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149-151 Heath Road, Richmond

Energy Strategy Report

CIBSE LOW CARBON ENERGY ASSESSORS

Date: 24 August 2016

Project ref: 25498

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Executive Summary

This report details the proposed energy strategy for the 149-151 Heath Road scheme, which entails the demolition of an existing disused building. The new scheme comprises two ground floor commercial units totalling 110m^2. The first to third floors shall provide three 1-bed apartments and seven 2-bed apartments. The scheme is located within the London Borough of Richmond Upon Thames.

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)

An energy assessment has been carried out based on design information to identify the most appropriate renewable strategy. The building fabric performance, of the development, has been specified to exceed the Building Regulations Part L 2013 requirements. High efficiency gas combination boilers have been specified for the residential units with a high efficiency communal boiler being specified for the commercial units. MVHR units will also be incorporated in both the residential and commercial units. Improved thermal detailing for the thermal bridges will be considered in the design of the residential unit and shall be calculated at a later stage. The project is required to follow the London Plan through the Energy Hierarchy. It has the potential to provide a 35% improvement over the Building Regulations 2013 minimum target; through passive design measures, energy efficient equipment and renewable technologies.

The proposed PV system will serve the residential units and have been specified to achieve an overall 15.40% saving in carbon emissions. The reductions show an ambition towards meeting the targets set out in the London Plan and by the London Borough of Richmond Upon Thames.

1 Introduction

1.1 Site Analysis

The 149-151 Heath Road development is located within the London Borough of Richmond Upon Thames.

The proposal entails the demolition of an existing disused building. The new scheme comprises two ground floor commercial units totalling 110m^2. The first to third floors shall provide three 1-bed apartments and seven 2-bed apartments. The roof shall be used for the installation of PV panels as well as a green roof. The development occupies the whole site but outdoor space has been made available in the form of communal terrace space on the first and second floors with private terraces for the penthouse apartments. Private car and bike parking shall be made at the rear of the development along with designated space for the storage of waste and recycling bins.

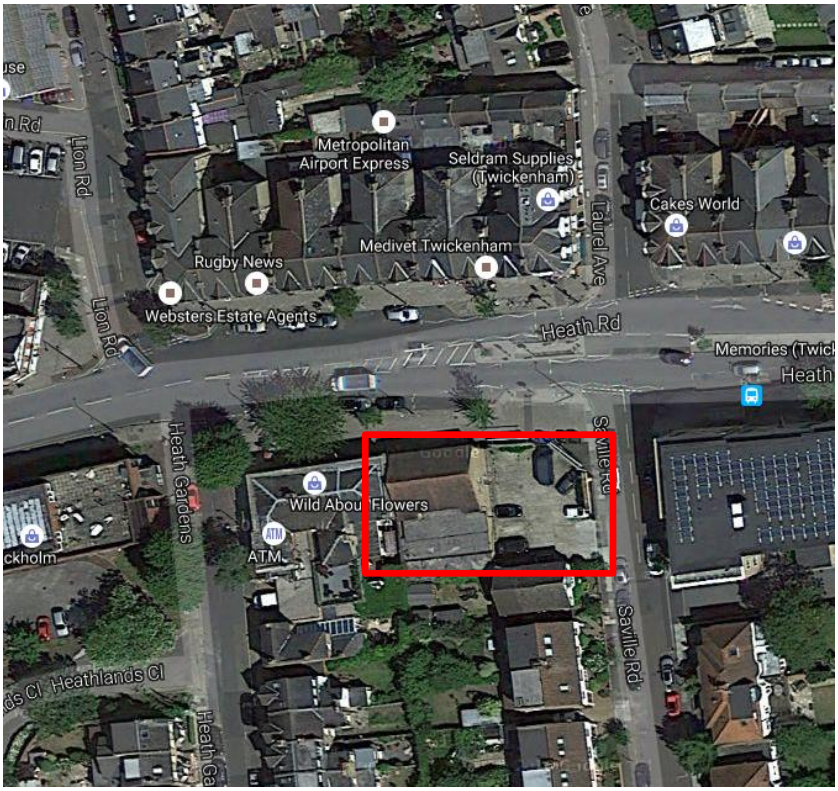


Figure 1-1 Site location © Google Maps

1.2 Objective

This report summarises the work undertaken to support the development of an energy strategy for the 149-151 Heath Road 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 final solution for ensuring a low carbon development.

This report outlines the energy strategy for the development, including passive design, energy and CO_2 footprint of the proposed scheme, and renewable energy options.

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

2 Policy

2.1 The London Plan Policies on Energy

The London Plan, March 2016, 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

The mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emission reductions in buildings:

2013 - 2016: 35% improvement over Part L 2013

Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy. This report contains a detailed energy assessment in line with the requirements of Policy 5.2.

Policy 5.6: Decentralised Energy in Development Proposals

Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

Major development proposals should select energy systems in accordance with the following hierarchy:

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

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

Policy 5.7: Renewable Energy

Within the framework of the energy hierarchy (see Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.

There is a presumption that all major development proposals will seek to reduce carbon dioxide emissions by at least 20% through the use of on-site renewable energy generation wherever feasible. Development proposals should seek to utilise renewable energy technologies such as: biomass heating; cooling and electricity; renewable energy from waste; photovoltaics; solar water heating; wind and heat pumps. The Mayor encourages the use of a full range of renewable energy technologies, which should be incorporated wherever site conditions make them feasible and

where they contribute to the highest overall and most cost effective carbon dioxide emissions savings for a development proposal.

2.2 London Borough of Richmond Upon Thames Policies on Energy

Policy DM SD 1: Sustainable Construction

New buildings should be flexible to respond to future social, technological and economic needs by conforming to the Borough's Sustainable Construction Checklist SPD.

New homes must achieve a minimum 40% reduction from 2013 to 2016.

Policy DM SD 2: Renewable Energy and Decentralised Energy Networks

Developments of one dwelling unit or more, or 100sqm of non-residential floor space or more will be required to reduce their total CO_2 emissions by following a hierarchy that first requires an efficient design to minimise the amount of energy used, secondly, by using low carbon technologies and finally, where feasible and viable, including a contribution from renewable sources.

The Council encourages developers to achieve a 20% reduction where feasible in total site CO_2 emissions from the use of on-site renewable energy, to improve savings beyond those generated by energy efficiency measures, as set out in Core Strategy Policy CP2.

2.3 Code for Sustainable Homes withdrawn

The Government have announced the official withdrawal of the Code for Sustainable Homes. The Deregulation Bill has been given Royal Assent. In the Ministerial Statement, the following was confirmed:

The government's policy is that planning permissions should not be granted requiring, or subject to conditions requiring, compliance with any technical housing standards other than for those areas where authorities have existing policies on access, internal space, or water efficiency.

This statement therefore addresses key sustainability criteria in relation to local and regional policy, in place of a Code for Sustainable Homes pre-assessment.

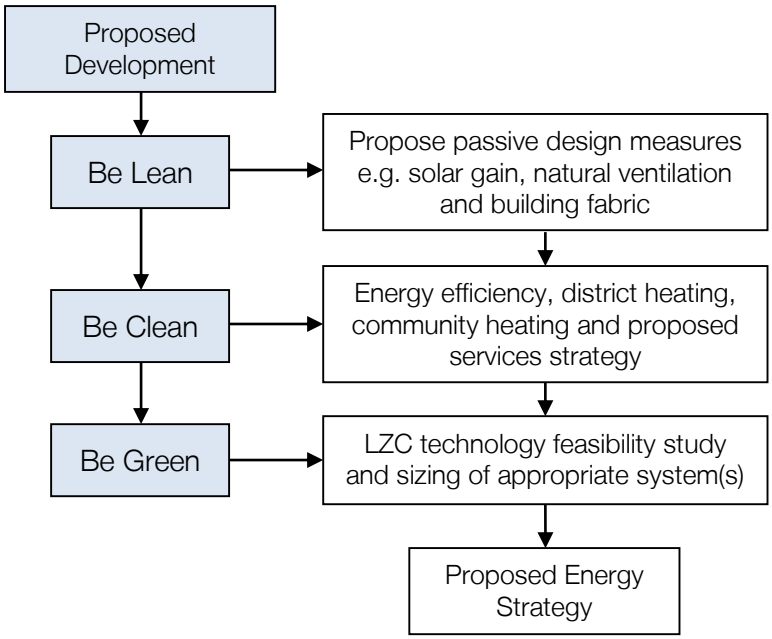
3 Approach

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 149-151 Heath Road 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 Jessica James who is an On Construction Domestic Energy Assessor (OCDEA). The energy consumption and carbon emissions 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 Richmond Upon Thames 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 & CO_2														Unregulated Energy & CO_2	
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 ($kgCO_2$/yr)			Energy (kWh/yr)	CO_2 (kg/yr)
Residential	34,330	21,317	55,647	12,020	0	0	0	750	2,871	3,621	1,879	59,267	13,899	18,608	9658
Commercial	3,866	0	3,866	835	0	197	1,158	0	5,494	6,849	3,554	10,517	4,389	2,148	1115
Total	38,195	21,317	59,512	12,855	0	197	1,158	750	8,365	10,469	5,434	69,785	18,288	20,756	10,772

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) and unregulated energy (appliances and equipment) derived from outputs of the Standard Assessment Procedure.

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 Solar Gain Control and Daylighting

Where possible, windows and natural daylight have been provided to ensure appropriate daylighting levels throughout the development and reduce the lighting demand. The size and orientation of external windows has been considered carefully to balance daylight with excessive solar gains. Windows are specified to incorporate low emissivity coatings to limit overheating while ensuring adequate daylight.

The impact of solar gains has been incorporated into the SAP and TAS analysis for compliance with Part L 2013 and using a mechanical ventilation strategy the risk of solar overheating has been concluded to be not significant for the development.

5.2 Building Fabric Efficiency

To further improve the passive design of the development, the thermal fabric has been specified to meet or exceed current Building Regulations targets. Table 5-1 shows the proposed U-values that will be considered for the development and have been assumed for the energy strategy analysis at this stage.

Element	Measure	
	Residential	Commercial
External Walls	0.15 W/m^{2}K	0.15 W/m^{2}K
Stairwell/Lift Shelter Wall	0.15 W/m^{2}K	N/A
Penthouse Upper Panel Wall	0.15 W/m^{2}K	N/A
Penthouse Lower Panel Wall (South Facing)	0.30 W/m^{2}K	N/A
Party Walls*	0.00 W/m^{2}K*	0.45 W/m^{2}K
Roof (Main roof and terraces)	0.13 W/m^{2}K	N/A
Exposed Ground Floor	0.11 W/m^{2}K	0.11 W/m^{2}K
Windows/ Rooflights	1.20 W/m^{2}K	1.20 W/m^{2}K
External Doors	1.20 W/m^{2}K	1.20 W/m^{2}K
Air Tightness	Pressure test will be carried out to determine air tightness. This will be an assumed: 3 m^3/m^2/h	Pressure test will be carried out to determine air tightness. This will be an assumed: 5 m^3/m^2/h
Thermal Bridging	Independently assessed, designed to be equivalent to accredited details figures	Default value

	Details to be calculated at the detailed design stage	

Table 5-1 Proposed Be Lean passive design measures

*Where party walls have a cavity these are to meet the following requirements:
- Sealed to prevent air going in and out of any cavity
- Sealed at the top, bottom and vertically
- All cavities are to be fully filled

5.1 Improvement Over Part L

Based on the performance of the passive design measures proposed above, as calculated using SAP 2012, Table 5-2 and Figure 5-1 demonstrate the percentage improvement these have over Building Regulations 2013 baseline levels for the development before the inclusion of any energy efficient measures or low or zero carbon technologies have been considered. Table 5-2 confirms that the development achieves a 0.1% improvement over Building Regulations Part L 2013.

Site Wide	CO_2 Emissions (tonnes /annum)	CO_2 Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	18.29		
Be Lean (after demand reduction)	18.28	0.01	0.1%

Table 5-2 % improvement over Building Regulations Part L 2013 at the Be Lean Stage

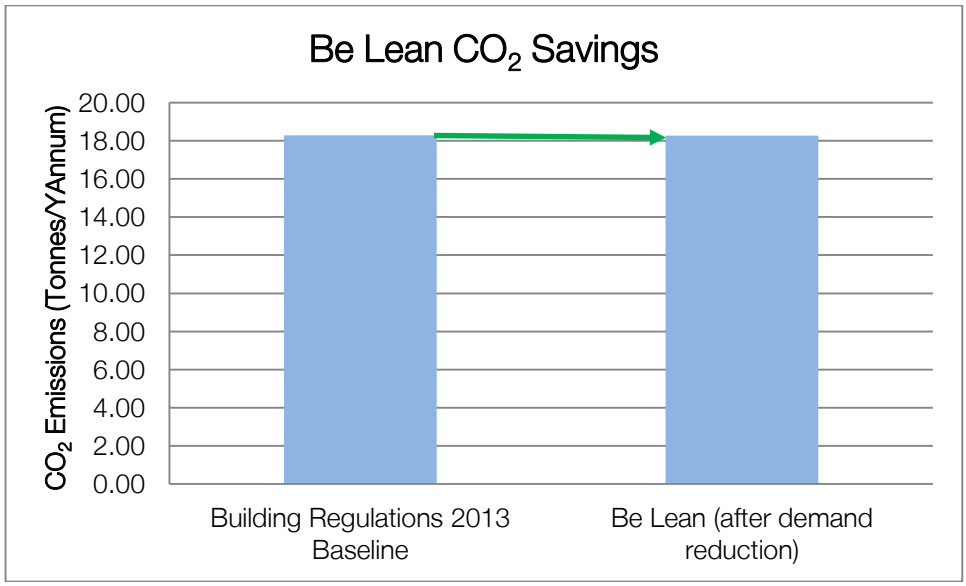


Figure 5-1 Improvement over Building Regulations Part L 2013 through the Energy Hierarchy at the Be Lean Stage

The Be Lean stage has the potential to provide 0.1% improvement over Building Regulations Part L 2013 baseline; through passive design measures. Table 5-3 breaks down the energy use for the Be Lean case.

Be Lean															
Regulated Energy & CO_2														Unregulated Energy & CO_2	
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 ($kgCO_2$/yr)			Energy (kWh/yr)	CO_2 (kg/yr)
Residential	34,627	20,563	55,191	11,921	0	0	0	300	3,583	3,883	2,015	59,074	13,936	18,608	9658
Commercial	5,428	0	5,428	1,173	0	171	630	0	5,471	6,100	3,166	11,529	4,339	2,148	1115
Total	**40,056**	**20,563**	**60,619**	**13,094**	**0**	**171**	**630**	**300**	**9,054**	**9,983**	**5,181**	**70,602**	**18,275**	**20,756**	**10,772**

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

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, the potential Camden heat network has been identified in the purple shading in Figure 6-1 below.

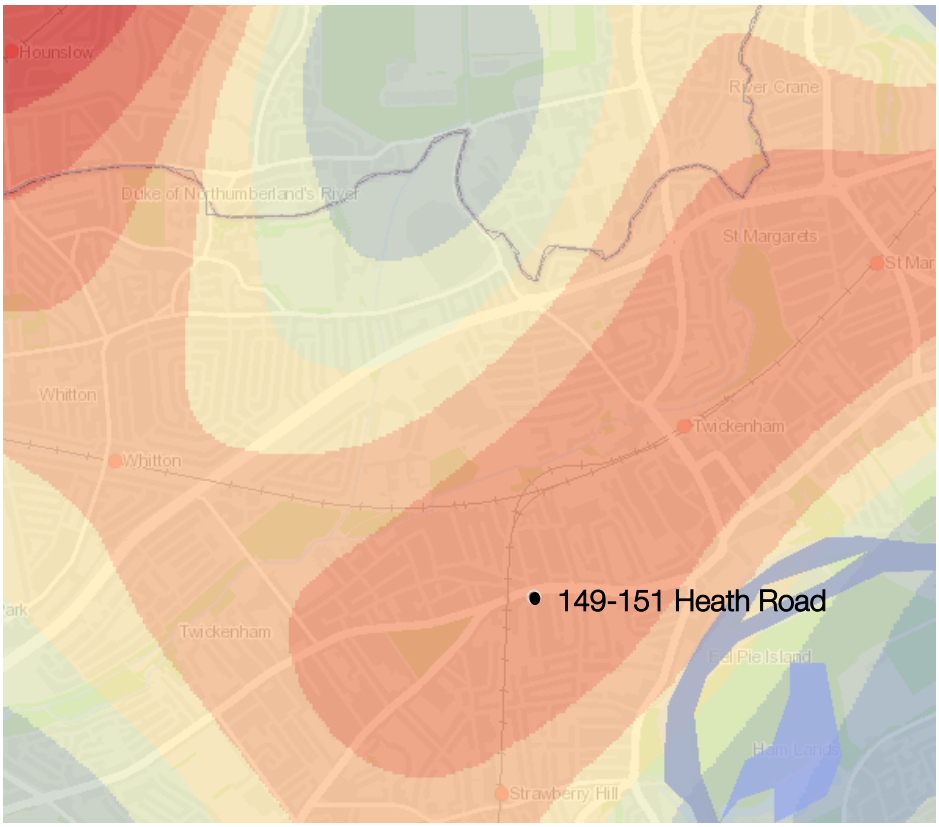


Figure 6-1 London Heat Map ©

Due to the size and location of the development it would not be viable to connect to a district heating system.

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 5, energy efficient equipment has been proposed where possible to support the services strategy. Table 6-1 shows the proposed services strategy and energy efficiency measures for the development.

Services	Measure	
	Residential	Commercial
Space Heating	Combi Gas Condensing Boiler 90% efficient Space heating from underfloor heating	Communal Gas Boiler 95% efficient (5% distribution losses)
Heating Controls	Time and temperature zone controls	-
Hot Water Heating	Combi Gas Condensing Boiler 90% efficient	Instantaneous Electric water heaters Grid Supplied Electricity 100% efficient
Ventilation	MVHR 90% efficient SFP 0.5 w/l/s Rigid Duct/ Insulated Approved Installation	MVHR SFP 1.1W/l/s seasonal efficiency 85%
Comfort Cooling	N/A	VRF (COP 3.8)
Lighting	100% low energy lighting	95 lumens/circuit-watts
Lighting Control	PIR/Daylight/Timer controls fitted to lighting in external areas	Manual on/Auto off Manual daylight control

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 and Table 6-2 demonstrate the percentage improvement these have over Building Regulations 2013 baseline levels for the development before any low or zero carbon technologies have been considered.

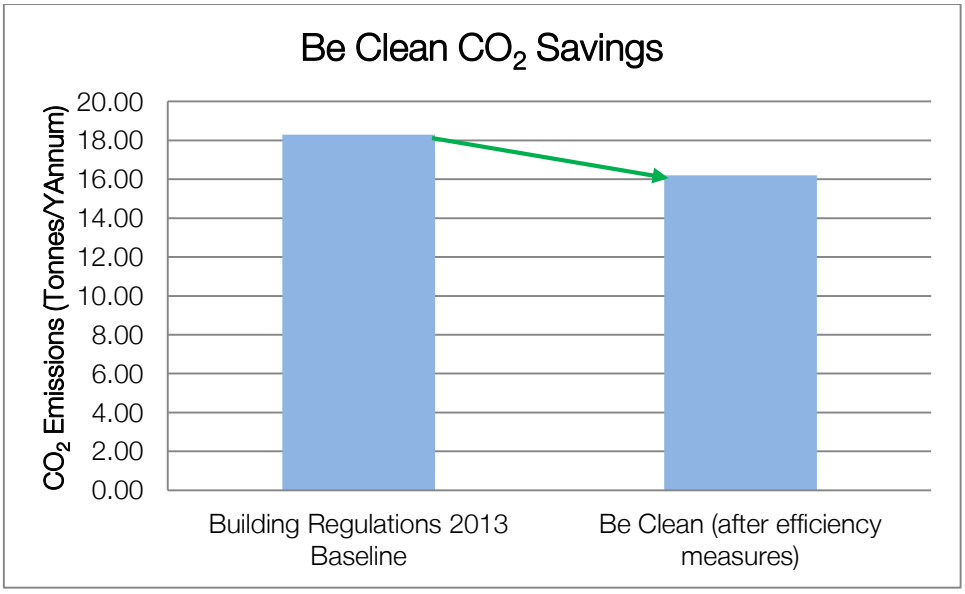


Figure 6-2 Improvement over Building Regulations Part L 2013 with a Communal Gas Boiler

Site Wide	CO_2 Emissions (tonnes /annum)	CO_2 Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	18.29		
Be Lean (after demand reduction)	18.28	0.01	0.1%
Be Clean (after efficiency measures)	16.19	2.08	11%
Total Cumulative Savings		2.09	11%

Table 6-2 % improvement over Building Regulations Part L 2013 through the Energy Hierarchy at the Be Clean Stage

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

Be Clean															
Regulated Energy & CO_2														Unregulated Energy & CO_2	
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 ($kgCO_2$/yr)			Energy (kWh/yr)	CO_2 (kg/yr)
Residential	24,756	20,106	44,862	9,690	0	0	0	1,737	2,867	4,605	2,390	**49,467**	**12,080**	18,608	9658
Commercial	3,180	0	3,180	687	0	171	614	519	5,471	6,604	3,427	**9,784**	**4,114**	2,148	1116
Total	**27,936**	**20,106**	**48,042**	**10,377**	**0**	**171**	**614**	**2,257**	**8,338**	**11,208**	**5,817**	**59,251**	**16,194**	**20,756**	**10,772**

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 the London Borough of Richmond Upon Thames 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 flat roof spaces 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	The architectural plans show that PV panels will be installed on the roof so they are south facing	✓

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	CHP is not technically viable for a development of this scale.	✗
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	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 limited 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 however it's being discounted because of high noise levels.	✗

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 Solar PV which the architect plans show will be installed on the roof of the development. The system will only provide power to the residential units. The chosen should be accurately sized during the detailed design stages and MCS (Microgeneration Certification Scheme) approved equipment and installers used.

