	12.9071			(27)
Door			1.8900	1.4000	2.6460			(26)
Heat Loss Floor 1			59.8500	0.2060	12.3263			(28b)
External Wall 1	20.5000	12.2500	8.2500	0.1400	1.1550			(29a)
Corridor wall	33.5100	1.8900	31.6200	0.2320	7.3364			(29a)
External Roof 1	41.5200		41.5200	0.1100	4.5672			(30)
Total net area of external elements Aum(A, m2)			155.3800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	40.9381			(33)
Party Wall 1			53.0200	0.0000	0.0000			(32)
Party Ceilings 1			18.3300					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.6490 (36)
Total fabric heat loss	(33) + (36) =	49.5871 (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	15.4182	14.9817	14.9817	14.3270	14.5453	13.4540	13.6723	13.4540	13.4540	14.1088	13.8905	14.7635	(38)
Heat transfer coeff	65.0053	64.5688	64.5688	63.9141	64.1323	63.0411	63.2593	63.0411	63.0411	63.6958	63.4776	64.3506	(39)

Average = Sum(39)m / 12 = 63.8413 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0861	1.0788	1.0788	1.0679	1.0716	1.0533	1.0570	1.0533	1.0533	1.0643	1.0606	1.0752	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

HLP (average) 1.0667 (40)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.9774 (42)
Average daily hot water use (litres/day)	81.1630 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	89.2793	86.0328	82.7863	79.5398	76.2932	73.0467	73.0467	76.2932	79.5398	82.7863	86.0328	89.2793	(44)
Energy conte	132.3986	115.7967	119.4918	104.1759	99.9592	86.2572	79.9300	91.7208	92.8163	108.1684	118.0743	128.2210	(45)
Energy content (annual)										Total = Sum(45)m =		1277.0102	(45)
Distribution loss (46)m = 0.15 x (45)m	19.8598	17.3695	17.9238	15.6264	14.9939	12.9386	11.9895	13.7581	13.9224	16.2253	17.7111	19.2332	(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)
Combi loss	45.4958	39.5987	42.1870	39.2251	38.8782	36.0230	37.2238	38.8782	39.2251	42.1870	42.4271	45.4958	(61)

Total heat required for water heating calculated for each month

	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168	(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													
	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168	(64)
								Total per year (kWh/year) = Sum(64)m =				1763.8549	(64)
Heat gains from water heating, kWh/month													
	55.3965	48.4021	50.2778	44.4447	42.9560	37.6863	35.8827	40.2167	40.6677	46.5127	49.8665	54.0074	(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	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	118.6434	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	38.4615	34.1612	27.7817	21.0326	15.7221	13.2732	14.3422	18.6425	25.0220	31.7712	37.0816	39.5305	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	257.5649	260.2376	253.5024	239.1641	221.0645	204.0534	192.6889	190.0162	196.7514	211.0897	229.1894	246.2004	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	48.8417	(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)													
	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	-79.0956	(71)
Water heating gains (Table 5)													
	74.4576	72.0269	67.5777	61.7288	57.7365	52.3421	48.2294	54.0547	56.4829	62.5171	69.2590	72.5906	(72)
Total internal gains													
	461.8736	457.8152	440.2514	413.3150	385.9126	361.0582	346.6501	354.1030	369.6458	396.7676	426.9195	449.7111	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.3200	11.5683	0.7000	0.8000	0.7700	32.8626	(74)
Southwest	4.9300	39.0225	0.7000	0.8000	0.7700	74.6591	(79)

Solar gains	107.5218	171.0326	255.0993	365.2187	435.0620	479.0060	453.1853	399.0462	316.8212	212.1159	134.3037	89.5721	(83)
Total gains	569.3954	628.8478	695.3507	778.5336	820.9746	840.0643	799.8354	753.1492	686.4670	608.8835	561.2232	539.2832	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	63.9371	64.3693	64.3693	65.0287	64.8074	65.9292	65.7018	65.9292	65.9292	65.2515	65.4759	64.5876	
alpha	5.2625	5.2913	5.2913	5.3352	5.3205	5.3953	5.3801	5.3953	5.3953	5.3501	5.3651	5.3058	
util living area													
	0.9772	0.9608	0.9064	0.7689	0.5644	0.3296	0.1898	0.2176	0.4729	0.8003	0.9487	0.9815	(86)
MIT	20.4189	20.5220	20.7070	20.8701	20.9356	20.9491	20.9495	20.9496	20.9458	20.8693	20.6371	20.3980	(87)
Th 2	20.0122	20.0181	20.0181	20.0271	20.0241	20.0391	20.0361	20.0391	20.0391	20.0301	20.0331	20.0211	(88)
util rest of house													
	0.9701	0.9492	0.8804	0.7184	0.4954	0.2580	0.1136	0.1372	0.3878	0.7416	0.9313	0.9757	(89)
MIT 2	19.2661	19.4160	19.6682	19.8769	19.9401	19.9652	19.9622	19.9654	19.9636	19.8842	19.5920	19.2439	(90)
Living area fraction									fLA = Living area / (4) =			0.4871	(91)
MIT	19.8276	19.9547	20.1742	20.3607	20.4249	20.4444	20.4431	20.4448	20.4420	20.3640	20.1010	19.8060	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.6776	19.8047	20.0242	20.2107	20.2749	20.2944	20.2931	20.2948	20.2920	20.2140	19.9510	19.6560	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9672	0.9463	0.8806	0.7285	0.5135	0.2770	0.1339	0.1586	0.4105	0.7536	0.9295	0.9730	(94)
Useful gains	550.7270	595.0507	612.3308	567.1612	421.5643	232.7334	107.0996	119.4427	281.7754	458.8810	521.6646	524.7195	(95)
Ext temp.	5.6000	6.1000	8.1000	10.6000	13.6000	16.6000	18.6000	18.4000	15.8000	12.3000	8.5000	5.6000	(96)
Heat loss rate W													
	915.1156	884.8930	769.9288	614.2563	428.0799	232.8995	107.1014	119.4476	283.1808	504.0899	726.8804	904.5126	(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													
	271.1051	194.7740	117.2529	33.9084	4.8476	0.0000	0.0000	0.0000	0.0000	33.6354	147.7554	282.5660	(98)
Space heating												1085.8449	(98)
Space heating per m2											(98) / (4) =	18.1428	(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.	5.6000	6.1000	8.1000	10.6000	13.6000	16.6000	18.6000	18.4000	15.8000	12.3000	8.5000	5.6000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	466.5041	341.6004	353.0302	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9871	0.9961	0.9938	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	460.4727	340.2644	350.8588	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	917.9354	873.3472	817.5207	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	329.3731	396.6136	347.1964	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1073.1832	(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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	82.3433	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												82.3433	(107)