7.1 Summary of CO_2 Emission Savings

The most appropriate LZC technology for the development has been identified as Solar PV in order to show ambition towards meeting the London Plan and the London Borough of Richmond Upon Thames target for on-site renewables. Table 7-2 shows the proposed system size and the estimate energy and carbon emissions savings for this development.

	Energy & CO_2				
Proposed LZC Technologies	Energy Generated (kWh/yr)	% site energy demand met	CO_2 saved by system ($kgCO_2/yr$)	% reduction in site CO_2 emissions	25 year CO_2 saving ($kgCO_2$)
Total Solar PV = 9.35 kWp 29 no.s High Efficiency 30 deg, S facing	8,026	10.03%	4,166	15.4%	104,138

Table 7-2 Energy, carbon and financial performance of the proposed LZC technologies

7.2 Improvement Over Part L with LZCs

Figure 7-1 demonstrate the percentage improvement over the Building Regulations 2013 baseline levels for the development incorporating the Solar PV. Table 7-3 and Figure 7-2 confirm that the development can achieve 35% improvement over the Part L 2013 target emissions with proposed strategy.

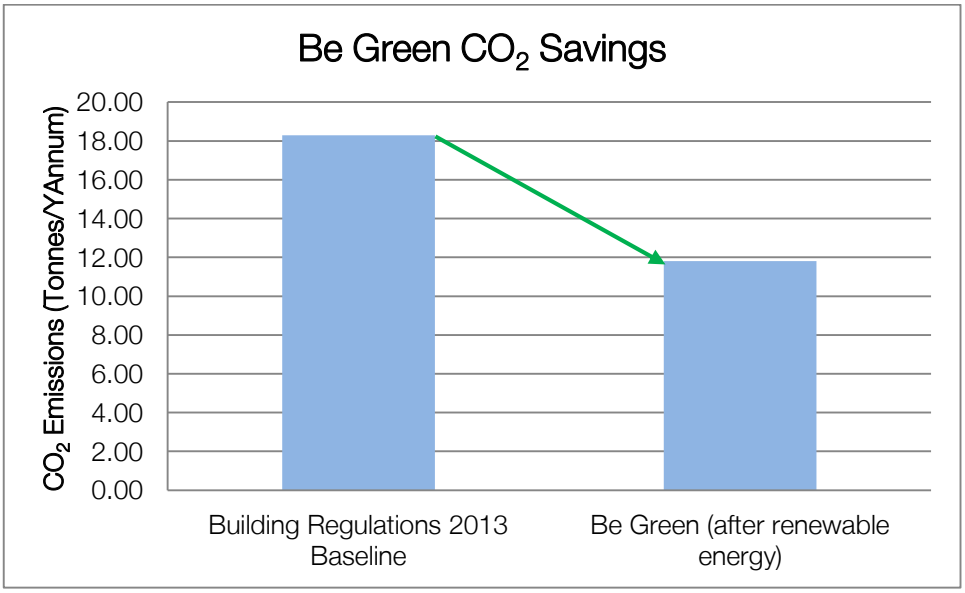


Figure 7-1 % Improvement over Building Regulations Part L 2013 after LZCs

Site Wide	CO_2 Emissions (tonnes /annum)	CO_2 Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	18.29		
Be Lean (after demand reduction)	18.28	0.01	0.1%
Be Clean (after efficiency measures)	16.19	2.08	11%
Be Green (after renewable energy)	11.80	4.39	24%
Total Cumulative Savings		6.49	35%

Table 7-3 % Improvement over Building Regulations Part L through the Energy Hierarchy

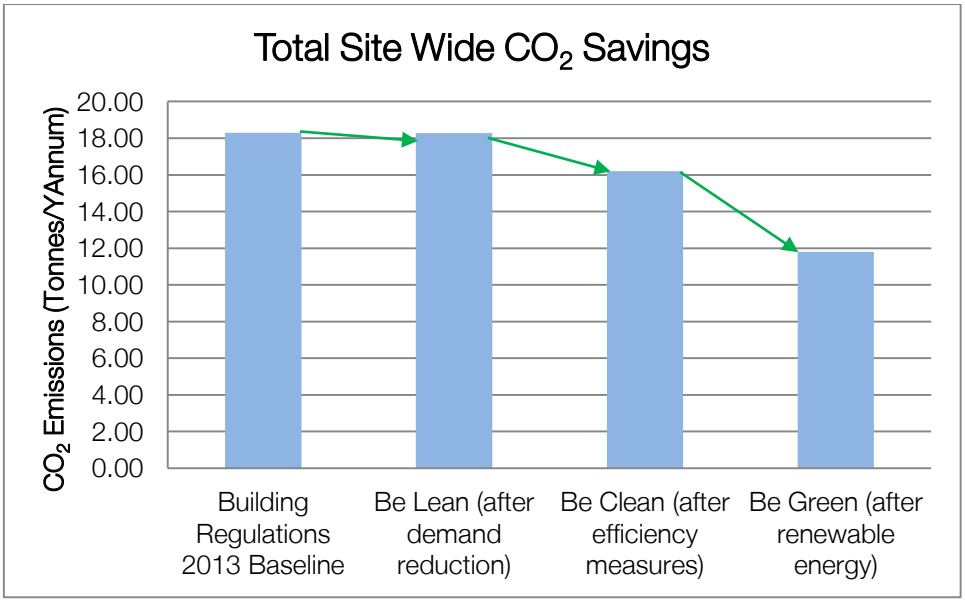


Figure 7-2 Summary of CO_2 savings (tonnes CO_2/annum) over Building Regulations 2013 baseline

The energy use for the Be Green case broken down in Table 7-24.

Be Green Emission Breakdown																
Regulated Energy & CO_2															Unregulated Energy & CO_2	
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)	Pumps & Fans (kWh/ yr)	Lighting (kWh/yr)	Cooling (kWh/ yr)	PV (kWh/ yr)	Total (kWh/ yr)	Electricity CO_2 ($kgCO_2$/ yr)			Energy (kWh/ yr)	CO_2 (kg/yr)
Residential	24,756	20,106	44,862	9,690	0	0	0	1,737	2,867	-8,026	-3,421	-1,776	49,467	7,915	18,608	9,658
Commercial	0	0	0	0	774	171	555	519	5,471		7,490	3,887	6,546	3,887	2,148	1,115
Total	24,756	20,106	44,862	9,690	774	171	555	2,257	8,338	-8,026	4,069	2,112	56,013	11,802	20,756	10,772

Table 7-4 Estimated regulated and unregulated energy demand and carbon emissions per energy source

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 35% improvement over the Building Regulations Part L 2013 Target Emissions Rate (TER) and overall 15.40% saving in carbon emissions from the LZCs technologies.

The design team have made all reasonable endeavours to achieve the minimum requirements of the London Plan and the London Borough of Richmond Upon Thames. The proposed savings from renewables shows an ambition towards meeting the required 20% under Richmond Planning policy, it does achieve the required improvement over Building Regulations Part L 2013, in line with the London Plan and Richmond policy. In addition, 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 are low and exceed current Building Regulations, improved thermal detailing for the thermal bridges will be considered in the design of the residential unit and shall be calculated at a later stage. Energy efficiency has been maximised throughout the M&E strategy and in the reduction of unregulated energy uses. 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 $kgCO_2/kWh$

Table A-1 Energy intensity values

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

Table A-2 Natural Gas and Electricity fuel prices

Renewable Technology Outputs	
PV panel size	1.046 x 1.56
PV panel rated output (kWp)	0.327
Efficiency (kWp/m^2)	0.20

Table A-2 PV Specification Details

Appendix B

SAP Calculations

Sample Report Ltd
1 Sample Street
Sampletown

Full SAP Calculation Printout

Property Reference: 25498 - Flat 01
Survey Reference: Be Lean PT3
Property: London, TW1 4BH

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

SAP Rating:	83 B	**CO2 Emissions (t/year):**	1.15	**DER:**	19.14 Pass	**TER:**	19.60	**Percentage DER<TER:**	2.36 %
Environmental:	85 B	**General Requirements Compliance:**	Pass	**DFEE:**	43.30 Pass	**TFEE:**	55.88	**Percentage DFEE<TFEE:**	22.52 %

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 'Be Lean PT3'
SAP2012 - 9.92 input data (DesignData) -


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

FullRefNo:                    Be Lean PT3

Regs Region:                  England
SAP Region:                   Thames Valley
Postcode:                     TW1 4BH
DwellingOrientation:          East
Property Type:                Flat, End-Terrace
Storeys:                      1
Date Built:                   2016
Sheltered Sides:              1
Sunlight Shade:               Average or unknown
Measurements                  Perimeter, Floor Area, Storey Height
    1st Storey:              29.12, 71.72, 2.68
Living Area:                  24.67 m2, fraction: 34.4%
Thermal Mass:                 Simple calculation
Thermal Mass Simple:          Low
Thermal MassValue:            100
External Walls                Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1               61.17, 78.04, 0, Other, Cavity, 0, 0.15, Gross
Party Walls                   Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                  22.65, 0, Other, FilledWithEdge, 0, 0
External Roofs                Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
    External Roof 1          9.08, 9.08, 0, Other, 0.11
Party Ceilings                Area, Kappa, Construction, Element
    Party Ceilings 1         62.64, 80, Concrete floor slab, carpeted
Heat Loss Floors              Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
    Heat Loss Floor 1        39.27, 0, Other, Exposed Floor - Solid, 0, 0.11
Party Floors                  Area, Kappa, Construction, Element
    Party Floor 1            32.45, 80
Description                   Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
    Windows                  Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
    Flat Door                Manufacturer, Solid Door, , , , , , ,
Openings                      Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    S F Windows              Window, External Wall 1, South, , None, 0, , 0, 0, 0, 6.08,
    Flat Door                Solid Door, External Wall 1, South, , , , , 0, 0, 0, 2.33,
    N F Windows              Window, External Wall 1, North, , None, 0, , 0, 0, 0, 5.86,
    E F Window               Window, External Wall 1, East, , None, 0, , 0, 0, 0, 2.60,
Conservatory:                 None
Draught Proofing:             100
Draught Lobby:                No
Thermal Bridges
    Bridging:                Calculate Bridges
    Y                        0.117
    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, 7.68, 0.3, 0.3, 2.30,
    1.                       External wall, E3 Sill, Table K1 - Approved, Yes, 6.63, 0.04, 0.04, 0.27,
    2.                       External wall, E4 Jamb, Table K1 - Approved, Yes, 29.56, 0.05, 0.05, 1.48,
    3.                       External wall, E20 Exposed floor (normal), Table K1 - Default, No, 23.79, 0.32, 0.32, 7.61,
    4.                       External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Approved, Yes, 29.12, 0.07, 0.07, 2.04,
    5.                       External wall, E16 Corner (normal), Table K1 - Approved, No, 8.04, 0.09, 0.09, 0.72,
    6.                       External wall, E18 Party wall between dwellings, Table K1 - Approved, Yes, 5.36, 0.06, 0.06, 0.32,
Pressure Test:                True
Designed q50:                 3
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:            3
Passive Vents:                0
Flueless Gas Fires:           0
Cooling System                None
Light Fittings:               8
LEL Fittings:                 6
Percentage of LEL Fittings:   75
External Lights Fitted:       No
External LELs Fitted:         No
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  SAP Table
    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      No
    Ctrl SAP Code           2110
    Burner Control          OnOff
    Flue Type               None or Unknown
    Fan Assisted Flue       No
    Pumped                  Pump in heated space
    Heat Pump Age           2013 or later
    Heat Emitter            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 72 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) 19.60 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 19.14 kg/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.9 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)43.3 kWh/m²OK

---

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	OK

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

---

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

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc
Combi boiler
Efficiency: 88%
Minimum: 88% 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:75%
Minimum 75% OK

---

8 Mechanical ventilation
Not applicable

---

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

Overshading:	Average
Windows facing North:	5.86 m², No overhang
Windows facing East:	2.60 m², No overhang
Windows facing South:	6.08 m², No overhang
Air change rate:	6.00 ach
Blinds/curtains:	None

---

10 Key features

Party wall U-value	0.00 W/m²K
Roof U-value	0.11 W/m²K
Exposed floor U-value	0.11 W/m²K
Air permeability	3.0 m³/m²h

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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(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							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1561	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.3061	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2831	(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	0.3610	0.3539	0.3468	0.3114	0.3044	0.2690	0.2690	0.2619	0.2831	0.3044	0.3185	0.3327	(22b)
Effective ac	0.5652	0.5626	0.5601	0.5485	0.5463	0.5362	0.5362	0.5343	0.5401	0.5463	0.5507	0.5553	(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	
Windows (Uw = 1.20)			14.5400	1.1450	16.6489			(27)
Flat Door			2.3300	1.2000	2.7960			(26)
Heat Loss Floor 1			39.2700	0.1100	4.3197			(28b)
External Wall 1	78.0400	16.8700	61.1700	0.1500	9.1755			(29a)
External Roof 1	9.0800		9.0800	0.1100	0.9988			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.9389			(33)
Party Wall 1			22.6500	0.0000	0.0000			(32)
Party Floor 1			32.4500					(32d)
Party Ceilings 1			62.6400					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7436 (36)
Total fabric heat loss	(33) + (36) =	48.6825 (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	35.8473	35.6868	35.5295	34.7907	34.6524	34.0089	34.0089	33.8898	34.2568	34.6524	34.9321	35.2244	(38)
Heat transfer coeff	84.5297	84.3692	84.2119	83.4731	83.3349	82.6914	82.6914	82.5722	82.9392	83.3349	83.6145	83.9069	(39)
Average = Sum(39)m / 12 =												83.4725	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1786	1.1764	1.1742	1.1639	1.1619	1.1530	1.1530	1.1513	1.1564	1.1619	1.1658	1.1699	(40)
HLP (average)												1.1639	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2871 (42)
Average daily hot water use (litres/day)	88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6599	18.9439	19.5484	17.0428	16.3530	14.1114	13.0762	15.0052	15.1844	17.6959	19.3165	20.9765	(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	49.6196	43.1879	46.0109	42.7805	42.4022	39.2882	40.5978	42.4022	42.7805	46.0109	46.2728	49.6196	(61)
Total heat required for water heating calculated for each month	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627	(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

	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
											Total per year (kWh/year) = Sum(64)m =	1923.7334 (64)

Heat gains from water heating, kWh/month

	60.4177	52.7893	54.8350	48.4733	46.8496	41.1022	39.1351	43.8620	44.3539	50.7287	54.3865	58.9027 (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	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	(66)

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

	22.5575	20.0353	16.2938	12.3355	9.2209	7.7847	8.4116	10.9337	14.6753	18.6336	21.7482	23.1844	(67)

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

	201.2777	203.3663	198.1030	186.8981	172.7539	159.4604	150.5795	148.4908	153.7541	164.9590	179.1032	192.3968	(68)

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

	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	(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)

	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)

Water heating gains (Table 5)

	81.2066	78.5555	73.7030	67.3240	62.9699	57.0864	52.6010	58.9543	61.6026	68.1838	75.5367	79.1704	(72)

Total internal gains

	365.3489	362.2644	348.4070	326.8648	305.2519	284.6387	271.8993	278.6861	290.3392	312.0836	336.6953	355.0587	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.8600	10.6334	0.6300	0.7000	0.7700	19.0433	(74)
East	2.6000	19.6403	0.6300	0.7000	0.7700	15.6060	(76)
South	6.0800	46.7521	0.6300	0.7000	0.7700	86.8713	(78)

Solar gains	121.5206	209.1941	293.3467	377.4856	437.1156	440.6476	422.0163	376.2400	322.1417	233.0001	145.9233	103.7738	(83)
Total gains	486.8695	571.4585	641.7537	704.3504	742.3675	725.2863	693.9156	654.9261	612.4809	545.0837	482.6186	458.8325	(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	23.5683	23.6131	23.6572	23.8666	23.9062	24.0923	24.0923	24.1270	24.0203	23.9062	23.8263	23.7433	
alpha	2.5712	2.5742	2.5771	2.5911	2.5937	2.6062	2.6062	2.6085	2.6014	2.5937	2.5884	2.5829	
util living area	0.9566	0.9347	0.8995	0.8362	0.7371	0.6019	0.4730	0.5116	0.6974	0.8626	0.9372	0.9622	(86)
MIT	19.1459	19.3699	19.7032	20.1136	20.4727	20.7242	20.8306	20.8135	20.6264	20.1589	19.5773	19.0998	(87)
Th 2	19.9372	19.9390	19.9407	19.9490	19.9506	19.9578	19.9578	19.9591	19.9550	19.9506	19.9474	19.9441	(88)
util rest of house	0.9502	0.9252	0.8845	0.8105	0.6935	0.5317	0.3772	0.4163	0.6344	0.8355	0.9264	0.9565	(89)
MIT 2	17.4564	17.7795	18.2572	18.8405	19.3285	19.6501	19.7637	19.7506	19.5390	18.9168	18.0890	17.3947	(90)
Living area fraction										fLA = Living area / (4) =		0.3440	(91)
MIT	18.0376	18.3266	18.7546	19.2784	19.7221	20.0196	20.1307	20.1162	19.9130	19.3441	18.6010	17.9812	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0376	18.3266	18.7546	19.2784	19.7221	20.0196	20.1307	20.1162	19.9130	19.3441	18.6010	17.9812	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9349	0.9068	0.8640	0.7915	0.6830	0.5362	0.3940	0.4317	0.6315	0.8168	0.9087	0.9425	(94)
Useful gains	455.1982	518.1908	554.4527	557.4821	507.0148	388.8758	273.4254	282.7196	386.8057	445.2189	438.5458	432.4454	(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	1161.2327	1132.7891	1031.9841	866.3182	668.5222	448.1521	291.9556	306.8556	482.1282	728.6866	961.6484	1156.3414	(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	525.2897	413.0100	355.2834	222.3620	120.1615	0.0000	0.0000	0.0000	0.0000	210.9000	376.6339	538.5786	(98)
Space heating												2762.2191	(98)
Space heating per m2											(98) / (4) =	38.5139	(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 %)	88.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3138.8854	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	525.2897	413.0100	355.2834	222.3620	120.1615	0.0000	0.0000	0.0000	0.0000	210.9000	376.6339	538.5786	(98)
Space heating efficiency (main heating system 1)													
	88.0000	88.0000	88.0000	88.0000	88.0000	0.0000	0.0000	0.0000	0.0000	88.0000	88.0000	88.0000	(210)
Space heating fuel (main heating system)													
	596.9201	469.3296	403.7311	252.6841	136.5472	0.0000	0.0000	0.0000	0.0000	239.6591	427.9930	612.0212	(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												
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
Efficiency of water heater												88.0000 (216)
(217)m	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000 (217)
Fuel for water heating, kWh/month												
	220.4762	192.5916	200.3791	177.7262	172.0703	151.5499	145.1964	161.8599	163.6475	186.3453	198.9199	215.2986 (219)
Water heating fuel used												2186.0607 (219)
Annual totals kWh/year												
Space heating fuel - main system												3138.8854 (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)												398.3717 (232)
Total delivered energy for all uses												5753.3179 (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	3138.8854	0.2160	677.9992	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2186.0607	0.2160	472.1891	(264)
Space and water heating			1150.1884	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	398.3717	0.5190	206.7549	(268)
Total CO2, kg/year			1372.5133	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			19.1400	(273)

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

DER		19.1400	ZC1
Total Floor Area	TFA	71.7200	
Assumed number of occupants	N	2.2871	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.6304	ZC2
CO2 emissions from cooking, equation (L16)		2.4246	ZC3
Total CO2 emissions		38.1949	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		38.1949	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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096 (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							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1561	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.4061	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3756	(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	0.4789	0.4695	0.4601	0.4132	0.4038	0.3568	0.3568	0.3475	0.3756	0.4038	0.4226	0.4414	(22b)
Effective ac	0.6147	0.6102	0.6059	0.5854	0.5815	0.5637	0.5637	0.5604	0.5705	0.5815	0.5893	0.5974	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3300	1.0000	2.3300			(26)
TER Opening Type (Uw = 1.40)			14.5400	1.3258	19.2765			(27)
Heat Loss Floor 1			39.2700	0.1300	5.1051			(28b)
External Wall 1	78.0400	16.8700	61.1700	0.1800	11.0106			(29a)
External Roof 1	9.0800		9.0800	0.1300	1.1804			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.9026			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.8899 (36)
Total fabric heat loss	(33) + (36) =	51.7925 (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	38.9888	38.7063	38.4294	37.1290	36.8857	35.7530	35.7530	35.5433	36.1893	36.8857	37.3779	37.8925	(38)
Heat transfer coeff	90.7813	90.4988	90.2220	88.9215	88.6782	87.5455	87.5455	87.3358	87.9818	88.6782	89.1704	89.6850	(39)
Average = Sum(39)m / 12 =												88.9203	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2658	1.2618	1.2580	1.2398	1.2364	1.2207	1.2207	1.2177	1.2267	1.2364	1.2433	1.2505	(40)
HLP (average)												1.2398	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2871 (42)
Average daily hot water use (litres/day)	88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6599	18.9439	19.5484	17.0428	16.3530	14.1114	13.0762	15.0052	15.1844	17.6959	19.3165	20.9765	(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	49.6196	43.1879	46.0109	42.7805	42.4022	39.2882	40.5978	42.4022	42.7805	46.0109	46.2728	49.6196	(61)
Total heat required for water heating calculated for each month	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627	(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	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627	(64)
								Total per year (kWh/year) = Sum(64)m =				1923.7334	(64)

Heat gains from water heating, kWh/month

60.4177 52.7893 54.8350 48.4733 46.8496 41.1022 39.1351 43.8620 44.3539 50.7287 54.3865 58.9027 (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	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	(66)

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

18.0460 16.0283 13.0351 9.8684 7.3767 6.2277 6.7293 8.7470 11.7402 14.9069 17.3985 18.5475 (67)

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

201.2777 203.3663 198.1030 186.8981 172.7539 159.4604 150.5795 148.4908 153.7541 164.9590 179.1032 192.3968 (68)

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

34.4357 34.4357 34.4357 34.4357 34.4357 34.4357 34.4357 34.4357 34.4357 34.4357 34.4357 34.4357 (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)

-91.4859 -91.4859 -91.4859 -91.4859 -91.4859 -91.4859 -91.4859 -91.4859 -91.4859 -91.4859 -91.4859 -91.4859 (71)

Water heating gains (Table 5)

81.2066 78.5555 73.7030 67.3240 62.9699 57.0864 52.6010 58.9543 61.6026 68.1838 75.5367 79.1704 (72)

Total internal gains

360.8374 358.2573 345.1483 324.3977 303.4077 283.0817 270.2170 276.4994 287.4041 308.3569 332.3457 350.4218 (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	5.8600	10.6334	0.6300	0.7000	0.7700	19.0433	(74)
East	2.6000	19.6403	0.6300	0.7000	0.7700	15.6060	(76)
South	6.0800	46.7521	0.6300	0.7000	0.7700	86.8713	(78)

Solar gains	121.5206	209.1941	293.3467	377.4856	437.1156	440.6476	422.0163	376.2400	322.1417	233.0001	145.9233	103.7738	(83)
Total gains	482.3580	567.4514	638.4950	701.8833	740.5233	723.7293	692.2333	652.7394	609.5458	541.3570	478.2690	454.1957	(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	54.8632	55.0345	55.2034	56.0107	56.1644	56.8910	56.8910	57.0277	56.6089	56.1644	55.8544	55.5339	
alpha	4.6575	4.6690	4.6802	4.7340	4.7443	4.7927	4.7927	4.8018	4.7739	4.7443	4.7236	4.7023	

util living area

0.9967 0.9925 0.9819 0.9496 0.8672 0.7078 0.5411 0.5910 0.8251 0.9654 0.9931 0.9975 (86)

MIT	19.6723	19.8529	20.1250	20.4725	20.7647	20.9379	20.9862	20.9793	20.8655	20.4848	20.0157	19.6451	(87)
Th 2	19.8677	19.8709	19.8739	19.8883	19.8910	19.9035	19.9035	19.9058	19.8987	19.8910	19.8855	19.8798	(88)

util rest of house

0.9956 0.9899 0.9754 0.9308 0.8178 0.6119 0.4141 0.4624 0.7461 0.9486 0.9903 0.9967 (89)

MIT 2	18.1152	18.3801	18.7757	19.2773	19.6630	19.8629	19.8986	19.8976	19.7939	19.3049	18.6287	18.0838	(90)
Living area fraction									fLA = Living area / (4) =			0.3440	(91)
MIT	18.6508	18.8867	19.2399	19.6884	20.0420	20.2327	20.2727	20.2697	20.1625	19.7108	19.1058	18.6209	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6508	18.8867	19.2399	19.6884	20.0420	20.2327	20.2727	20.2697	20.1625	19.7108	19.1058	18.6209	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9938	0.9868	0.9706	0.9266	0.8255	0.6426	0.4581	0.5069	0.7675	0.9451	0.9876	0.9953	(94)
Useful gains	479.3770	559.9792	619.7122	650.3890	611.2889	465.0953	317.1152	330.8989	467.7987	511.6521	472.3267	452.0406	(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

1302.7858 1265.7808 1149.4163 959.3203 739.7497 493.1141 321.5311 337.9631 533.3914 807.9281 1070.5595 1293.3347 (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

612.6161 474.2986 394.0998 222.4305 95.5749 0.0000 0.0000 0.0000 0.0000 220.4293 430.7276 625.9228 (98)

Space heating 3076.0997 (98)

Space heating per m2 (98) / (4) = 42.8904 (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 3293.4687 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Space heating requirement

612.6161 474.2986 394.0998 222.4305 95.5749 0.0000 0.0000 0.0000 0.0000 220.4293 430.7276 625.9228 (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)

655.9059 507.8144 421.9484 238.1483 102.3286 0.0000 0.0000 0.0000 0.0000 236.0057 461.1645 670.1528 (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
194.0190 169.4806 176.3336 156.3990 151.4219 133.3639 127.7728 142.4367 144.0098 163.9838 175.0495 189.4627 (64)
Efficiency of water heater 80.3000 (216)
(217)m 87.7454 87.5026 87.0167 85.9375 83.9284 80.3000 80.3000 80.3000 80.3000 85.7966 87.2296 87.8330 (217)
Fuel for water heating, kWh/month
221.1159 193.6864 202.6434 181.9916 180.4179 166.0821 159.1193 177.3807 179.3397 191.1309 200.6768 215.7079 (219)
Water heating fuel used 2269.2926 (219)
Annual totals kWh/year
Space heating fuel - main system 3293.4687 (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) 318.6974 (232)
Total delivered energy for all uses 5956.4587 (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	3293.4687	0.2160	711.3892 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2269.2926	0.2160	490.1672 (264)
Space and water heating			1201.5564 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	318.6974	0.5190	165.4040 (268)
Total CO2, kg/m2/year			1405.8854 (272)
Emissions per m2 for space and water heating			16.7534 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.3062 (272b)
Emissions per m2 for pumps and fans			0.5427 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.7534 * 1.00) + 2.3062 + 0.5427, rounded to 2 d.p.			19.6000 (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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(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							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1561 (8)
Pressure test		Yes
Measured/design q50		3.0000
Infiltration rate		0.3061 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2831 (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	0.3610	0.3539	0.3468	0.3114	0.3044	0.2690	0.2690	0.2619	0.2831	0.3044	0.3185	0.3327	(22b)
Effective ac	0.5652	0.5626	0.5601	0.5485	0.5463	0.5362	0.5362	0.5343	0.5401	0.5463	0.5507	0.5553	(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	
Windows (Uw = 1.20)			14.5400	1.1450	16.6489			(27)
Flat Door			2.3300	1.2000	2.7960			(26)
Heat Loss Floor 1			39.2700	0.1100	4.3197			(28b)
External Wall 1	78.0400	16.8700	61.1700	0.1500	9.1755			(29a)
External Roof 1	9.0800		9.0800	0.1100	0.9988			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.9389			(33)
Party Wall 1			22.6500	0.0000	0.0000			(32)
Party Floor 1			32.4500					(32d)
Party Ceilings 1			62.6400					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7436 (36)
Total fabric heat loss	(33) + (36) =	48.6825 (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	35.8473	35.6868	35.5295	34.7907	34.6524	34.0089	34.0089	33.8898	34.2568	34.6524	34.9321	35.2244	(38)
Heat transfer coeff	84.5297	84.3692	84.2119	83.4731	83.3349	82.6914	82.6914	82.5722	82.9392	83.3349	83.6145	83.9069	(39)
Average = Sum(39)m / 12 =												83.4725	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1786	1.1764	1.1742	1.1639	1.1619	1.1530	1.1530	1.1513	1.1564	1.1619	1.1658	1.1699	(40)
HLP (average)												1.1639	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2871 (42)
Average daily hot water use (litres/day)	88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(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	30.6849	26.8372	27.6936	24.1439	23.1667	19.9911	18.5247	21.2573	21.5112	25.0693	27.3651	29.7167	(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	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.0460	16.0283	13.0351	9.8684	7.3767	6.2277	6.7293	8.7470	11.7402	14.9069	17.3985	18.5475	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	201.2777	203.3663	198.1030	186.8981	172.7539	159.4604	150.5795	148.4908	153.7541	164.9590	179.1032	192.3968	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	(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)													
	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)
Water heating gains (Table 5)													
	41.2431	39.9363	37.2226	33.5332	31.1380	27.7654	24.8988	28.5717	29.8767	33.6952	38.0070	39.9418	(72)
Total internal gains													
	317.8740	316.6381	305.6678	287.6069	268.5759	250.7607	239.5147	243.1167	252.6782	270.8684	291.8160	308.1933	(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	5.8600	10.6334	0.6300	0.7000	0.7700	19.0433 (74)
East	2.6000	19.6403	0.6300	0.7000	0.7700	15.6060 (76)
South	6.0800	46.7521	0.6300	0.7000	0.7700	86.8713 (78)

Solar gains	121.5206	209.1941	293.3467	377.4856	437.1156	440.6476	422.0163	376.2400	322.1417	233.0001	145.9233	103.7738	(83)
Total gains	439.3945	525.8322	599.0145	665.0926	705.6915	691.4083	661.5310	619.3567	574.8199	503.8685	437.7393	411.9671	(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	23.5683	23.6131	23.6572	23.8666	23.9062	24.0923	24.0923	24.1270	24.0203	23.9062	23.8263	23.7433	
alpha	2.5712	2.5742	2.5771	2.5911	2.5937	2.6062	2.6062	2.6085	2.6014	2.5937	2.5884	2.5829	
util living area													
	0.9652	0.9449	0.9118	0.8511	0.7547	0.6208	0.4911	0.5333	0.7207	0.8804	0.9487	0.9701	(86)
MIT	18.5641	18.8734	19.3328	19.8994	20.3985	20.7512	20.9030	20.8767	20.6073	19.9505	19.1494	18.5014	(87)
Th 2	19.9372	19.9390	19.9407	19.9490	19.9506	19.9578	19.9578	19.9591	19.9550	19.9506	19.9474	19.9441	(88)
util rest of house													
	0.9599	0.9366	0.8982	0.8270	0.7123	0.5505	0.3932	0.4362	0.6591	0.8559	0.9396	0.9655	(89)
MIT 2	17.7171	18.0226	18.4738	19.0261	19.4918	19.8024	19.9142	19.9001	19.6897	19.0873	18.3050	17.6600	(90)
Living area fraction										fLA = Living area / (4) =		0.3440	(91)
MIT	18.0085	18.3153	18.7693	19.3265	19.8037	20.1288	20.2543	20.2361	20.0053	19.3842	18.5955	17.9494	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0085	18.3153	18.7693	19.3265	19.8037	20.1288	20.2543	20.2361	20.0053	19.3842	18.5955	17.9494	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9470	0.9205	0.8798	0.8103	0.7057	0.5629	0.4226	0.4637	0.6624	0.8399	0.9244	0.9539	(94)
Useful gains	416.1252	484.0031	526.9980	538.9426	497.9968	389.1833	279.5357	287.2079	380.7465	423.1832	404.6477	392.9613	(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													
	1158.7745	1131.8373	1033.2187	870.3312	675.3222	457.1824	302.1787	316.7519	489.7817	732.0310	961.1892	1153.6698	(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													
	552.5311	435.3446	376.6282	238.5998	131.9301	0.0000	0.0000	0.0000	0.0000	229.7828	400.7099	565.9671	(98)
Space heating												2931.4937	(98)
Space heating per m2											(98) / (4) =	40.8741	(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	777.2990	611.9162	627.5488	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7708	0.8308	0.8071	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	599.1631	508.3736	506.5201	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	893.1309	856.4863	808.5813	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	211.6568	258.9959	224.7336	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												695.3863	(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	52.9142	64.7490	56.1834	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												173.8466	(107)
Space cooling per m2												2.4240	(108)
Energy for space heating												40.8741	(99)
Energy for space cooling												2.4240	(108)
Total												43.2981	(109)
Dwelling Fabric Energy Efficiency (DFEE)												43.3	(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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(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							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1561	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.4061	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3756	(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	0.4789	0.4695	0.4601	0.4132	0.4038	0.3568	0.3568	0.3475	0.3756	0.4038	0.4226	0.4414	(22b)
Effective ac	0.6147	0.6102	0.6059	0.5854	0.5815	0.5637	0.5637	0.5604	0.5705	0.5815	0.5893	0.5974	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3300	1.0000	2.3300			(26)
TER Opening Type (Uw = 1.40)			14.5400	1.3258	19.2765			(27)
Heat Loss Floor 1			39.2700	0.1300	5.1051			(28b)
External Wall 1	78.0400	16.8700	61.1700	0.1800	11.0106			(29a)
External Roof 1	9.0800		9.0800	0.1300	1.1804			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.9026			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.8899	(36)
Total fabric heat loss					(33) + (36) =		51.7925	(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	38.9888	38.7063	38.4294	37.1290	36.8857	35.7530	35.7530	35.5433	36.1893	36.8857	37.3779	37.8925	(38)
Heat transfer coeff	90.7813	90.4988	90.2220	88.9215	88.6782	87.5455	87.5455	87.3358	87.9818	88.6782	89.1704	89.6850	(39)
Average = Sum(39)m / 12 =												88.9203	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2658	1.2618	1.2580	1.2398	1.2364	1.2207	1.2207	1.2177	1.2267	1.2364	1.2433	1.2505	(40)
HLP (average)												1.2398	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2871	(42)
Average daily hot water use (litres/day)	88.5198	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(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	30.6849	26.8372	27.6936	24.1439	23.1667	19.9911	18.5247	21.2573	21.5112	25.0693	27.3651	29.7167	(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	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	(66)

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

	18.0460	16.0283	13.0351	9.8684	7.3767	6.2277	6.7293	8.7470	11.7402	14.9069	17.3985	18.5475	(67)

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

	201.2777	203.3663	198.1030	186.8981	172.7539	159.4604	150.5795	148.4908	153.7541	164.9590	179.1032	192.3968	(68)

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

	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	(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)

	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)

Water heating gains (Table 5)

	41.2431	39.9363	37.2226	33.5332	31.1380	27.7654	24.8988	28.5717	29.8767	33.6952	38.0070	39.9418	(72)

Total internal gains

	317.8740	316.6381	305.6678	287.6069	268.5759	250.7607	239.5147	243.1167	252.6782	270.8684	291.8160	308.1933	(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	5.8600	10.6334	0.6300	0.7000	0.7700	19.0433	(74)
East	2.6000	19.6403	0.6300	0.7000	0.7700	15.6060	(76)
South	6.0800	46.7521	0.6300	0.7000	0.7700	86.8713	(78)

Solar gains	121.5206	209.1941	293.3467	377.4856	437.1156	440.6476	422.0163	376.2400	322.1417	233.0001	145.9233	103.7738	(83)
Total gains	439.3945	525.8322	599.0145	665.0926	705.6915	691.4083	661.5310	619.3567	574.8199	503.8685	437.7393	411.9671	(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	54.8632	55.0345	55.2034	56.0107	56.1644	56.8910	56.8910	57.0277	56.6089	56.1644	55.8544	55.5339	
alpha	4.6575	4.6690	4.6802	4.7340	4.7443	4.7927	4.7927	4.8018	4.7739	4.7443	4.7236	4.7023	
util living area	0.9978	0.9945	0.9858	0.9582	0.8835	0.7307	0.5632	0.6176	0.8486	0.9734	0.9952	0.9984	(86)
MIT	19.6180	19.8012	20.0783	20.4348	20.7406	20.9288	20.9837	20.9751	20.8459	20.4433	19.9650	19.5914	(87)
Th 2	19.8677	19.8709	19.8739	19.8883	19.8910	19.9035	19.9035	19.9058	19.8987	19.8910	19.8855	19.8798	(88)
util rest of house	0.9970	0.9926	0.9806	0.9419	0.8376	0.6352	0.4325	0.4857	0.7741	0.9599	0.9933	0.9978	(89)
MIT 2	18.6171	18.8019	19.0787	19.4365	19.7166	19.8710	19.8995	19.8989	19.8145	19.4523	18.9774	18.6001	(90)
Living area fraction										fLA = Living area / (4) =		0.3440	(91)
MIT	18.9614	19.1457	19.4226	19.7799	20.0688	20.2349	20.2724	20.2691	20.1693	19.7932	19.3171	18.9410	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9614	19.1457	19.4226	19.7799	20.0688	20.2349	20.2724	20.2691	20.1693	19.7932	19.3171	18.9410	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9909	0.9780	0.9400	0.8460	0.6663	0.4780	0.5317	0.7950	0.9584	0.9919	0.9971	(94)
Useful gains	437.7044	521.0734	585.8125	625.1743	597.0383	460.6628	316.2210	329.2861	456.9840	482.9184	434.1913	410.7865	(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	1330.9819	1289.2176	1165.8978	967.4570	742.1315	493.3084	321.5053	337.9124	533.9848	815.2386	1089.4036	1322.0510	(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	664.5984	516.1929	431.5834	246.4435	107.9493	0.0000	0.0000	0.0000	0.0000	247.2463	471.7529	677.9808	(98)
Space heating												3363.7476	(98)
Space heating per m2											(98) / (4) =	46.9011	(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	822.9279	647.8369	663.7519	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8594	0.9203	0.8982	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	707.2265	596.1860	596.1642	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	893.1309	856.4863	808.5813	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	133.8512	193.6634	158.0383	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												485.5529	(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	33.4628	48.4159	39.5096	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												121.3882	(107)
Space cooling per m2												1.6925	(108)
Energy for space heating												46.9011	(99)
Energy for space cooling												1.6925	(108)
Total												48.5936	(109)
Target Fabric Energy Efficiency (TFEE)												55.9	(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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(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							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1561	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.3061	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2831	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.5000	3.5000	3.3000	3.4000	3.1000	3.3000	3.0000	3.0000	3.1000	3.1000	3.5000	(22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8500	0.7750	0.8250	0.7500	0.7500	0.7750	0.7750	0.8750	(22a)
Adj infilt rate	0.2690	0.2477	0.2477	0.2336	0.2407	0.2194	0.2336	0.2123	0.2123	0.2194	0.2194	0.2477	(22b)
Effective ac	0.5362	0.5307	0.5307	0.5273	0.5290	0.5241	0.5273	0.5225	0.5225	0.5241	0.5241	0.5307	(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	
Windows (Uw = 1.20)			14.5400	1.1450	16.6489			(27)
Flat Door			2.3300	1.2000	2.7960			(26)
Heat Loss Floor 1			39.2700	0.1100	4.3197			(28b)
External Wall 1	78.0400	16.8700	61.1700	0.1500	9.1755			(29a)
External Roof 1	9.0800		9.0800	0.1100	0.9988			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.9389			(33)
Party Wall 1			22.6500	0.0000	0.0000			(32)
Party Floor 1			32.4500					(32d)
Party Ceilings 1			62.6400					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7436 (36)
Total fabric heat loss	(33) + (36) =	48.6825 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	34.0089	33.6610	33.6610	33.4449	33.5513	33.2415	33.4449	33.1446	33.1446	33.2415	33.2415	33.6610	(38)
Heat transfer coeff	82.6914	82.3434	82.3434	82.1273	82.2338	81.9240	82.1273	81.8270	81.8270	81.9240	81.9240	82.3434	(39)
Average = Sum(39)m / 12 =												82.1363	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1530	1.1481	1.1481	1.1451	1.1466	1.1423	1.1451	1.1409	1.1409	1.1423	1.1423	1.1481	(40)
HLP (average)												1.1452	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2871 (42)
Average daily hot water use (litres/day)	88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6599	18.9439	19.5484	17.0428	16.3530	14.1114	13.0762	15.0052	15.1844	17.6959	19.3165	20.9765	(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	49.6196	43.1879	46.0109	42.7805	42.4022	39.2882	40.5978	42.4022	42.7805	46.0109	46.2728	49.6196	(61)
Total heat required for water heating calculated for each month	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627	(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

	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
										Total per year (kWh/year) = Sum(64)m =		1923.7334 (64)
RHI water heating demand												1924 (64)
Heat gains from water heating, kWh/month												
	60.4177	52.7893	54.8350	48.4733	46.8496	41.1022	39.1351	43.8620	44.3539	50.7287	54.3865	58.9027 (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	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.3936	50.0883	40.7346	30.8387	23.0523	19.4617	21.0291	27.3344	36.6881	46.5840	54.3704	57.9610	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	300.4144	303.5318	295.6761	278.9524	257.8417	238.0005	224.7455	221.6281	229.4837	246.2075	267.3182	287.1593	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	(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)													
	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)
Water heating gains (Table 5)													
	81.2066	78.5555	73.7030	67.3240	62.9699	57.0864	52.6010	58.9543	61.6026	68.1838	75.5367	79.1704	(72)
Total internal gains													
	537.7677	531.9286	509.8667	476.8681	443.6168	414.3017	398.1285	407.6698	427.5275	460.7283	496.9784	524.0437	(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	5.8600	11.9672	0.6300	0.7000	0.7700	21.4320	(74)
East	2.6000	22.3142	0.6300	0.7000	0.7700	17.7307	(76)
South	6.0800	50.8329	0.6300	0.7000	0.7700	94.4539	(78)

Solar gains	133.6166	203.5207	288.2144	382.4513	434.4973	467.9095	444.7618	403.3017	341.2611	250.0973	160.1937	112.9895	(83)
Total gains	671.3842	735.4493	798.0811	859.3193	878.1141	882.2111	842.8903	810.9715	768.7885	710.8256	657.1721	637.0332	(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	24.0923	24.1941	24.1941	24.2577	24.2263	24.3179	24.2577	24.3467	24.3467	24.3179	24.3179	24.1941	
alpha	2.6062	2.6129	2.6129	2.6172	2.6151	2.6212	2.6172	2.6231	2.6231	2.6212	2.6212	2.6129	
util living area													
	0.9022	0.8752	0.8237	0.7282	0.5873	0.3921	0.2390	0.2751	0.5158	0.7370	0.8618	0.9113	(86)
MIT	19.6355	19.8070	20.0943	20.4395	20.7085	20.8551	20.8903	20.8865	20.7975	20.4978	20.0250	19.5966	(87)
Th 2	19.9578	19.9617	19.9617	19.9642	19.9630	19.9665	19.9642	19.9676	19.9676	19.9665	19.9665	19.9617	(88)
util rest of house													
	0.8886	0.8583	0.7995	0.6903	0.5285	0.3105	0.1419	0.1768	0.4374	0.6923	0.8401	0.8987	(89)
MIT 2	18.1699	18.4143	18.8164	19.2870	19.6281	19.7891	19.8124	19.8143	19.7375	19.3761	18.7315	18.1184	(90)
Living area fraction									fLA = Living area / (4) =			0.3440	(91)
MIT	18.6741	18.8934	19.2560	19.6834	19.9997	20.1557	20.1831	20.1831	20.1021	19.7619	19.1764	18.6269	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6741	18.8934	19.2560	19.6834	19.9997	20.1557	20.1831	20.1831	20.1021	19.7619	19.1764	18.6269	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8683	0.8376	0.7806	0.6790	0.5307	0.3260	0.1628	0.1977	0.4483	0.6824	0.8204	0.8789	(94)
Useful gains	582.9855	616.0358	622.9988	583.4832	466.0162	287.6023	137.2117	160.3562	344.6220	485.0878	539.1693	559.9053	(95)
Ext temp.	5.5000	6.1000	7.8000	10.4000	13.5000	16.5000	18.5000	18.2000	15.5000	12.0000	8.4000	5.5000	(96)
Heat loss rate W													
	1089.3807	1053.4501	943.3225	762.4243	534.4964	299.4933	138.2315	162.2687	376.5772	635.8883	882.8445	1080.9110	(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													
	376.7580	293.9424	238.3208	128.8377	50.9493	0.0000	0.0000	0.0000	0.0000	112.1956	247.4462	387.6282	(98)
Space heating												1836.0781	(98)
RHI space heating demand												1836	(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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(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							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1561	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.3061	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2831	(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	0.3610	0.3539	0.3468	0.3114	0.3044	0.2690	0.2690	0.2619	0.2831	0.3044	0.3185	0.3327	(22b)
Effective ac	0.5652	0.5626	0.5601	0.5485	0.5463	0.5362	0.5362	0.5343	0.5401	0.5463	0.5507	0.5553	(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	
Windows (Uw = 1.20)			14.5400	1.1450	16.6489			(27)
Flat Door			2.3300	1.2000	2.7960			(26)
Heat Loss Floor 1			39.2700	0.1100	4.3197			(28b)
External Wall 1	78.0400	16.8700	61.1700	0.1500	9.1755			(29a)
External Roof 1	9.0800		9.0800	0.1100	0.9988			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.9389			(33)
Party Wall 1			22.6500	0.0000	0.0000			(32)
Party Floor 1			32.4500					(32d)
Party Ceilings 1			62.6400					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7436 (36)
Total fabric heat loss	(33) + (36) =	48.6825 (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	35.8473	35.6868	35.5295	34.7907	34.6524	34.0089	34.0089	33.8898	34.2568	34.6524	34.9321	35.2244	(38)
Heat transfer coeff	84.5297	84.3692	84.2119	83.4731	83.3349	82.6914	82.6914	82.5722	82.9392	83.3349	83.6145	83.9069	(39)
Average = Sum(39)m / 12 =												83.4725	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1786	1.1764	1.1742	1.1639	1.1619	1.1530	1.1530	1.1513	1.1564	1.1619	1.1658	1.1699	(40)
HLP (average)												1.1639	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2871 (42)
Average daily hot water use (litres/day)	88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6599	18.9439	19.5484	17.0428	16.3530	14.1114	13.0762	15.0052	15.1844	17.6959	19.3165	20.9765	(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	49.6196	43.1879	46.0109	42.7805	42.4022	39.2882	40.5978	42.4022	42.7805	46.0109	46.2728	49.6196	(61)
Total heat required for water heating calculated for each month	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627	(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

	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
											Total per year (kWh/year) = Sum(64)m =	1923.7334 (64)

Heat gains from water heating, kWh/month

	60.4177	52.7893	54.8350	48.4733	46.8496	41.1022	39.1351	43.8620	44.3539	50.7287	54.3865	58.9027 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	(66)

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

	56.3936	50.0883	40.7346	30.8387	23.0523	19.4617	21.0291	27.3344	36.6881	46.5840	54.3704	57.9610 (67)

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

	300.4144	303.5318	295.6761	278.9524	257.8417	238.0005	224.7455	221.6281	229.4837	246.2075	267.3182	287.1593 (68)

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

	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100 (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)

	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859 (71)

Water heating gains (Table 5)

	81.2066	78.5555	73.7030	67.3240	62.9699	57.0864	52.6010	58.9543	61.6026	68.1838	75.5367	79.1704 (72)

Total internal gains

	537.7677	531.9286	509.8667	476.8681	443.6168	414.3017	398.1285	407.6698	427.5275	460.7283	496.9784	524.0437 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.8600	10.6334	0.6300	0.7000	0.7700	19.0433	(74)
East	2.6000	19.6403	0.6300	0.7000	0.7700	15.6060	(76)
South	6.0800	46.7521	0.6300	0.7000	0.7700	86.8713	(78)

Solar gains	121.5206	209.1941	293.3467	377.4856	437.1156	440.6476	422.0163	376.2400	322.1417	233.0001	145.9233	103.7738	(83)
Total gains	659.2882	741.1227	803.2134	854.3537	880.7324	854.9492	820.1448	783.9098	749.6691	693.7284	642.9017	627.8175	(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	23.5683	23.6131	23.6572	23.8666	23.9062	24.0923	24.0923	24.1270	24.0203	23.9062	23.8263	23.7433	
alpha	2.5712	2.5742	2.5771	2.5911	2.5937	2.6062	2.6062	2.6085	2.6014	2.5937	2.5884	2.5829	
util living area													
	0.9194	0.8921	0.8503	0.7789	0.6742	0.5369	0.4123	0.4438	0.6195	0.7965	0.8904	0.9273	(86)
MIT	19.4057	19.6051	19.8990	20.2559	20.5594	20.7661	20.8491	20.8376	20.6958	20.3122	19.8005	19.3609	(87)
Th 2	19.9372	19.9390	19.9407	19.9490	19.9506	19.9578	19.9578	19.9591	19.9550	19.9506	19.9474	19.9441	(88)
util rest of house													
	0.9086	0.8779	0.8303	0.7485	0.6278	0.4686	0.3250	0.3562	0.5545	0.7623	0.8737	0.9174	(89)
MIT 2	17.8260	18.1102	18.5266	19.0274	19.4323	19.6911	19.7767	19.7685	19.6132	19.1167	18.4008	17.7673	(90)
Living area fraction										fLA = Living area / (4) =		0.3440	(91)
MIT	18.3694	18.6244	18.9987	19.4500	19.8200	20.0608	20.1456	20.1363	19.9856	19.5280	18.8823	18.3155	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3694	18.6244	18.9987	19.4500	19.8200	20.0608	20.1456	20.1363	19.9856	19.5280	18.8823	18.3155	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8887	0.8568	0.8096	0.7324	0.6215	0.4757	0.3414	0.3718	0.5566	0.7465	0.8532	0.8983	(94)
Useful gains	585.9028	635.0040	650.2678	625.7084	547.3972	406.7095	279.9584	291.4939	417.2366	517.8653	548.5000	563.9894	(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													
	1189.2818	1157.9193	1052.5358	880.6381	676.6778	451.5646	293.1869	308.5127	488.1447	744.0112	985.1715	1184.3871	(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													
	448.9140	351.3991	299.2874	183.5494	96.1848	0.0000	0.0000	0.0000	0.0000	168.2525	314.4035	461.5758	(98)
Space heating												2323.5664	(98)
Space heating per m2											(98) / (4) =	32.3977	(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 %)	88.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2640.4164	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	448.9140	351.3991	299.2874	183.5494	96.1848	0.0000	0.0000	0.0000	0.0000	168.2525	314.4035	461.5758	(98)
Space heating efficiency (main heating system 1)													
	88.0000	88.0000	88.0000	88.0000	88.0000	0.0000	0.0000	0.0000	0.0000	88.0000	88.0000	88.0000	(210)
Space heating fuel (main heating system)													
	510.1295	399.3171	340.0993	208.5789	109.3009	0.0000	0.0000	0.0000	0.0000	191.1961	357.2767	524.5180	(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												
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
Efficiency of water heater												88.0000 (216)
(217)m	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000 (217)
Fuel for water heating, kWh/month												
	220.4762	192.5916	200.3791	177.7262	172.0703	151.5499	145.1964	161.8599	163.6475	186.3453	198.9199	215.2986 (219)
Water heating fuel used												2186.0607 (219)
Annual totals kWh/year												
Space heating fuel - main system												2640.4164 (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)												398.3717 (232)
Total delivered energy for all uses												5254.8489 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2640.4164	3.4800	91.8865	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2186.0607	3.4800	76.0749	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	398.3717	13.1900	52.5452	(250)
Additional standing charges			120.0000	(251)
Total energy cost			344.4636	(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] =	1.2395	(257)
SAP value		82.7089	
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	2640.4164	0.2160	570.3299	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2186.0607	0.2160	472.1891	(264)
Space and water heating			1042.5191	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	398.3717	0.5190	206.7549	(268)
Total kg/year			1264.8440	(272)
CO2 emissions per m2			17.6400	(273)
EI value			85.4790	
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) / 0.8800 = 4.241, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.25) / 0.8800 = 0.2633, stars = 4
Water heating energy efficiency	3.48 / 0.8800 = 3.955, stars = 4
Water heating environmental impact	0.216 / 0.8800 = 0.2455, 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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(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							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1561	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.3061	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2831	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.5000	3.5000	3.3000	3.4000	3.1000	3.3000	3.0000	3.0000	3.1000	3.1000	3.5000	(22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8500	0.7750	0.8250	0.7500	0.7500	0.7750	0.7750	0.8750	(22a)
Adj infilt rate	0.2690	0.2477	0.2477	0.2336	0.2407	0.2194	0.2336	0.2123	0.2123	0.2194	0.2194	0.2477	(22b)
Effective ac	0.5362	0.5307	0.5307	0.5273	0.5290	0.5241	0.5273	0.5225	0.5225	0.5241	0.5241	0.5307	(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	
Windows (Uw = 1.20)			14.5400	1.1450	16.6489			(27)
Flat Door			2.3300	1.2000	2.7960			(26)
Heat Loss Floor 1			39.2700	0.1100	4.3197			(28b)
External Wall 1	78.0400	16.8700	61.1700	0.1500	9.1755			(29a)
External Roof 1	9.0800		9.0800	0.1100	0.9988			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.9389			(33)
Party Wall 1			22.6500	0.0000	0.0000			(32)
Party Floor 1			32.4500					(32d)
Party Ceilings 1			62.6400					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7436 (36)
Total fabric heat loss	(33) + (36) =	48.6825 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	34.0089	33.6610	33.6610	33.4449	33.5513	33.2415	33.4449	33.1446	33.1446	33.2415	33.2415	33.6610	(38)
Heat transfer coeff	82.6914	82.3434	82.3434	82.1273	82.2338	81.9240	82.1273	81.8270	81.8270	81.9240	81.9240	82.3434	(39)
Average = Sum(39)m / 12 =												82.1363	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1530	1.1481	1.1481	1.1451	1.1466	1.1423	1.1451	1.1409	1.1409	1.1423	1.1423	1.1481	(40)
HLP (average)												1.1452	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2871 (42)
Average daily hot water use (litres/day)	88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6599	18.9439	19.5484	17.0428	16.3530	14.1114	13.0762	15.0052	15.1844	17.6959	19.3165	20.9765	(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	49.6196	43.1879	46.0109	42.7805	42.4022	39.2882	40.5978	42.4022	42.7805	46.0109	46.2728	49.6196	(61)
Total heat required for water heating calculated for each month	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627	(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

	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
											Total per year (kWh/year) = Sum(64)m =	1923.7334 (64)

Heat gains from water heating, kWh/month

	60.4177	52.7893	54.8350	48.4733	46.8496	41.1022	39.1351	43.8620	44.3539	50.7287	54.3865	58.9027 (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	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	(66)

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

	56.3936	50.0883	40.7346	30.8387	23.0523	19.4617	21.0291	27.3344	36.6881	46.5840	54.3704	57.9610 (67)

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

	300.4144	303.5318	295.6761	278.9524	257.8417	238.0005	224.7455	221.6281	229.4837	246.2075	267.3182	287.1593 (68)

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

	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100 (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)

	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859 (71)

Water heating gains (Table 5)

	81.2066	78.5555	73.7030	67.3240	62.9699	57.0864	52.6010	58.9543	61.6026	68.1838	75.5367	79.1704 (72)

Total internal gains

	537.7677	531.9286	509.8667	476.8681	443.6168	414.3017	398.1285	407.6698	427.5275	460.7283	496.9784	524.0437 (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	5.8600	11.9672	0.6300	0.7000	0.7700	21.4320 (74)
East	2.6000	22.3142	0.6300	0.7000	0.7700	17.7307 (76)
South	6.0800	50.8329	0.6300	0.7000	0.7700	94.4539 (78)

Solar gains	133.6166	203.5207	288.2144	382.4513	434.4973	467.9095	444.7618	403.3017	341.2611	250.0973	160.1937	112.9895 (83)
Total gains	671.3842	735.4493	798.0811	859.3193	878.1141	882.2111	842.8903	810.9715	768.7885	710.8256	657.1721	637.0332 (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	24.0923	24.1941	24.1941	24.2577	24.2263	24.3179	24.2577	24.3467	24.3467	24.3179	24.3179	24.1941	
alpha	2.6062	2.6129	2.6129	2.6172	2.6151	2.6212	2.6172	2.6231	2.6231	2.6212	2.6212	2.6129	
util living area	0.9022	0.8752	0.8237	0.7282	0.5873	0.3921	0.2390	0.2751	0.5158	0.7370	0.8618	0.9113	(86)
MIT	19.6355	19.8070	20.0943	20.4395	20.7085	20.8551	20.8903	20.8865	20.7975	20.4978	20.0250	19.5966	(87)
Th 2	19.9578	19.9617	19.9617	19.9642	19.9630	19.9665	19.9642	19.9676	19.9676	19.9665	19.9665	19.9617	(88)
util rest of house	0.8886	0.8583	0.7995	0.6903	0.5285	0.3105	0.1419	0.1768	0.4374	0.6923	0.8401	0.8987	(89)
MIT 2	18.1699	18.4143	18.8164	19.2870	19.6281	19.7891	19.8124	19.8143	19.7375	19.3761	18.7315	18.1184	(90)
Living area fraction										fLA = Living area / (4) =		0.3440	(91)
MIT	18.6741	18.8934	19.2560	19.6834	19.9997	20.1557	20.1831	20.1831	20.1021	19.7619	19.1764	18.6269	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6741	18.8934	19.2560	19.6834	19.9997	20.1557	20.1831	20.1831	20.1021	19.7619	19.1764	18.6269	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8683	0.8376	0.7806	0.6790	0.5307	0.3260	0.1628	0.1977	0.4483	0.6824	0.8204	0.8789	(94)
Useful gains	582.9855	616.0358	622.9988	583.4832	466.0162	287.6023	137.2117	160.3562	344.6220	485.0878	539.1693	559.9053	(95)
Ext temp.	5.5000	6.1000	7.8000	10.4000	13.5000	16.5000	18.5000	18.2000	15.5000	12.0000	8.4000	5.5000	(96)
Heat loss rate W	1089.3807	1053.4501	943.3225	762.4243	534.4964	299.4933	138.2315	162.2687	376.5772	635.8883	882.8445	1080.9110	(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	376.7580	293.9424	238.3208	128.8377	50.9493	0.0000	0.0000	0.0000	0.0000	112.1956	247.4462	387.6282	(98)
Space heating												1836.0781	(98)
Space heating per m2											(98) / (4) =	25.6006	(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 %) 88.0000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 2086.4524 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	376.7580	293.9424	238.3208	128.8377	50.9493	0.0000	0.0000	0.0000	0.0000	112.1956	247.4462	387.6282	(98)
Space heating efficiency (main heating system 1)													
	88.0000	88.0000	88.0000	88.0000	88.0000	0.0000	0.0000	0.0000	0.0000	88.0000	88.0000	88.0000	(210)
Space heating fuel (main heating system)													
	428.1341	334.0254	270.8191	146.4064	57.8969	0.0000	0.0000	0.0000	0.0000	127.4949	281.1888	440.4866	(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												
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
Efficiency of water heater												88.0000 (216)
(217)m	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000 (217)
Fuel for water heating, kWh/month												
	220.4762	192.5916	200.3791	177.7262	172.0703	151.5499	145.1964	161.8599	163.6475	186.3453	198.9199	215.2986 (219)
Water heating fuel used												2186.0607 (219)
Annual totals kWh/year												
Space heating fuel - main system												2086.4524 (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)												398.3717 (232)
Total delivered energy for all uses												4700.8849 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2086.4524	4.2800	89.3002 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2186.0607	4.2800	93.5634 (247)
Pumps and fans for heating	30.0000	15.4400	4.6320 (249)
Energy for lighting	398.3717	15.4400	61.5086 (250)
Additional standing charges			92.0000 (251)
Total energy cost			341.0042 (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	2086.4524	0.2160	450.6737 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2186.0607	0.2160	472.1891 (264)
Space and water heating			922.8628 (265)
Pumps and fans	30.0000	0.5190	15.5700 (267)
Energy for lighting	398.3717	0.5190	206.7549 (268)
Total kg/year			1145.1878 (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	2086.4524	1.2200	2545.4719 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2186.0607	1.2200	2666.9941 (264)
Space and water heating			5212.4660 (265)
Pumps and fans	30.0000	3.0700	92.1000 (267)
Energy for lighting	398.3717	3.0700	1223.0013 (268)
Primary energy kWh/year			6527.5673 (272)
Primary energy kWh/m2/year			91.0146 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 83
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)

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

Potential energy efficiency rating: B 83
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	£66	£66	£0
Mains gas	£275	£275	£0
Space heating	£186	£186	£0
Water heating	£94	£94	£0
Lighting	£62	£62	£0
Total cost of fuels	£341	£341	£0
Total cost of uses	£342	£342	£0
Delivered energy	66 kWh/m²	66 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.1 tonnes	1.1 tonnes	0.0 tonnes
CO2 emissions per m²	16 kg/m²	16 kg/m²	0 kg/m²
Primary energy	91 kWh/m²	91 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	East
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	380.58 (P1)
Transmission heat loss coefficient	48.68 (37)
Summer heat loss coefficient	429.26 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
South	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)
East	1.000	0.90	1.000	0.900 (P8)
South	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	5.8600	81.1852	0.6300	0.7000	0.9000	169.9409
East	2.6000	117.5071	0.6300	0.7000	0.9000	109.1342
South	6.0800	112.2060	0.6300	0.7000	0.9000	243.6931
total:						522.7683

	Jun	Jul	Aug	
Solar gains	552	523	475	(P3)
Internal gains	411	395	405	
Total summer gains	964	918	879	(P5)
Summer gain/loss ratio	2.24	2.14	2.05	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	19.54	21.34	21.15	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

Sample Report Ltd
1 Sample Street
Sampletown

Full SAP Calculation Printout

Property Reference: 25498 - Flat 01
Survey Reference: Be Clean PT3
Property: London, TW1 4BH

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

SAP Rating:	84 B	**CO2 Emissions (t/year):**	0.98	**DER:**	16.38 Pass	**TER:**	19.63	**Percentage DER<TER:**	16.58 %
Environmental:	88 B	**General Requirements Compliance:**	Pass	**DFEE:**	43.32 Pass	**TFEE:**	55.98	**Percentage DFEE<TFEE:**	22.62 %

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 'Be Clean PT3'
SAP2012 - 9.92 input data (DesignData) -


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

FullRefNo:                    Be Clean PT3

Regs Region:                  England
SAP Region:                   Thames Valley
Postcode:                     TW1 4BH
DwellingOrientation:          East
Property Type:                Flat, End-Terrace
Storeys:                      1
Date Built:                   2016
Sheltered Sides:              1
Sunlight Shade:               Average or unknown
Measurements                  Perimeter, Floor Area, Storey Height
    1st Storey:              29.12, 71.72, 2.68
Living Area:                  24.67 m2, fraction: 34.4%
Thermal Mass:                 Simple calculation
Thermal Mass Simple:          Low
Thermal MassValue:            100
External Walls                Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1               61.47, 78.04, 0, Other, Cavity, 0, 0.15, Gross
Party Walls                   Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                  22.65, 0, Other, FilledWithEdge, 0, 0
External Roofs                Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
    External Roof 1          9.08, 9.08, 0, Other, 0.11
Party Ceilings                Area, Kappa, Construction, Element
    Party Ceilings 1         62.64, 80, Concrete floor slab, carpeted
Heat Loss Floors              Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
    Heat Loss Floor 1        39.27, 0, Other, Exposed Floor - Solid, 0, 0.11
Party Floors                  Area, Kappa, Construction, Element
    Party Floor 1            32.45, 80
Description                   Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
    Windows                  Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
    Flat Door                Manufacturer, Solid Door, , , , , , ,
Openings                      Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    S F Windows              Window, External Wall 1, South, , None, 0, , 0, 0, 0, 5.78,
    Flat Door                Solid Door, External Wall 1, South, , , , , 0, 0, 0, 2.33,
    N F Windows              Window, External Wall 1, North, , None, 0, , 0, 0, 0, 5.86,
    E F Window               Window, External Wall 1, East, , None, 0, , 0, 0, 0, 2.60,
Conservatory:                 None
Draught Proofing:             100
Draught Lobby:                No
Thermal Bridges
    Bridging:                Calculate Bridges
    Y                        0.117
    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, , No, 0, 0, 0, 0.00,
    1.                       External wall, E2 Other lintels (including other steel lintels), Table K1 - Approved, Yes, 7.68, 0.3, 0.3, 2.30,
    2.                       External wall, E3 Sill, Table K1 - Approved, Yes, 6.63, 0.04, 0.04, 0.27,
    3.                       External wall, E4 Jamb, Table K1 - Approved, Yes, 29.56, 0.05, 0.05, 1.48,
    4.                       External wall, E5 Ground floor (normal), , No, 0, 0, 0, 0.00,
    5.                       External wall, E19 Ground floor (inverted), , No, 0, 0, 0, 0.00,
    6.                       External wall, E20 Exposed floor (normal), Table K1 - Default, No, 23.79, 0.32, 0.32, 7.61,
    7.                       External wall, E21 Exposed floor (inverted), , No, 0, 0, 0, 0.00,
    8.                       External wall, E22 Basement floor, , No, 0, 0, 0, 0.00,
    9.                       External wall, E6 Intermediate floor within a dwelling, , No, 0, 0, 0, 0.00,
    10.                      External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Approved, Yes, 29.12, 0.07, 0.07, 2.04,
    11.                      External wall, E8 Balcony within a dwelling, wall insulation continuous, , No, 0, 0, 0, 0.00,
    12.                      External wall, E9 Balcony between dwellings, wall insulation continuous, , No, 0, 0, 0, 0.00,
    13.                      External wall, E23 Balcony within or between dwellings, balcony support penetrates wall insulation , , No, 0, 0, 0, 0.00,
    14.                      External wall, E10 Eaves (insulation at ceiling level), , No, 0, 0, 0, 0.00,
    15.                      External wall, E24 Eaves (insulation at ceiling level - inverted), , No, 0, 0, 0, 0.00,
    16.                      External wall, E11 Eaves (insulation at rafter level), , No, 0, 0, 0, 0.00,
    17.                      External wall, E12 Gable (insulation at ceiling level), , No, 0, 0, 0, 0.00,
    18.                      External wall, E13 Gable (insulation at rafter level), , No, 0, 0, 0, 0.00,
    19.                      External wall, E14 Flat roof, , No, 0, 0, 0, 0.00,
    20.                      External wall, E15 Flat roof with parapet, , No, 0, 0, 0, 0.00,
    21.                      External wall, E16 Corner (normal), Table K1 - Approved, No, 8.04, 0.09, 0.09, 0.72,
    22.                      External wall, E17 Corner (inverted - internal area greater than external area), , No, 0, 0, 0, 0.00,
    23.                      External wall, E18 Party wall between dwellings, Table K1 - Approved, Yes, 5.36, 0.06, 0.06, 0.32,
    24.                      External wall, E25 Staggered party wall between dwellings, , No, 0, 0, 0, 0.00,
    25.                      Party wall, P1 Party wall - Ground floor, , No, 0, 0, 0, 0.00,
    26.                      Party wall, P6 Party wall - Ground floor (inverted), , No, 0, 0, 0, 0.00,
    27.                      Party wall, P2 Party wall - Intermediate floor within a dwelling, , No, 0, 0, 0, 0.00,
    28.                      Party wall, P3 Party wall - Intermediate floor between dwellings (in blocks of flats), , No, 0, 0, 0, 0.00,
    29.                      Party wall, P7 Party Wall - Exposed floor (normal), , No, 0, 0, 0, 0.00,
    30.                      Party wall, P8 Party Wall - Exposed floor (inverted), , No, 0, 0, 0, 0.00,
    31.                      Party wall, P4 Party wall - Roof (insulation at ceiling level), , No, 0, 0, 0, 0.00,
    32.                      Party wall, P5 Party wall - Roof (insulation at rafter level), , No, 0, 0, 0, 0.00,
```

```
    33.                     External roof, R1 Head of roof window, , No, 0, 0, 0, 0.00,
    34.                     External roof, R2 Sill of roof window, , No, 0, 0, 0, 0.00,
    35.                     External roof, R3 Jamb of roof window, , No, 0, 0, 0, 0.00,
    36.                     External roof, R4 Ridge (vaulted ceiling), , No, 0, 0, 0, 0.00,
    37.                     External roof, R5 Ridge (inverted), , No, 0, 0, 0, 0.00,
    38.                     External roof, R6 Flat ceiling, , No, 0, 0, 0, 0.00,
    39.                     External roof, R7 Flat ceiling (inverted), , No, 0, 0, 0, 0.00,
    40.                     External roof, R8 Roof to wall (rafter), , No, 0, 0, 0, 0.00,
    41.                     External roof, R9 Roof to wall (flat ceiling), , No, 0, 0, 0, 0.00,
Pressure Test:               True
Designed q50:                3
AsBuilt q50:                 15
Property Tested:             False
Mechanical Ventilation
    MV System Present        Yes
    Windows In Hot Weather   Windows fully open
    Cross Ventilation        Yes
    Night Ventilation        Yes
    Air Change Rate          6.00
    Approved Installation    Yes
    DataType                 Data Sheet
    Type                     Balanced mechanical ventilation with heat recovery
    HR Duct Insulated        Yes
    ManufacturerSFP          0.5
    DuctType                 Rigid
    HR Efficiency            90
    Wet Rooms                3
    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               None
Light Fittings:              8
LEL Fittings:                8
Percentage of LEL Fittings:  100
External Lights Fitted:      No
External LELs Fitted:        No
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   SAP Table
    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       No
    Ctrl SAP Code            2110
    Burner Control           OnOff
    Flue Type                None or Unknown
    Fan Assisted Flue        No
    Pumped                   Pump in heated space
    Heat Pump Age            2013 or later
    Heat Emitter             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 72 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) 19.63 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.38 kg/m²OK
-------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.0 kWh/m²
```

Dwelling Fabric Energy Efficiency (DFEE)43.3 kWh/m²OK

---

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	OK

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

---

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

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc
Combi boiler
Efficiency: 90%
Minimum: 88% 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: 5.86 m², No overhang
Windows facing East: 2.60 m², No overhang
Windows facing South: 5.78 m², No overhang
Air change rate: 6.00 ach
Blinds/curtains: None

---

10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Exposed floor U-value 0.11 W/m²K
Air permeability 3.0 m³/m²h

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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

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

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5000 (23c)

Effective ac	0.2944	0.2909	0.2875	0.2701	0.2667	0.2493	0.2493	0.2458	0.2563	0.2667	0.2736	0.2805	(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	
Windows (Uw = 1.20)			14.2400	1.1450	16.3053			(27)
Flat Door			2.3300	1.2000	2.7960			(26)
Heat Loss Floor 1			39.2700	0.1100	4.3197			(28b)
External Wall 1	78.0400	16.5700	61.4700	0.1500	9.2205			(29a)
External Roof 1	9.0800		9.0800	0.1100	0.9988			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		33.6403			(33)
Party Wall 1			22.6500	0.0000	0.0000			(32)
Party Floor 1			32.4500					(32d)
Party Ceilings 1			62.6400					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7436 (36)
Total fabric heat loss	(33) + (36) =	48.3839 (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	18.6739	18.4539	18.2339	17.1338	16.9138	15.8137	15.8137	15.5937	16.2537	16.9138	17.3538	17.7939	(38)
Heat transfer coeff	67.0579	66.8379	66.6178	65.5177	65.2977	64.1976	64.1976	63.9776	64.6377	65.2977	65.7378	66.1778	(39)
Average = Sum(39)m / 12 =												65.4627	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9350	0.9319	0.9289	0.9135	0.9105	0.8951	0.8951	0.8920	0.9013	0.9105	0.9166	0.9227	(40)
HLP (average)												0.9128	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.2871 (42)
Average daily hot water use (litres/day)		88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6599	18.9439	19.5484	17.0428	16.3530	14.1114	13.0762	15.0052	15.1844	17.6959	19.3165	20.9765	(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	49.6196	43.1879	46.0109	42.7805	42.4022	39.2882	40.5978	42.4022	42.7805	46.0109	46.2728	49.6196	(61)

Total heat required for water heating calculated for each month

	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (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												
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
								Total per year (kWh/year) = Sum(64)m =				1923.7334 (64)
Heat gains from water heating, kWh/month												
	60.4177	52.7893	54.8350	48.4733	46.8496	41.1022	39.1351	43.8620	44.3539	50.7287	54.3865	58.9027 (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	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.0845	16.0625	13.0629	9.8894	7.3925	6.2410	6.7437	8.7657	11.7653	14.9387	17.4357	18.5871	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	201.2777	203.3663	198.1030	186.8981	172.7539	159.4604	150.5795	148.4908	153.7541	164.9590	179.1032	192.3968	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	(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)													
	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)
Water heating gains (Table 5)													
	81.2066	78.5555	73.7030	67.3240	62.9699	57.0864	52.6010	58.9543	61.6026	68.1838	75.5367	79.1704	(72)
Total internal gains													
	360.8760	358.2915	345.1761	324.4188	303.4235	283.0950	270.2313	276.5180	287.4292	308.3887	332.3828	350.4614	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.8600	10.6334	0.6300	0.7000	0.7700	19.0433	(74)
East	2.6000	19.6403	0.6300	0.7000	0.7700	15.6060	(76)
South	5.7800	46.7521	0.6300	0.7000	0.7700	82.5849	(78)

Solar gains	117.2342	202.1741	284.4044	367.3789	426.5838	430.5121	412.1133	366.6229	312.8004	225.4283	140.8424	100.0700	(83)
Total gains	478.1101	560.4656	629.5805	691.7977	730.0073	713.6072	682.3447	643.1409	600.2296	533.8170	473.2253	450.5314	(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	29.7090	29.8068	29.9052	30.4074	30.5098	31.0326	31.0326	31.1394	30.8214	30.5098	30.3056	30.1041	
alpha	2.9806	2.9871	2.9937	3.0272	3.0340	3.0688	3.0688	3.0760	3.0548	3.0340	3.0204	3.0069	
util living area	0.9531	0.9263	0.8820	0.8003	0.6792	0.5256	0.3973	0.4342	0.6330	0.8341	0.9289	0.9596	(86)
MIT	19.5690	19.7844	20.0792	20.4245	20.6843	20.8389	20.8890	20.8816	20.7768	20.4349	19.9471	19.5326	(87)
Th 2	20.1379	20.1404	20.1430	20.1560	20.1586	20.1717	20.1717	20.1743	20.1664	20.1586	20.1534	20.1482	(88)
util rest of house	0.9468	0.9168	0.8669	0.7752	0.6396	0.4693	0.3281	0.3637	0.5782	0.8075	0.9182	0.9542	(89)
MIT 2	18.2040	18.5144	18.9355	19.4261	19.7739	19.9748	20.0269	20.0234	19.9025	19.4524	18.7619	18.1592	(90)
Living area fraction										fLA = Living area / (4) =		0.3440	(91)
MIT	18.6735	18.9512	19.3289	19.7695	20.0870	20.2720	20.3235	20.3186	20.2032	19.7904	19.1695	18.6316	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6735	18.9512	19.3289	19.7695	20.0870	20.2720	20.3235	20.3186	20.2032	19.7904	19.1695	18.6316	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9336	0.9011	0.8504	0.7625	0.6360	0.4764	0.3411	0.3764	0.5808	0.7942	0.9031	0.9420	(94)
Useful gains	446.3500	505.0354	535.3777	527.4773	464.3140	339.9446	232.7374	242.0836	348.6145	423.9784	427.3902	424.3889	(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	963.8592	939.1523	854.6318	712.1480	547.6545	364.1300	239.0371	250.7045	394.4997	600.1112	793.4252	955.0513	(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	385.0269	291.7266	237.5251	132.9629	62.0053	0.0000	0.0000	0.0000	0.0000	131.0428	263.5452	394.8129	(98)
Space heating												1898.6476	(98)
Space heating per m2											(98) / (4) =	26.4731	(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 %)	90.0000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	2109.6084 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	385.0269	291.7266	237.5251	132.9629	62.0053	0.0000	0.0000	0.0000	0.0000	131.0428	263.5452	394.8129	(98)
Space heating efficiency (main heating system 1)													

	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000 (210)
Space heating fuel (main heating system)												
	427.8076	324.1406	263.9167	147.7365	68.8948	0.0000	0.0000	0.0000	0.0000	145.6031	292.8280	438.6810 (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												
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
Efficiency of water heater												90.0000 (216)
(217)m	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000 (217)
Fuel for water heating, kWh/month												
	215.5767	188.3118	195.9262	173.7767	168.2465	148.1821	141.9698	158.2630	160.0109	182.2043	194.4994	210.5142 (219)
Water heating fuel used												2137.4816 (219)
Annual totals kWh/year												
Space heating fuel - main system												2109.6084 (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)	146.5598 (230a)
central heating pump	30.0000 (230c)
Total electricity for the above, kWh/year	176.5598 (231)
Electricity for lighting (calculated in Appendix L)	319.3775 (232)
Total delivered energy for all uses	4743.0273 (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	2109.6084	0.2160	455.6754 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2137.4816	0.2160	461.6960 (264)
Space and water heating			917.3714 (265)
Pumps and fans	176.5598	0.5190	91.6345 (267)
Energy for lighting	319.3775	0.5190	165.7569 (268)
Total CO2, kg/year			1174.7629 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.3800 (273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES			
DER		16.3800	ZC1
Total Floor Area	TFA	71.7200	
Assumed number of occupants	N	2.2871	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.6304	ZC2
CO2 emissions from cooking, equation (L16)		2.4246	ZC3
Total CO2 emissions		35.4349	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		35.4349	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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096 (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							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1561	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.4061	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3756	(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	0.4789	0.4695	0.4601	0.4132	0.4038	0.3568	0.3568	0.3475	0.3756	0.4038	0.4226	0.4414	(22b)
Effective ac	0.6147	0.6102	0.6059	0.5854	0.5815	0.5637	0.5637	0.5604	0.5705	0.5815	0.5893	0.5974	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3300	1.0000	2.3300			(26)
TER Opening Type (Uw = 1.40)			14.2400	1.3258	18.8788			(27)
Heat Loss Floor 1			39.2700	0.1300	5.1051			(28b)
External Wall 1	78.0400	16.5700	61.4700	0.1800	11.0646			(29a)
External Roof 1	9.0800		9.0800	0.1300	1.1804			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.5589			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.8899	(36)
Total fabric heat loss					(33) + (36) =		51.4488	(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	38.9888	38.7063	38.4294	37.1290	36.8857	35.7530	35.7530	35.5433	36.1893	36.8857	37.3779	37.8925	(38)
Heat transfer coeff	90.4376	90.1551	89.8782	88.5778	88.3345	87.2018	87.2018	86.9920	87.6381	88.3345	88.8267	89.3413	(39)
Average = Sum(39)m / 12 =												88.5766	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2610	1.2570	1.2532	1.2350	1.2317	1.2159	1.2159	1.2129	1.2219	1.2317	1.2385	1.2457	(40)
HLP (average)												1.2350	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2871	(42)
Average daily hot water use (litres/day)	88.5198	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6599	18.9439	19.5484	17.0428	16.3530	14.1114	13.0762	15.0052	15.1844	17.6959	19.3165	20.9765	(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	49.6196	43.1879	46.0109	42.7805	42.4022	39.2882	40.5978	42.4022	42.7805	46.0109	46.2728	49.6196	(61)
Total heat required for water heating calculated for each month	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627	(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	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627	(64)
								Total per year (kWh/year) = Sum(64)m =				1923.7334	(64)

Heat gains from water heating, kWh/month

60.4177 52.7893 54.8350 48.4733 46.8496 41.1022 39.1351 43.8620 44.3539 50.7287 54.3865 58.9027 (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	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	(66)

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

	18.0845	16.0625	13.0629	9.8894	7.3925	6.2410	6.7437	8.7657	11.7653	14.9387	17.4357	18.5871	(67)

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

	201.2777	203.3663	198.1030	186.8981	172.7539	159.4604	150.5795	148.4908	153.7541	164.9590	179.1032	192.3968	(68)

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

	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	(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)

	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)

Water heating gains (Table 5)

	81.2066	78.5555	73.7030	67.3240	62.9699	57.0864	52.6010	58.9543	61.6026	68.1838	75.5367	79.1704	(72)

Total internal gains

	360.8760	358.2915	345.1761	324.4188	303.4235	283.0950	270.2313	276.5180	287.4292	308.3887	332.3828	350.4614	(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	5.8600	10.6334	0.6300	0.7000	0.7700	19.0433	(74)
East	2.6000	19.6403	0.6300	0.7000	0.7700	15.6060	(76)
South	5.7800	46.7521	0.6300	0.7000	0.7700	82.5849	(78)

Solar gains	117.2342	202.1741	284.4044	367.3789	426.5838	430.5121	412.1133	366.6229	312.8004	225.4283	140.8424	100.0700	(83)
Total gains	478.1101	560.4656	629.5805	691.7977	730.0073	713.6072	682.3447	643.1409	600.2296	533.8170	473.2253	450.5314	(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	55.0718	55.2443	55.4145	56.2281	56.3829	57.1153	57.1153	57.2530	56.8310	56.3829	56.0705	55.7475	
alpha	4.6715	4.6830	4.6943	4.7485	4.7589	4.8077	4.8077	4.8169	4.7887	4.7589	4.7380	4.7165	
util living area													
	0.9968	0.9928	0.9827	0.9518	0.8713	0.7133	0.5463	0.5967	0.8303	0.9669	0.9934	0.9976	(86)
MIT	19.6732	19.8504	20.1202	20.4670	20.7607	20.9365	20.9859	20.9787	20.8626	20.4806	20.0147	19.6467	(87)
Th 2	19.8715	19.8746	19.8777	19.8921	19.8948	19.9073	19.9073	19.9097	19.9025	19.8948	19.8893	19.8836	(88)
util rest of house													
	0.9957	0.9904	0.9766	0.9336	0.8229	0.6176	0.4188	0.4677	0.7524	0.9508	0.9907	0.9968	(89)
MIT 2	18.1191	18.3791	18.7716	19.2729	19.6619	19.8655	19.9023	19.9011	19.7947	19.3023	18.6300	18.0888	(90)
Living area fraction										fLA = Living area / (4) =		0.3440	(91)
MIT	18.6537	18.8852	19.2355	19.6836	20.0399	20.2339	20.2750	20.2718	20.1620	19.7076	19.1063	18.6247	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6537	18.8852	19.2355	19.6836	20.0399	20.2339	20.2750	20.2718	20.1620	19.7076	19.1063	18.6247	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9940	0.9874	0.9719	0.9293	0.8301	0.6482	0.4630	0.5124	0.7732	0.9473	0.9880	0.9954	(94)
Useful gains	475.2582	553.4080	611.8715	642.9217	605.9819	462.5669	315.9189	329.5334	464.1091	505.6616	467.5694	448.4650	(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													
	1298.1112	1260.8377	1144.6430	955.1913	736.7006	491.2862	320.4665	336.8172	531.2655	804.5163	1066.4788	1288.7199	(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													
	612.2026	475.3928	396.3820	224.8341	97.2547	0.0000	0.0000	0.0000	0.0000	222.3479	431.2148	625.1496	(98)
Space heating												3084.7784	(98)
Space heating per m2											(98) / (4) =	43.0114	(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 3302.7606 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	612.2026	475.3928	396.3820	224.8341	97.2547	0.0000	0.0000	0.0000	0.0000	222.3479	431.2148	625.1496	(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)													
	655.4632	508.9858	424.3918	240.7217	104.1270	0.0000	0.0000	0.0000	0.0000	238.0599	461.6860	669.3251	(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												
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
Efficiency of water heater												80.3000 (216)
(217)m	87.7441	87.5073	87.0297	85.9642	83.9690	80.3000	80.3000	80.3000	80.3000	85.8183	87.2320	87.8306 (217)
Fuel for water heating, kWh/month												
	221.1192	193.6759	202.6132	181.9350	180.3307	166.0821	159.1193	177.3807	179.3397	191.0826	200.6711	215.7137 (219)
Water heating fuel used												2269.0631 (219)
Annual totals kWh/year												
Space heating fuel - main system												3302.7606 (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)												319.3775 (232)
Total delivered energy for all uses												5966.2012 (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	3302.7606	0.2160	713.3963 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2269.0631	0.2160	490.1176 (264)
Space and water heating			1203.5139 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	319.3775	0.5190	165.7569 (268)
Total CO2, kg/m2/year			1408.1959 (272)
Emissions per m2 for space and water heating			16.7807 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.3112 (272b)
Emissions per m2 for pumps and fans			0.5427 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.7807 * 1.00) + 2.3112 + 0.5427, rounded to 2 d.p.			19.6300 (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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(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							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1561	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.3061	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2831	(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	0.3610	0.3539	0.3468	0.3114	0.3044	0.2690	0.2690	0.2619	0.2831	0.3044	0.3185	0.3327	(22b)
Effective ac	0.5652	0.5626	0.5601	0.5485	0.5463	0.5362	0.5362	0.5343	0.5401	0.5463	0.5507	0.5553	(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	
Windows (Uw = 1.20)			14.2400	1.1450	16.3053			(27)
Flat Door			2.3300	1.2000	2.7960			(26)
Heat Loss Floor 1			39.2700	0.1100	4.3197			(28b)
External Wall 1	78.0400	16.5700	61.4700	0.1500	9.2205			(29a)
External Roof 1	9.0800		9.0800	0.1100	0.9988			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.6403			(33)
Party Wall 1			22.6500	0.0000	0.0000			(32)
Party Floor 1			32.4500					(32d)
Party Ceilings 1			62.6400					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7436 (36)
Total fabric heat loss	(33) + (36) =	48.3839 (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	35.8473	35.6868	35.5295	34.7907	34.6524	34.0089	34.0089	33.8898	34.2568	34.6524	34.9321	35.2244	(38)
Heat transfer coeff	84.2312	84.0707	83.9134	83.1746	83.0364	82.3929	82.3929	82.2737	82.6407	83.0364	83.3160	83.6084	(39)
Average = Sum(39)m / 12 =												83.1739	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1744	1.1722	1.1700	1.1597	1.1578	1.1488	1.1488	1.1472	1.1523	1.1578	1.1617	1.1658	(40)
HLP (average)												1.1597	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2871 (42)
Average daily hot water use (litres/day)	88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(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	30.6849	26.8372	27.6936	24.1439	23.1667	19.9911	18.5247	21.2573	21.5112	25.0693	27.3651	29.7167	(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	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	(66)

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

	18.0845	16.0625	13.0629	9.8894	7.3925	6.2410	6.7437	8.7657	11.7653	14.9387	17.4357	18.5871	(67)

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

	201.2777	203.3663	198.1030	186.8981	172.7539	159.4604	150.5795	148.4908	153.7541	164.9590	179.1032	192.3968	(68)

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

	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	(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)

	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)

Water heating gains (Table 5)

	41.2431	39.9363	37.2226	33.5332	31.1380	27.7654	24.8988	28.5717	29.8767	33.6952	38.0070	39.9418	(72)

Total internal gains

	317.9125	316.6723	305.6957	287.6280	268.5916	250.7740	239.5291	243.1354	252.7033	270.9002	291.8531	308.2328	(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	5.8600	10.6334	0.6300	0.7000	0.7700	19.0433	(74)
East	2.6000	19.6403	0.6300	0.7000	0.7700	15.6060	(76)
South	5.7800	46.7521	0.6300	0.7000	0.7700	82.5849	(78)

Solar gains	117.2342	202.1741	284.4044	367.3789	426.5838	430.5121	412.1133	366.6229	312.8004	225.4283	140.8424	100.0700	(83)
Total gains	435.1466	518.8464	590.1001	655.0069	695.1754	681.2861	651.6424	609.7583	565.5037	496.3285	432.6955	408.3028	(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	23.6518	23.6970	23.7414	23.9523	23.9922	24.1795	24.1795	24.2146	24.1070	23.9922	23.9116	23.8280	
alpha	2.5768	2.5798	2.5828	2.5968	2.5995	2.6120	2.6120	2.6143	2.6071	2.5995	2.5941	2.5885	
util living area													
	0.9659	0.9463	0.9141	0.8545	0.7590	0.6256	0.4957	0.5383	0.7258	0.8833	0.9498	0.9707	(86)
MIT	18.5636	18.8677	19.3244	19.8910	20.3923	20.7480	20.9015	20.8748	20.6023	19.9438	19.1464	18.5020	(87)
Th 2	19.9405	19.9423	19.9441	19.9524	19.9539	19.9612	19.9612	19.9625	19.9584	19.9539	19.9508	19.9475	(88)
util rest of house													
	0.9607	0.9382	0.9008	0.8308	0.7170	0.5554	0.3976	0.4411	0.6646	0.8592	0.9409	0.9662	(89)
MIT 2	17.7189	18.0195	18.4682	19.0211	19.4896	19.8034	19.9167	19.9023	19.6888	19.0838	18.3045	17.6629	(90)
Living area fraction									fLA = Living area / (4) =			0.3440	(91)
MIT	18.0095	18.3113	18.7627	19.3203	19.8001	20.1283	20.2554	20.2368	20.0030	19.3796	18.5941	17.9515	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0095	18.3113	18.7627	19.3203	19.8001	20.1283	20.2554	20.2368	20.0030	19.3796	18.5941	17.9515	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9480	0.9223	0.8825	0.8141	0.7102	0.5676	0.4269	0.4685	0.6675	0.8432	0.9259	0.9547	(94)
Useful gains	412.5266	478.5226	520.7822	533.2149	493.6861	386.6740	278.1904	285.6610	377.4910	418.5138	400.6471	389.7968	(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													
	1154.7651	1127.4969	1029.0078	866.7041	672.6026	455.4920	301.1824	315.6706	487.8289	729.0239	957.6439	1149.7425	(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													
	552.2254	436.1107	378.1199	240.1122	133.1139	0.0000	0.0000	0.0000	0.0000	231.0195	401.0377	565.3996	(98)
Space heating												2937.1390	(98)
Space heating per m2											(98) / (4) =	40.9529	(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	774.4930	609.7072	625.2802	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7681	0.8285	0.8045	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	594.8725	505.1431	503.0424	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	881.3175	844.9473	797.3872	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	206.2404	252.8143	218.9925	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												678.0472	(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	51.5601	63.2036	54.7481	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												169.5118	(107)
Space cooling per m2												2.3635	(108)
Energy for space heating												40.9529	(99)
Energy for space cooling												2.3635	(108)
Total												43.3164	(109)
Dwelling Fabric Energy Efficiency (DFEE)												43.3	(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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(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							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1561	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.4061	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3756	(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	0.4789	0.4695	0.4601	0.4132	0.4038	0.3568	0.3568	0.3475	0.3756	0.4038	0.4226	0.4414	(22b)
Effective ac	0.6147	0.6102	0.6059	0.5854	0.5815	0.5637	0.5637	0.5604	0.5705	0.5815	0.5893	0.5974	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3300	1.0000	2.3300			(26)
TER Opening Type (Uw = 1.40)			14.2400	1.3258	18.8788			(27)
Heat Loss Floor 1			39.2700	0.1300	5.1051			(28b)
External Wall 1	78.0400	16.5700	61.4700	0.1800	11.0646			(29a)
External Roof 1	9.0800		9.0800	0.1300	1.1804			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.5589			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.8899 (36)
Total fabric heat loss	(33) + (36) =	51.4488 (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	38.9888	38.7063	38.4294	37.1290	36.8857	35.7530	35.7530	35.5433	36.1893	36.8857	37.3779	37.8925	(38)
Heat transfer coeff	90.4376	90.1551	89.8782	88.5778	88.3345	87.2018	87.2018	86.9920	87.6381	88.3345	88.8267	89.3413	(39)
Average = Sum(39)m / 12 =												88.5766	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2610	1.2570	1.2532	1.2350	1.2317	1.2159	1.2159	1.2129	1.2219	1.2317	1.2385	1.2457	(40)
HLP (average)												1.2350	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2871 (42)
Average daily hot water use (litres/day)	88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(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	30.6849	26.8372	27.6936	24.1439	23.1667	19.9911	18.5247	21.2573	21.5112	25.0693	27.3651	29.7167	(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	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	(66)

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

	18.0845	16.0625	13.0629	9.8894	7.3925	6.2410	6.7437	8.7657	11.7653	14.9387	17.4357	18.5871	(67)

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

	201.2777	203.3663	198.1030	186.8981	172.7539	159.4604	150.5795	148.4908	153.7541	164.9590	179.1032	192.3968	(68)

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

	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	(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)

	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)

Water heating gains (Table 5)

	41.2431	39.9363	37.2226	33.5332	31.1380	27.7654	24.8988	28.5717	29.8767	33.6952	38.0070	39.9418	(72)
Total internal gains													
	317.9125	316.6723	305.6957	287.6280	268.5916	250.7740	239.5291	243.1354	252.7033	270.9002	291.8531	308.2328	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	5.8600	10.6334	0.6300	0.7000	0.7700	19.0433 (74)
East	2.6000	19.6403	0.6300	0.7000	0.7700	15.6060 (76)
South	5.7800	46.7521	0.6300	0.7000	0.7700	82.5849 (78)

Solar gains	117.2342	202.1741	284.4044	367.3789	426.5838	430.5121	412.1133	366.6229	312.8004	225.4283	140.8424	100.0700	(83)
Total gains	435.1466	518.8464	590.1001	655.0069	695.1754	681.2861	651.6424	609.7583	565.5037	496.3285	432.6955	408.3028	(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	55.0718	55.2443	55.4145	56.2281	56.3829	57.1153	57.1153	57.2530	56.8310	56.3829	56.0705	55.7475	
alpha	4.6715	4.6830	4.6943	4.7485	4.7589	4.8077	4.8077	4.8169	4.7887	4.7589	4.7380	4.7165	
util living area													
	0.9979	0.9948	0.9866	0.9601	0.8875	0.7364	0.5689	0.6238	0.8538	0.9747	0.9955	0.9984	(86)
MIT	19.6188	19.7986	20.0732	20.4289	20.7361	20.9270	20.9832	20.9744	20.8424	20.4389	19.9639	19.5929	(87)
Th 2	19.8715	19.8746	19.8777	19.8921	19.8948	19.9073	19.9073	19.9097	19.9025	19.8948	19.8893	19.8836	(88)
util rest of house													
	0.9971	0.9930	0.9817	0.9445	0.8426	0.6413	0.4376	0.4916	0.7806	0.9619	0.9936	0.9979	(89)
MIT 2	18.6209	18.8023	19.0768	19.4343	19.7166	19.8739	19.9032	19.9025	19.8158	19.4513	18.9793	18.6046	(90)
Living area fraction										fLA = Living area / (4) =		0.3440	(91)
MIT	18.9642	19.1450	19.4196	19.7764	20.0673	20.2361	20.2747	20.2712	20.1689	19.7910	19.3180	18.9446	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9642	19.1450	19.4196	19.7764	20.0673	20.2361	20.2747	20.2712	20.1689	19.7910	19.3180	18.9446	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9963	0.9914	0.9791	0.9425	0.8507	0.6722	0.4834	0.5377	0.8009	0.9603	0.9923	0.9972	(94)
Useful gains	433.5402	514.3844	577.7403	617.3446	591.3666	457.9633	314.9825	327.8432	452.9375	476.6238	429.3435	407.1779	(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													
	1326.1912	1284.2620	1161.1869	963.4075	739.1183	491.4806	320.4386	336.7626	531.8681	811.8844	1085.2859	1317.2976	(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													
	664.1323	517.3578	434.0843	249.1653	109.9272	0.0000	0.0000	0.0000	0.0000	249.4339	472.2786	677.1291	(98)
Space heating												3373.5084	(98)
Space heating per m2											(98) / (4) =	47.0372	(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	819.6969	645.2933	661.1395	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8564	0.9183	0.8956	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	701.9709	592.5504	592.1216	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	881.3175	844.9473	797.3872	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	129.1296	187.7833	152.7176	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												469.6305	(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	32.2824	46.9458	38.1794	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												117.4076	(107)
Space cooling per m2												1.6370	(108)
Energy for space heating												47.0372	(99)
Energy for space cooling												1.6370	(108)
Total												48.6742	(109)
Target Fabric Energy Efficiency (TFEE)												56.0	(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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.5000	3.5000	3.3000	3.4000	3.1000	3.3000	3.0000	3.0000	3.1000	3.1000	3.5000	(22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8500	0.7750	0.8250	0.7500	0.7500	0.7750	0.7750	0.8750	(22a)
Adj infilt rate	0.1318	0.1214	0.1214	0.1145	0.1179	0.1075	0.1145	0.1041	0.1041	0.1075	0.1075	0.1214	(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	0.2493	0.2389	0.2389	0.2320	0.2354	0.2250	0.2320	0.2216	0.2216	0.2250	0.2250	0.2389	(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	
Windows (Uw = 1.20)			14.2400	1.1450	16.3053			(27)
Flat Door			2.3300	1.2000	2.7960			(26)
Heat Loss Floor 1			39.2700	0.1100	4.3197			(28b)
External Wall 1	78.0400	16.5700	61.4700	0.1500	9.2205			(29a)
External Roof 1	9.0800		9.0800	0.1100	0.9988			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		33.6403			(33)
Party Wall 1			22.6500	0.0000	0.0000			(32)
Party Floor 1			32.4500					(32d)
Party Ceilings 1			62.6400					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7436 (36)
Total fabric heat loss	(33) + (36) =	48.3839 (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	15.8137	15.1536	15.1536	14.7136	14.9336	14.2735	14.7136	14.0535	14.0535	14.2735	14.2735	15.1536	(38)
Heat transfer coeff	64.1976	63.5376	63.5376	63.0975	63.3175	62.6575	63.0975	62.4375	62.4375	62.6575	62.6575	63.5376	(39)

Average = Sum(39)m / 12 = 63.0975 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8951	0.8859	0.8859	0.8798	0.8828	0.8736	0.8798	0.8706	0.8706	0.8736	0.8736	0.8859	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

HLP (average) 0.8798 (40)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.2871 (42)
Average daily hot water use (litres/day) 88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6599	18.9439	19.5484	17.0428	16.3530	14.1114	13.0762	15.0052	15.1844	17.6959	19.3165	20.9765	(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	49.6196	43.1879	46.0109	42.7805	42.4022	39.2882	40.5978	42.4022	42.7805	46.0109	46.2728	49.6196	(61)

Total heat required for water heating calculated for each month

	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (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												
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
								Total per year (kWh/year) = Sum(64)m =				1923.7334 (64)
RHI water heating demand												1924 (64)
Heat gains from water heating, kWh/month												
	60.4177	52.7893	54.8350	48.4733	46.8496	41.1022	39.1351	43.8620	44.3539	50.7287	54.3865	58.9027 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	45.2112	40.1562	32.6572	24.7236	18.4812	15.6026	16.8592	21.9142	29.4131	37.3467	43.5892	46.4678	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	300.4144	303.5318	295.6761	278.9524	257.8417	238.0005	224.7455	221.6281	229.4837	246.2075	267.3182	287.1593	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	(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)													
	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)
Water heating gains (Table 5)													
	81.2066	78.5555	73.7030	67.3240	62.9699	57.0864	52.6010	58.9543	61.6026	68.1838	75.5367	79.1704	(72)
Total internal gains													
	526.5852	521.9965	501.7893	470.7530	439.0457	410.4425	393.9586	402.2496	420.2525	451.4910	486.1971	512.5504	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.8600	11.9672	0.6300	0.7000	0.7700	21.4320	(74)
East	2.6000	22.3142	0.6300	0.7000	0.7700	17.7307	(76)
South	5.7800	50.8329	0.6300	0.7000	0.7700	89.7933	(78)

Solar gains	128.9560	196.7935	279.6086	372.4523	424.2574	457.3603	434.5422	393.2326	331.5858	242.1091	154.6840	108.9976	(83)
Total gains	655.5412	718.7899	781.3979	843.2053	863.3031	867.8028	828.5008	795.4822	751.8383	693.6001	640.8812	621.5480	(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	31.0326	31.3550	31.3550	31.5737	31.4640	31.7954	31.5737	31.9075	31.9075	31.7954	31.7954	31.3550	
alpha	3.0688	3.0903	3.0903	3.1049	3.0976	3.1197	3.1049	3.1272	3.1272	3.1197	3.1197	3.0903	
util living area													
	0.8840	0.8479	0.7816	0.6630	0.5075	0.3183	0.1895	0.2183	0.4345	0.6741	0.8296	0.8951	(86)
MIT	20.0607	20.2194	20.4441	20.6870	20.8375	20.9018	20.9118	20.9114	20.8792	20.7146	20.3811	20.0317	(87)
Th 2	20.1717	20.1795	20.1795	20.1847	20.1821	20.1900	20.1847	20.1926	20.1926	20.1900	20.1900	20.1795	(88)
util rest of house													
	0.8704	0.8310	0.7580	0.6290	0.4611	0.2633	0.1281	0.1560	0.3770	0.6341	0.8081	0.8825	(89)
MIT 2	18.9287	19.1566	19.4668	19.7950	19.9793	20.0552	20.0573	20.0655	20.0374	19.8416	19.3953	18.8947	(90)
Living area fraction									fLA = Living area / (4) =			0.3440	(91)
MIT	19.3181	19.5221	19.8030	20.1018	20.2745	20.3464	20.3512	20.3565	20.3270	20.1419	19.7344	19.2858	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3181	19.5221	19.8030	20.1018	20.2745	20.3464	20.3512	20.3565	20.3270	20.1419	19.7344	19.2858	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8543	0.8158	0.7463	0.6254	0.4665	0.2740	0.1407	0.1687	0.3868	0.6316	0.7946	0.8666	(94)
Useful gains	560.0111	586.4081	583.1301	527.3036	402.7270	237.7926	116.5761	134.2125	290.7869	438.0675	509.2644	538.6457	(95)
Ext temp.	5.5000	6.1000	7.8000	10.4000	13.5000	16.5000	18.5000	18.2000	15.5000	12.0000	8.4000	5.5000	(96)
Heat loss rate W													
	887.0863	852.8106	762.6385	612.1617	428.9457	241.0076	116.8051	134.6455	301.3857	510.1511	710.1839	875.9180	(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													
	243.3440	179.0225	133.5542	61.0978	19.5067	0.0000	0.0000	0.0000	0.0000	53.6302	144.6620	250.9306	(98)
Space heating												1085.7480	(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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

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

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5000 (23c)

Effective ac	0.2944	0.2909	0.2875	0.2701	0.2667	0.2493	0.2493	0.2458	0.2563	0.2667	0.2736	0.2805	(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	
Windows (Uw = 1.20)			14.2400	1.1450	16.3053			(27)
Flat Door			2.3300	1.2000	2.7960			(26)
Heat Loss Floor 1			39.2700	0.1100	4.3197			(28b)
External Wall 1	78.0400	16.5700	61.4700	0.1500	9.2205			(29a)
External Roof 1	9.0800		9.0800	0.1100	0.9988			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.6403			(33)
Party Wall 1			22.6500	0.0000	0.0000			(32)
Party Floor 1			32.4500					(32d)
Party Ceilings 1			62.6400					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7436 (36)
Total fabric heat loss	(33) + (36) =	48.3839 (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	18.6739	18.4539	18.2339	17.1338	16.9138	15.8137	15.8137	15.5937	16.2537	16.9138	17.3538	17.7939	(38)
Heat transfer coeff	67.0579	66.8379	66.6178	65.5177	65.2977	64.1976	64.1976	63.9776	64.6377	65.2977	65.7378	66.1778	(39)
Average = Sum(39)m / 12 =												65.4627	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9350	0.9319	0.9289	0.9135	0.9105	0.8951	0.8951	0.8920	0.9013	0.9105	0.9166	0.9227	(40)
HLP (average)												0.9128	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2871 (42)
Average daily hot water use (litres/day)	88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6599	18.9439	19.5484	17.0428	16.3530	14.1114	13.0762	15.0052	15.1844	17.6959	19.3165	20.9765	(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	49.6196	43.1879	46.0109	42.7805	42.4022	39.2882	40.5978	42.4022	42.7805	46.0109	46.2728	49.6196	(61)
Total heat required for water heating calculated for each month													

	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627	(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													
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627	(64)
								Total per year (kWh/year) = Sum(64)m =				1923.7334	(64)
Heat gains from water heating, kWh/month													
	60.4177	52.7893	54.8350	48.4733	46.8496	41.1022	39.1351	43.8620	44.3539	50.7287	54.3865	58.9027	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	45.2112	40.1562	32.6572	24.7236	18.4812	15.6026	16.8592	21.9142	29.4131	37.3467	43.5892	46.4678	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	300.4144	303.5318	295.6761	278.9524	257.8417	238.0005	224.7455	221.6281	229.4837	246.2075	267.3182	287.1593	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	(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)													
	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)
Water heating gains (Table 5)													
	81.2066	78.5555	73.7030	67.3240	62.9699	57.0864	52.6010	58.9543	61.6026	68.1838	75.5367	79.1704	(72)
Total internal gains													
	526.5852	521.9965	501.7893	470.7530	439.0457	410.4425	393.9586	402.2496	420.2525	451.4910	486.1971	512.5504	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.8600	10.6334	0.6300	0.7000	0.7700	19.0433	(74)
East	2.6000	19.6403	0.6300	0.7000	0.7700	15.6060	(76)
South	5.7800	46.7521	0.6300	0.7000	0.7700	82.5849	(78)

Solar gains	117.2342	202.1741	284.4044	367.3789	426.5838	430.5121	412.1133	366.6229	312.8004	225.4283	140.8424	100.0700	(83)
Total gains	643.8194	724.1705	786.1937	838.1319	865.6295	840.9547	806.0719	768.8725	733.0529	676.9193	627.0395	612.6204	(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	29.7090	29.8068	29.9052	30.4074	30.5098	31.0326	31.0326	31.1394	30.8214	30.5098	30.3056	30.1041	
alpha	2.9806	2.9871	2.9937	3.0272	3.0340	3.0688	3.0688	3.0760	3.0548	3.0340	3.0204	3.0069	
util living area	0.9082	0.8738	0.8208	0.7304	0.6076	0.4592	0.3412	0.3702	0.5482	0.7533	0.8710	0.9176	(86)
MIT	19.8295	20.0140	20.2613	20.5436	20.7457	20.8618	20.8970	20.8927	20.8216	20.5667	20.1637	19.7959	(87)
Th 2	20.1379	20.1404	20.1430	20.1560	20.1586	20.1717	20.1717	20.1743	20.1664	20.1586	20.1534	20.1482	(88)
util rest of house	0.8974	0.8597	0.8011	0.7017	0.5675	0.4070	0.2801	0.3079	0.4950	0.7208	0.8543	0.9078	(89)
MIT 2	18.5739	18.8361	19.1844	19.5808	19.8463	19.9970	20.0327	20.0319	19.9497	19.6222	19.0631	18.5342	(90)
Living area fraction									fLA = Living area / (4) =			0.3440	(91)
MIT	19.0058	19.2413	19.5549	19.9119	20.1557	20.2945	20.3300	20.3280	20.2496	19.9471	19.4417	18.9682	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0058	19.2413	19.5549	19.9119	20.1557	20.2945	20.3300	20.3280	20.2496	19.9471	19.4417	18.9682	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8808	0.8428	0.7861	0.6928	0.5673	0.4150	0.2920	0.3197	0.5005	0.7119	0.8383	0.8917	(94)
Useful gains	567.0468	610.3166	618.0064	580.6979	491.0814	348.9816	235.3710	245.8181	366.8824	481.9109	525.6479	546.2901	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	986.1384	958.5413	869.6863	721.4778	552.1379	365.5710	239.4594	251.3011	397.4964	610.3426	811.3152	977.3286	(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	311.8042	234.0070	187.2498	101.3615	45.4261	0.0000	0.0000	0.0000	0.0000	95.5532	205.6805	320.6927	(98)
Space heating												1501.7750	(98)
Space heating per m2											(98) / (4) =	20.9394	(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 %)	90.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1668.6389	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	311.8042	234.0070	187.2498	101.3615	45.4261	0.0000	0.0000	0.0000	0.0000	95.5532	205.6805	320.6927	(98)
Space heating efficiency (main heating system 1)													

	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000 (210)
Space heating fuel (main heating system)												
	346.4491	260.0078	208.0554	112.6239	50.4734	0.0000	0.0000	0.0000	0.0000	106.1702	228.5338	356.3252 (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

194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)

Efficiency of water heater 90.0000 (216)

(217)m	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000 (217)

Fuel for water heating, kWh/month

215.5767	188.3118	195.9262	173.7767	168.2465	148.1821	141.9698	158.2630	160.0109	182.2043	194.4994	210.5142 (219)

Water heating fuel used 2137.4816 (219)
Annual totals kWh/year
Space heating fuel - main system 1668.6389 (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) 146.5598 (230a)
central heating pump 30.0000 (230c)
Total electricity for the above, kWh/year 176.5598 (231)
Electricity for lighting (calculated in Appendix L) 319.3775 (232)
Total delivered energy for all uses 4302.0578 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1668.6389	3.4800	58.0686 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2137.4816	3.4800	74.3844 (247)
Mechanical ventilation fans	146.5598	13.1900	19.3312 (249)
Pumps and fans for heating	30.0000	13.1900	3.9570 (249)
Energy for lighting	319.3775	13.1900	42.1259 (250)
Additional standing charges			120.0000 (251)
Total energy cost			317.8671 (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] = 1.1438 (257)
SAP value 84.0440
SAP rating (Section 12) 84 (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	1668.6389	0.2160	360.4260 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2137.4816	0.2160	461.6960 (264)
Space and water heating			822.1220 (265)
Pumps and fans	176.5598	0.5190	91.6345 (267)
Energy for lighting	319.3775	0.5190	165.7569 (268)
Total kg/year			1079.5135 (272)
CO2 emissions per m2			15.0500 (273)
EI value			87.6067
EI rating			88 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency 3.48 × (1 + 0.29 × 0.25) / 0.9000 = 4.147, stars = 4
Main heating environmental impact 0.216 × (1 + 0.29 × 0.25) / 0.9000 = 0.2574, stars = 4
Water heating energy efficiency 3.48 / 0.9000 = 3.867, stars = 4
Water heating environmental impact 0.216 / 0.9000 = 0.2400, 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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.5000	3.5000	3.3000	3.4000	3.1000	3.3000	3.0000	3.0000	3.1000	3.1000	3.5000	(22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8500	0.7750	0.8250	0.7500	0.7500	0.7750	0.7750	0.8750	(22a)
Adj infilt rate	0.1318	0.1214	0.1214	0.1145	0.1179	0.1075	0.1145	0.1041	0.1041	0.1075	0.1075	0.1214	(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	0.2493	0.2389	0.2389	0.2320	0.2354	0.2250	0.2320	0.2216	0.2216	0.2250	0.2250	0.2389	(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	
Windows (Uw = 1.20)			14.2400	1.1450	16.3053			(27)
Flat Door			2.3300	1.2000	2.7960			(26)
Heat Loss Floor 1			39.2700	0.1100	4.3197			(28b)
External Wall 1	78.0400	16.5700	61.4700	0.1500	9.2205			(29a)
External Roof 1	9.0800		9.0800	0.1100	0.9988			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		33.6403			(33)
Party Wall 1			22.6500	0.0000	0.0000			(32)
Party Floor 1			32.4500					(32d)
Party Ceilings 1			62.6400					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.7436	(36)
Total fabric heat loss (33) + (36) =	48.3839	(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	15.8137	15.1536	15.1536	14.7136	14.9336	14.2735	14.7136	14.0535	14.0535	14.2735	14.2735	15.1536	(38)
Heat transfer coeff	64.1976	63.5376	63.5376	63.0975	63.3175	62.6575	63.0975	62.4375	62.4375	62.6575	62.6575	63.5376	(39)

Average = Sum(39)m / 12 = 63.0975 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8951	0.8859	0.8859	0.8798	0.8828	0.8736	0.8798	0.8706	0.8706	0.8736	0.8736	0.8859	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

HLP (average) 0.8798 (40)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.2871 (42)
Average daily hot water use (litres/day) 88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6599	18.9439	19.5484	17.0428	16.3530	14.1114	13.0762	15.0052	15.1844	17.6959	19.3165	20.9765	(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	49.6196	43.1879	46.0109	42.7805	42.4022	39.2882	40.5978	42.4022	42.7805	46.0109	46.2728	49.6196	(61)

Total heat required for water heating calculated for each month

	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (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												
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
								Total per year (kWh/year) = Sum(64)m =				1923.7334 (64)
Heat gains from water heating, kWh/month												
	60.4177	52.7893	54.8350	48.4733	46.8496	41.1022	39.1351	43.8620	44.3539	50.7287	54.3865	58.9027 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	45.2112	40.1562	32.6572	24.7236	18.4812	15.6026	16.8592	21.9142	29.4131	37.3467	43.5892	46.4678	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	300.4144	303.5318	295.6761	278.9524	257.8417	238.0005	224.7455	221.6281	229.4837	246.2075	267.3182	287.1593	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	(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)													
	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)
Water heating gains (Table 5)													
	81.2066	78.5555	73.7030	67.3240	62.9699	57.0864	52.6010	58.9543	61.6026	68.1838	75.5367	79.1704	(72)
Total internal gains													
	526.5852	521.9965	501.7893	470.7530	439.0457	410.4425	393.9586	402.2496	420.2525	451.4910	486.1971	512.5504	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.8600	11.9672	0.6300	0.7000	0.7700	21.4320	(74)
East	2.6000	22.3142	0.6300	0.7000	0.7700	17.7307	(76)
South	5.7800	50.8329	0.6300	0.7000	0.7700	89.7933	(78)

Solar gains	128.9560	196.7935	279.6086	372.4523	424.2574	457.3603	434.5422	393.2326	331.5858	242.1091	154.6840	108.9976	(83)
Total gains	655.5412	718.7899	781.3979	843.2053	863.3031	867.8028	828.5008	795.4822	751.8383	693.6001	640.8812	621.5480	(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	31.0326	31.3550	31.3550	31.5737	31.4640	31.7954	31.5737	31.9075	31.9075	31.7954	31.7954	31.3550	
alpha	3.0688	3.0903	3.0903	3.1049	3.0976	3.1197	3.1049	3.1272	3.1272	3.1197	3.1197	3.0903	
util living area													
	0.8840	0.8479	0.7816	0.6630	0.5075	0.3183	0.1895	0.2183	0.4345	0.6741	0.8296	0.8951	(86)
MIT	20.0607	20.2194	20.4441	20.6870	20.8375	20.9018	20.9118	20.9114	20.8792	20.7146	20.3811	20.0317	(87)
Th 2	20.1717	20.1795	20.1795	20.1847	20.1821	20.1900	20.1847	20.1926	20.1926	20.1900	20.1900	20.1795	(88)
util rest of house													
	0.8704	0.8310	0.7580	0.6290	0.4611	0.2633	0.1281	0.1560	0.3770	0.6341	0.8081	0.8825	(89)
MIT 2	18.9287	19.1566	19.4668	19.7950	19.9793	20.0552	20.0573	20.0655	20.0374	19.8416	19.3953	18.8947	(90)
Living area fraction									fLA = Living area / (4) =			0.3440	(91)
MIT	19.3181	19.5221	19.8030	20.1018	20.2745	20.3464	20.3512	20.3565	20.3270	20.1419	19.7344	19.2858	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3181	19.5221	19.8030	20.1018	20.2745	20.3464	20.3512	20.3565	20.3270	20.1419	19.7344	19.2858	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8543	0.8158	0.7463	0.6254	0.4665	0.2740	0.1407	0.1687	0.3868	0.6316	0.7946	0.8666	(94)
Useful gains	560.0111	586.4081	583.1301	527.3036	402.7270	237.7926	116.5761	134.2125	290.7869	438.0675	509.2644	538.6457	(95)
Ext temp.	5.5000	6.1000	7.8000	10.4000	13.5000	16.5000	18.5000	18.2000	15.5000	12.0000	8.4000	5.5000	(96)
Heat loss rate W													
	887.0863	852.8106	762.6385	612.1617	428.9457	241.0076	116.8051	134.6455	301.3857	510.1511	710.1839	875.9180	(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													
	243.3440	179.0225	133.5542	61.0978	19.5067	0.0000	0.0000	0.0000	0.0000	53.6302	144.6620	250.9306	(98)
Space heating												1085.7480	(98)
Space heating per m2											(98) / (4) =	15.1387	(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 %)	90.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1206.3867	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	243.3440	179.0225	133.5542	61.0978	19.5067	0.0000	0.0000	0.0000	0.0000	53.6302	144.6620	250.9306	(98)
Space heating efficiency (main heating system 1)													

	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000 (210)
Space heating fuel (main heating system)												
	270.3822	198.9139	148.3936	67.8865	21.6741	0.0000	0.0000	0.0000	0.0000	59.5891	160.7356	278.8118 (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												
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
Efficiency of water heater												90.0000 (216)
(217)m	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000 (217)
Fuel for water heating, kWh/month												
	215.5767	188.3118	195.9262	173.7767	168.2465	148.1821	141.9698	158.2630	160.0109	182.2043	194.4994	210.5142 (219)
Water heating fuel used												2137.4816 (219)
Annual totals kWh/year												
Space heating fuel - main system												1206.3867 (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)	146.5598 (230a)
central heating pump	30.0000 (230c)
Total electricity for the above, kWh/year	176.5598 (231)
Electricity for lighting (calculated in Appendix L)	319.3775 (232)
Total delivered energy for all uses	3839.8056 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1206.3867	4.2800	51.6333 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2137.4816	4.2800	91.4842 (247)
Mechanical ventilation fans	146.5598	15.4400	22.6288 (249)
Pumps and fans for heating	30.0000	15.4400	4.6320 (249)
Energy for lighting	319.3775	15.4400	49.3119 (250)
Additional standing charges			92.0000 (251)
Total energy cost			311.6903 (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	1206.3867	0.2160	260.5795 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2137.4816	0.2160	461.6960 (264)
Space and water heating			722.2755 (265)
Pumps and fans	176.5598	0.5190	91.6345 (267)
Energy for lighting	319.3775	0.5190	165.7569 (268)
Total kg/year			979.6670 (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	1206.3867	1.2200	1471.7917 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2137.4816	1.2200	2607.7276 (264)
Space and water heating			4079.5193 (265)
Pumps and fans	176.5598	3.0700	542.0386 (267)
Energy for lighting	319.3775	3.0700	980.4890 (268)
Primary energy kWh/year			5602.0469 (272)
Primary energy kWh/m2/year			78.1100 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 88

(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 84
Potential environmental impact rating: B 88

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	£77	£77	£0
Mains gas	£235	£235	£0
Space heating	£171	£171	£0
Water heating	£91	£91	£0
Lighting	£49	£49	£0
Total cost of fuels	£312	£312	£0
Total cost of uses	£311	£311	£0
Delivered energy	54 kWh/m²	54 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.0 tonnes	1.0 tonnes	0.0 tonnes
CO2 emissions per m²	14 kg/m²	14 kg/m²	0 kg/m²
Primary energy	78 kWh/m²	78 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	East
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	380.58 (P1)
Transmission heat loss coefficient	48.38 (37)
Summer heat loss coefficient	428.96 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
South	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)
East	1.000	0.90	1.000	0.900 (P8)
South	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	5.8600	81.1852	0.6300	0.7000	0.9000	169.9409
East	2.6000	117.5071	0.6300	0.7000	0.9000	109.1342
South	5.7800	112.2060	0.6300	0.7000	0.9000	231.6688
total:						510.7439

	Jun	Jul	Aug	
Solar gains	540	511	463	(P3)
Internal gains	407	391	399	
Total summer gains	947	902	862	(P5)
Summer gain/loss ratio	2.21	2.10	2.01	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	19.51	21.30	21.11	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

Sample Report Ltd
1 Sample Street
Sampletown

Full SAP Calculation Printout

Property Reference: 25498 - Flat 01
Survey Reference: Be Green PT3
Property: London, TW1 4BH

Issued on Date: 24.Aug.2016
Prop Type Ref:

SAP Rating:	90 B	**CO2 Emissions (t/year):**	0.51	**DER:**	9.86 Pass	**TER:**	19.63	**Percentage DER<TER:**	49.78 %
Environmental:	93 A	**General Requirements Compliance:**	Pass	**DFEE:**	43.32 Pass	**TFEE:**	55.98	**Percentage DFEE<TFEE:**	22.62 %

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 3.06r08
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Build (As Designed)

CALCULATION DETAILS for survey reference no 'Be Green PT3'
SAP2012 - 9.92 input data (DesignData) -


```
SAP2012 Input Data (Flat)      24/08/2016

FullRefNo:                     Be Green PT3

Regs Region:                   England
SAP Region:                    Thames Valley
Postcode:                      TW1 4BH
DwellingOrientation:           East
Property Type:                 Flat, End-Terrace
Storeys:                       1
Date Built:                    2016
Sheltered Sides:               1
Sunlight Shade:                Average or unknown
Measurements                   Perimeter, Floor Area, Storey Height
    1st Storey:               29.12, 71.72, 2.68
Living Area:                   24.67 m2, fraction: 34.4%
Thermal Mass:                  Simple calculation
Thermal Mass Simple:           Low
Thermal MassValue:             100
External Walls                 Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1                61.47, 78.04, 0, Other, Cavity, 0, 0.15, Gross
Party Walls                    Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                   22.65, 0, Other, FilledWithEdge, 0, 0
External Roofs                 Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
    External Roof 1           9.08, 9.08, 0, Other, 0.11
Party Ceilings                 Area, Kappa, Construction, Element
    Party Ceilings 1          62.64, 80, Concrete floor slab, carpeted
Heat Loss Floors               Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
    Heat Loss Floor 1         39.27, 0, Other, Exposed Floor - Solid, 0, 0.11
Party Floors                   Area, Kappa, Construction, Element
    Party Floor 1             32.45, 80
Description                    Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
    Windows                   Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
    Flat Door                 Manufacturer, Solid Door, , , , , , ,
Openings                       Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    S F Windows               Window, External Wall 1, South, , None, 0, , 0, 0, 0, 5.78,
    Flat Door                 Solid Door, External Wall 1, South, , , , , 0, 0, 0, 2.33,
    N F Windows               Window, External Wall 1, North, , None, 0, , 0, 0, 0, 5.86,
    E F Window                Window, External Wall 1, East, , None, 0, , 0, 0, 0, 2.60,
Conservatory:                  None
Draught Proofing:              100
Draught Lobby:                 No
Thermal Bridges
    Bridging:                 Calculate Bridges
    Y                         0.117
    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, , No, 0, 0, 0, 0.00,
    1.                        External wall, E2 Other lintels (including other steel lintels), Table K1 - Approved, Yes, 7.68, 0.3, 0.3, 2.30,
    2.                        External wall, E3 Sill, Table K1 - Approved, Yes, 6.63, 0.04, 0.04, 0.27,
    3.                        External wall, E4 Jamb, Table K1 - Approved, Yes, 29.56, 0.05, 0.05, 1.48,
    4.                        External wall, E5 Ground floor (normal), , No, 0, 0, 0, 0.00,
    5.                        External wall, E19 Ground floor (inverted), , No, 0, 0, 0, 0.00,
    6.                        External wall, E20 Exposed floor (normal), Table K1 - Default, No, 23.79, 0.32, 0.32, 7.61,
    7.                        External wall, E21 Exposed floor (inverted), , No, 0, 0, 0, 0.00,
    8.                        External wall, E22 Basement floor, , No, 0, 0, 0, 0.00,
    9.                        External wall, E6 Intermediate floor within a dwelling, , No, 0, 0, 0, 0.00,
    10.                       External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Approved, Yes, 29.12, 0.07, 0.07, 2.04,
    11.                       External wall, E8 Balcony within a dwelling, wall insulation continuous, , No, 0, 0, 0, 0.00,
    12.                       External wall, E9 Balcony between dwellings, wall insulation continuous, , No, 0, 0, 0, 0.00,
    13.                       External wall, E23 Balcony within or between dwellings, balcony support penetrates wall insulation , , No, 0, 0, 0, 0.00,
    14.                       External wall, E10 Eaves (insulation at ceiling level), , No, 0, 0, 0, 0.00,
    15.                       External wall, E24 Eaves (insulation at ceiling level - inverted), , No, 0, 0, 0, 0.00,
    16.                       External wall, E11 Eaves (insulation at rafter level), , No, 0, 0, 0, 0.00,
    17.                       External wall, E12 Gable (insulation at ceiling level), , No, 0, 0, 0, 0.00,
    18.                       External wall, E13 Gable (insulation at rafter level), , No, 0, 0, 0, 0.00,
    19.                       External wall, E14 Flat roof, , No, 0, 0, 0, 0.00,
    20.                       External wall, E15 Flat roof with parapet, , No, 0, 0, 0, 0.00,
    21.                       External wall, E16 Corner (normal), Table K1 - Approved, No, 8.04, 0.09, 0.09, 0.72,
    22.                       External wall, E17 Corner (inverted - internal area greater than external area), , No, 0, 0, 0, 0.00,
    23.                       External wall, E18 Party wall between dwellings, Table K1 - Approved, Yes, 5.36, 0.06, 0.06, 0.32,
    24.                       External wall, E25 Staggered party wall between dwellings, , No, 0, 0, 0, 0.00,
    25.                       Party wall, P1 Party wall - Ground floor, , No, 0, 0, 0, 0.00,
    26.                       Party wall, P6 Party wall - Ground floor (inverted), , No, 0, 0, 0, 0.00,
    27.                       Party wall, P2 Party wall - Intermediate floor within a dwelling, , No, 0, 0, 0, 0.00,
    28.                       Party wall, P3 Party wall - Intermediate floor between dwellings (in blocks of flats), , No, 0, 0, 0, 0.00,
    29.                       Party wall, P7 Party Wall - Exposed floor (normal), , No, 0, 0, 0, 0.00,
    30.                       Party wall, P8 Party Wall - Exposed floor (inverted), , No, 0, 0, 0, 0.00,
    31.                       Party wall, P4 Party wall - Roof (insulation at ceiling level), , No, 0, 0, 0, 0.00,
    32.                       Party wall, P5 Party wall - Roof (insulation at rafter level), , No, 0, 0, 0, 0.00,
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    33.                     External roof, R1 Head of roof window, , No, 0, 0, 0, 0.00,
    34.                     External roof, R2 Sill of roof window, , No, 0, 0, 0, 0.00,
    35.                     External roof, R3 Jamb of roof window, , No, 0, 0, 0, 0.00,
    36.                     External roof, R4 Ridge (vaulted ceiling), , No, 0, 0, 0, 0.00,
    37.                     External roof, R5 Ridge (inverted), , No, 0, 0, 0, 0.00,
    38.                     External roof, R6 Flat ceiling, , No, 0, 0, 0, 0.00,
    39.                     External roof, R7 Flat ceiling (inverted), , No, 0, 0, 0, 0.00,
    40.                     External roof, R8 Roof to wall (rafter), , No, 0, 0, 0, 0.00,
    41.                     External roof, R9 Roof to wall (flat ceiling), , No, 0, 0, 0, 0.00,
Pressure Test:               True
Designed q50:                3
AsBuilt q50:                 15
Property Tested:             False
Mechanical Ventilation
    MV System Present        Yes
    Windows In Hot Weather   Windows fully open
    Cross Ventilation        Yes
    Night Ventilation        Yes
    Air Change Rate          6.00
    Approved Installation    Yes
    DataType                 Data Sheet
    Type                     Balanced mechanical ventilation with heat recovery
    HR Duct Insulated        Yes
    ManufacturerSFP          0.5
    DuctType                 Rigid
    HR Efficiency            90
    Wet Rooms                3
    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               None
Light Fittings:              8
LEL Fittings:                8
Percentage of LEL Fittings:  100
External Lights Fitted:      No
External LELs Fitted:        No
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   SAP Table
    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       No
    Ctrl SAP Code            2110
    Burner Control           OnOff
    Flue Type                None or Unknown
    Fan Assisted Flue        No
    Pumped                   Pump in heated space
    Heat Pump Age            2013 or later
    Heat Emitter             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
Type                         More Dwellings, One Block
Apportioned Energy           901
Wind Turbine                 None
Terrain Type:                Urban
Small Scale Hydro            None
Special Features             None


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

DWELLING AS DESIGNED

Mid-floor flat, total floor area 72 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) 19.63 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER)  9.86 kg/m²OK
-------------------------------------------------------------------------------------------------
```

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.0 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)43.3 kWh/m²OK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.20 (max. 2.00)	1.20 (max. 3.30)	OK

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

---

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

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc
Combi boiler
Efficiency: 90%
Minimum: 88% 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: 5.86 m², No overhang
Windows facing East: 2.60 m², No overhang
Windows facing South: 5.78 m², No overhang
Air change rate: 6.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Exposed floor U-value 0.11 W/m²K
Air permeability 3.0 m³/m²h
Photovoltaic array

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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

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

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5000 (23c)

Effective ac	0.2944	0.2909	0.2875	0.2701	0.2667	0.2493	0.2493	0.2458	0.2563	0.2667	0.2736	0.2805	(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	
Windows (Uw = 1.20)			14.2400	1.1450	16.3053			(27)
Flat Door			2.3300	1.2000	2.7960			(26)
Heat Loss Floor 1			39.2700	0.1100	4.3197			(28b)
External Wall 1	78.0400	16.5700	61.4700	0.1500	9.2205			(29a)
External Roof 1	9.0800		9.0800	0.1100	0.9988			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.6403			(33)
Party Wall 1			22.6500	0.0000	0.0000			(32)
Party Floor 1			32.4500					(32d)
Party Ceilings 1			62.6400					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7436 (36)
Total fabric heat loss	(33) + (36) =	48.3839 (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	18.6739	18.4539	18.2339	17.1338	16.9138	15.8137	15.8137	15.5937	16.2537	16.9138	17.3538	17.7939	(38)
Heat transfer coeff	67.0579	66.8379	66.6178	65.5177	65.2977	64.1976	64.1976	63.9776	64.6377	65.2977	65.7378	66.1778	(39)
Average = Sum(39)m / 12 =												65.4627	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9350	0.9319	0.9289	0.9135	0.9105	0.8951	0.8951	0.8920	0.9013	0.9105	0.9166	0.9227	(40)
HLP (average)												0.9128	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.2871 (42)
Average daily hot water use (litres/day)		88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6599	18.9439	19.5484	17.0428	16.3530	14.1114	13.0762	15.0052	15.1844	17.6959	19.3165	20.9765	(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	49.6196	43.1879	46.0109	42.7805	42.4022	39.2882	40.5978	42.4022	42.7805	46.0109	46.2728	49.6196	(61)

Total heat required for water heating calculated for each month

	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (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												
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
									Total per year (kWh/year) = Sum(64)m =			1923.7334 (64)
Heat gains from water heating, kWh/month												
	60.4177	52.7893	54.8350	48.4733	46.8496	41.1022	39.1351	43.8620	44.3539	50.7287	54.3865	58.9027 (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	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.0845	16.0625	13.0629	9.8894	7.3925	6.2410	6.7437	8.7657	11.7653	14.9387	17.4357	18.5871	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	201.2777	203.3663	198.1030	186.8981	172.7539	159.4604	150.5795	148.4908	153.7541	164.9590	179.1032	192.3968	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	(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)													
	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)
Water heating gains (Table 5)													
	81.2066	78.5555	73.7030	67.3240	62.9699	57.0864	52.6010	58.9543	61.6026	68.1838	75.5367	79.1704	(72)
Total internal gains													
	360.8760	358.2915	345.1761	324.4188	303.4235	283.0950	270.2313	276.5180	287.4292	308.3887	332.3828	350.4614	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.8600	10.6334	0.6300	0.7000	0.7700	19.0433	(74)
East	2.6000	19.6403	0.6300	0.7000	0.7700	15.6060	(76)
South	5.7800	46.7521	0.6300	0.7000	0.7700	82.5849	(78)

Solar gains	117.2342	202.1741	284.4044	367.3789	426.5838	430.5121	412.1133	366.6229	312.8004	225.4283	140.8424	100.0700	(83)
Total gains	478.1101	560.4656	629.5805	691.7977	730.0073	713.6072	682.3447	643.1409	600.2296	533.8170	473.2253	450.5314	(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	29.7090	29.8068	29.9052	30.4074	30.5098	31.0326	31.0326	31.1394	30.8214	30.5098	30.3056	30.1041	
alpha	2.9806	2.9871	2.9937	3.0272	3.0340	3.0688	3.0688	3.0760	3.0548	3.0340	3.0204	3.0069	
util living area	0.9531	0.9263	0.8820	0.8003	0.6792	0.5256	0.3973	0.4342	0.6330	0.8341	0.9289	0.9596	(86)
MIT	19.5690	19.7844	20.0792	20.4245	20.6843	20.8389	20.8890	20.8816	20.7768	20.4349	19.9471	19.5326	(87)
Th 2	20.1379	20.1404	20.1430	20.1560	20.1586	20.1717	20.1717	20.1743	20.1664	20.1586	20.1534	20.1482	(88)
util rest of house	0.9468	0.9168	0.8669	0.7752	0.6396	0.4693	0.3281	0.3637	0.5782	0.8075	0.9182	0.9542	(89)
MIT 2	18.2040	18.5144	18.9355	19.4261	19.7739	19.9748	20.0269	20.0234	19.9025	19.4524	18.7619	18.1592	(90)
Living area fraction										fLA = Living area / (4) =		0.3440	(91)
MIT	18.6735	18.9512	19.3289	19.7695	20.0870	20.2720	20.3235	20.3186	20.2032	19.7904	19.1695	18.6316	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6735	18.9512	19.3289	19.7695	20.0870	20.2720	20.3235	20.3186	20.2032	19.7904	19.1695	18.6316	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9336	0.9011	0.8504	0.7625	0.6360	0.4764	0.3411	0.3764	0.5808	0.7942	0.9031	0.9420	(94)
Useful gains	446.3500	505.0354	535.3777	527.4773	464.3140	339.9446	232.7374	242.0836	348.6145	423.9784	427.3902	424.3889	(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	963.8592	939.1523	854.6318	712.1480	547.6545	364.1300	239.0371	250.7045	394.4997	600.1112	793.4252	955.0513	(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	385.0269	291.7266	237.5251	132.9629	62.0053	0.0000	0.0000	0.0000	0.0000	131.0428	263.5452	394.8129	(98)
Space heating												1898.6476	(98)
Space heating per m2											(98) / (4) =	26.4731	(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 %)	90.0000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	2109.6084 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	385.0269	291.7266	237.5251	132.9629	62.0053	0.0000	0.0000	0.0000	0.0000	131.0428	263.5452	394.8129	(98)
Space heating efficiency (main heating system 1)													

	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000 (210)
Space heating fuel (main heating system)												
	427.8076	324.1406	263.9167	147.7365	68.8948	0.0000	0.0000	0.0000	0.0000	145.6031	292.8280	438.6810 (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												
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
Efficiency of water heater												90.0000 (216)
(217)m	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000 (217)
Fuel for water heating, kWh/month												
	215.5767	188.3118	195.9262	173.7767	168.2465	148.1821	141.9698	158.2630	160.0109	182.2043	194.4994	210.5142 (219)
Water heating fuel used												2137.4816 (219)
Annual totals kWh/year												
Space heating fuel - main system												2109.6084 (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)												146.5598 (230a)
central heating pump												30.0000 (230c)
Total electricity for the above, kWh/year												176.5598 (231)
Electricity for lighting (calculated in Appendix L)												319.3775 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
Total delivered energy for all uses												4743.0273 (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	2109.6084	0.2160	455.6754	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2137.4816	0.2160	461.6960	(264)
Space and water heating			917.3714	(265)
Pumps and fans	176.5598	0.5190	91.6345	(267)
Energy for lighting	319.3775	0.5190	165.7569	(268)
Energy saving/generation technologies				
PV Unit	-901.0000	0.5190	-467.6190	(269)
Total CO2, kg/year			707.1439	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.8600	(273)

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

DER		9.8600	ZC1
Total Floor Area	TFA	71.7200	
Assumed number of occupants	N	2.2871	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.6304	ZC2
CO2 emissions from cooking, equation (L16)		2.4246	ZC3
Total CO2 emissions		28.9149	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		28.9149	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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(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							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1561	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.4061	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3756	(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	0.4789	0.4695	0.4601	0.4132	0.4038	0.3568	0.3568	0.3475	0.3756	0.4038	0.4226	0.4414	(22b)
Effective ac	0.6147	0.6102	0.6059	0.5854	0.5815	0.5637	0.5637	0.5604	0.5705	0.5815	0.5893	0.5974	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3300	1.0000	2.3300			(26)
TER Opening Type (Uw = 1.40)			14.2400	1.3258	18.8788			(27)
Heat Loss Floor 1			39.2700	0.1300	5.1051			(28b)
External Wall 1	78.0400	16.5700	61.4700	0.1800	11.0646			(29a)
External Roof 1	9.0800		9.0800	0.1300	1.1804			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.5589			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.8899	(36)
Total fabric heat loss					(33) + (36) =		51.4488	(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	38.9888	38.7063	38.4294	37.1290	36.8857	35.7530	35.7530	35.5433	36.1893	36.8857	37.3779	37.8925	(38)
Heat transfer coeff	90.4376	90.1551	89.8782	88.5778	88.3345	87.2018	87.2018	86.9920	87.6381	88.3345	88.8267	89.3413	(39)
Average = Sum(39)m / 12 =												88.5766	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2610	1.2570	1.2532	1.2350	1.2317	1.2159	1.2159	1.2129	1.2219	1.2317	1.2385	1.2457	(40)
HLP (average)												1.2350	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2871	(42)
Average daily hot water use (litres/day)	88.5198	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6599	18.9439	19.5484	17.0428	16.3530	14.1114	13.0762	15.0052	15.1844	17.6959	19.3165	20.9765	(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	49.6196	43.1879	46.0109	42.7805	42.4022	39.2882	40.5978	42.4022	42.7805	46.0109	46.2728	49.6196	(61)
Total heat required for water heating calculated for each month	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627	(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	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627	(64)
								Total per year (kWh/year) = Sum(64)m =				1923.7334	(64)

Heat gains from water heating, kWh/month

60.4177 52.7893 54.8350 48.4733 46.8496 41.1022 39.1351 43.8620 44.3539 50.7287 54.3865 58.9027 (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	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	(66)

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

	18.0845	16.0625	13.0629	9.8894	7.3925	6.2410	6.7437	8.7657	11.7653	14.9387	17.4357	18.5871	(67)

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

	201.2777	203.3663	198.1030	186.8981	172.7539	159.4604	150.5795	148.4908	153.7541	164.9590	179.1032	192.3968	(68)

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

	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	(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)

	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)

Water heating gains (Table 5)

	81.2066	78.5555	73.7030	67.3240	62.9699	57.0864	52.6010	58.9543	61.6026	68.1838	75.5367	79.1704	(72)

Total internal gains

	360.8760	358.2915	345.1761	324.4188	303.4235	283.0950	270.2313	276.5180	287.4292	308.3887	332.3828	350.4614	(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	5.8600	10.6334	0.6300	0.7000	0.7700	19.0433	(74)
East	2.6000	19.6403	0.6300	0.7000	0.7700	15.6060	(76)
South	5.7800	46.7521	0.6300	0.7000	0.7700	82.5849	(78)

Solar gains	117.2342	202.1741	284.4044	367.3789	426.5838	430.5121	412.1133	366.6229	312.8004	225.4283	140.8424	100.0700	(83)
Total gains	478.1101	560.4656	629.5805	691.7977	730.0073	713.6072	682.3447	643.1409	600.2296	533.8170	473.2253	450.5314	(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	55.0718	55.2443	55.4145	56.2281	56.3829	57.1153	57.1153	57.2530	56.8310	56.3829	56.0705	55.7475	
alpha	4.6715	4.6830	4.6943	4.7485	4.7589	4.8077	4.8077	4.8169	4.7887	4.7589	4.7380	4.7165	
util living area													
	0.9968	0.9928	0.9827	0.9518	0.8713	0.7133	0.5463	0.5967	0.8303	0.9669	0.9934	0.9976	(86)
MIT	19.6732	19.8504	20.1202	20.4670	20.7607	20.9365	20.9859	20.9787	20.8626	20.4806	20.0147	19.6467	(87)
Th 2	19.8715	19.8746	19.8777	19.8921	19.8948	19.9073	19.9073	19.9097	19.9025	19.8948	19.8893	19.8836	(88)
util rest of house													
	0.9957	0.9904	0.9766	0.9336	0.8229	0.6176	0.4188	0.4677	0.7524	0.9508	0.9907	0.9968	(89)
MIT 2	18.1191	18.3791	18.7716	19.2729	19.6619	19.8655	19.9023	19.9011	19.7947	19.3023	18.6300	18.0888	(90)
Living area fraction									fLA = Living area / (4) =			0.3440	(91)
MIT	18.6537	18.8852	19.2355	19.6836	20.0399	20.2339	20.2750	20.2718	20.1620	19.7076	19.1063	18.6247	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6537	18.8852	19.2355	19.6836	20.0399	20.2339	20.2750	20.2718	20.1620	19.7076	19.1063	18.6247	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9940	0.9874	0.9719	0.9293	0.8301	0.6482	0.4630	0.5124	0.7732	0.9473	0.9880	0.9954	(94)
Useful gains	475.2582	553.4080	611.8715	642.9217	605.9819	462.5669	315.9189	329.5334	464.1091	505.6616	467.5694	448.4650	(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													
	1298.1112	1260.8377	1144.6430	955.1913	736.7006	491.2862	320.4665	336.8172	531.2655	804.5163	1066.4788	1288.7199	(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													
	612.2026	475.3928	396.3820	224.8341	97.2547	0.0000	0.0000	0.0000	0.0000	222.3479	431.2148	625.1496	(98)
Space heating												3084.7784	(98)
Space heating per m2											(98) / (4) =	43.0114	(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	3302.7606 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	612.2026	475.3928	396.3820	224.8341	97.2547	0.0000	0.0000	0.0000	0.0000	222.3479	431.2148	625.1496	(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)													
	655.4632	508.9858	424.3918	240.7217	104.1270	0.0000	0.0000	0.0000	0.0000	238.0599	461.6860	669.3251	(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												
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
Efficiency of water heater												80.3000 (216)
(217)m	87.7441	87.5073	87.0297	85.9642	83.9690	80.3000	80.3000	80.3000	80.3000	85.8183	87.2320	87.8306 (217)
Fuel for water heating, kWh/month												
	221.1192	193.6759	202.6132	181.9350	180.3307	166.0821	159.1193	177.3807	179.3397	191.0826	200.6711	215.7137 (219)
Water heating fuel used												2269.0631 (219)
Annual totals kWh/year												
Space heating fuel - main system												3302.7606 (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)												319.3775 (232)
Total delivered energy for all uses												5966.2012 (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	3302.7606	0.2160	713.3963 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2269.0631	0.2160	490.1176 (264)
Space and water heating			1203.5139 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	319.3775	0.5190	165.7569 (268)
Total CO2, kg/m2/year			1408.1959 (272)
Emissions per m2 for space and water heating			16.7807 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.3112 (272b)
Emissions per m2 for pumps and fans			0.5427 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.7807 * 1.00) + 2.3112 + 0.5427, rounded to 2 d.p.			19.6300 (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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(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							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1561	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.3061	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2831	(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	0.3610	0.3539	0.3468	0.3114	0.3044	0.2690	0.2690	0.2619	0.2831	0.3044	0.3185	0.3327	(22b)
Effective ac	0.5652	0.5626	0.5601	0.5485	0.5463	0.5362	0.5362	0.5343	0.5401	0.5463	0.5507	0.5553	(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	
Windows (Uw = 1.20)			14.2400	1.1450	16.3053			(27)
Flat Door			2.3300	1.2000	2.7960			(26)
Heat Loss Floor 1			39.2700	0.1100	4.3197			(28b)
External Wall 1	78.0400	16.5700	61.4700	0.1500	9.2205			(29a)
External Roof 1	9.0800		9.0800	0.1100	0.9988			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.6403			(33)
Party Wall 1			22.6500	0.0000	0.0000			(32)
Party Floor 1			32.4500					(32d)
Party Ceilings 1			62.6400					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7436 (36)
Total fabric heat loss	(33) + (36) =	48.3839 (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	35.8473	35.6868	35.5295	34.7907	34.6524	34.0089	34.0089	33.8898	34.2568	34.6524	34.9321	35.2244	(38)
Heat transfer coeff	84.2312	84.0707	83.9134	83.1746	83.0364	82.3929	82.3929	82.2737	82.6407	83.0364	83.3160	83.6084	(39)
Average = Sum(39)m / 12 =												83.1739	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1744	1.1722	1.1700	1.1597	1.1578	1.1488	1.1488