Space cooling per m2 1.3758 (108)

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 %) 90.9000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 1194.5489 (211)
Cooling System Energy Efficiency Ratio (see Table 10c) 4.3200 (209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	271.1051	194.7740	117.2529	33.9084	4.8476	0.0000	0.0000	0.0000	0.0000	33.6354	147.7554	282.5660	(98)
Space heating efficiency (main heating system 1)													
	90.9000	90.9000	90.9000	90.9000	90.9000	0.0000	0.0000	0.0000	0.0000	90.9000	90.9000	90.9000	(210)
Space heating fuel (main heating system)													
	298.2455	214.2729	128.9911	37.3030	5.3329	0.0000	0.0000	0.0000	0.0000	37.0026	162.5472	310.8537	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement

	177.8944	155.3954	161.6788	143.4010	138.8374	122.2802	117.1538	130.5990	132.0413	150.3554	160.5014	173.7168	(64)
Efficiency of water heater												80.8000	(216)
(217)m	86.6106	86.1226	84.7588	82.5542	81.1040	80.8000	80.8000	80.8000	80.8000	82.4753	85.3454	86.7706	(217)
Fuel for water heating, kWh/month													
	205.3957	180.4349	190.7515	173.7053	171.1844	151.3369	144.9923	161.6325	163.4175	182.3036	188.0611	200.2024	(219)
Water heating fuel used												2113.4181	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	19.0609	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Cooling												19.0609	(221)
Annual totals kWh/year													
Space heating fuel - main system												1194.5489	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, DataSheet: in-use factor = 1.2500, SFP = 0.6250)
mechanical ventilation fans (SFP = 0.6250) 118.6526 (230a)
central heating pump 30.0000 (230c)
Total electricity for the above, kWh/year 148.6526 (231)
Electricity for lighting (calculated in Appendix L) 271.6969 (232)
Total delivered energy for all uses 3747.3775 (238)

10a. Fuel costs - using BEDF prices (395)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1194.5489	4.2800	51.1267	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2113.4181	4.2800	90.4543	(247)
Space cooling	19.0609	15.4400	2.9430	(248)
Mechanical ventilation fans	118.6526	15.4400	18.3200	(249)
Pumps and fans for heating	30.0000	15.4400	4.6320	(249)
Energy for lighting	271.6969	15.4400	41.9500	(250)
Additional standing charges			92.0000	(251)
Total energy cost			301.4260	(255)

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	1194.5489	0.2160	258.0226	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2113.4181	0.2160	456.4983	(264)
Space and water heating			714.5209	(265)
Space cooling	19.0609	0.5190	9.8926	(266)
Pumps and fans	148.6526	0.5190	77.1507	(267)
Energy for lighting	271.6969	0.5190	141.0107	(268)
Total kg/year			942.5749	(272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1194.5489	1.2200	1457.3496	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2113.4181	1.2200	2578.3701	(264)
Space and water heating			4035.7198	(265)
Space cooling	19.0609	3.0700	58.5171	(266)
Pumps and fans	148.6526	3.0700	456.3636	(267)
Energy for lighting	271.6969	3.0700	834.1096	(268)
Primary energy kWh/year			5384.7100	(272)
Primary energy kWh/m2/year			89.9701	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 83
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)			

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

Potential energy efficiency rating: B 83
Potential environmental impact rating: B 87

Fuel prices for cost data on this page from database revision number 395 TEST (24 Jun 2016)
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	£68	£68	£0
Mains gas	£234	£234	£0
Space heating	£166	£166	£0
Space cooling	£3	£3	£0
Water heating	£90	£90	£0
Lighting	£42	£42	£0
Total cost of fuels	£302	£302	£0
Total cost of uses	£301	£301	£0
Delivered energy	63 kWh/m²	63 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.9 tonnes	0.0 tonnes
CO2 emissions per m²	16 kg/m²	16 kg/m²	0 kg/m²
Primary energy	90 kWh/m²	90 kWh/m²	0 kWh/m²

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

No improvements selected / applicable

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	West
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	308.11 (P1)
Transmission heat loss coefficient	49.59 (37)
Summer heat loss coefficient	357.69 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	1.000	0.90	1.000	0.900 (P8)
South 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	7.3200	81.1852	0.7000	0.8000	0.9000	269.5634
South West	4.9300	119.9223	0.7000	0.8000	0.9000	268.1761
total:						537.7395

	Jun	Jul	Aug	
Solar gains	573	538	469	(P3)
Internal gains	358	344	351	
Total summer gains	931	881	820	(P5)
Summer gain/loss ratio	2.60	2.46	2.29	(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	18.85	20.61	20.34	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight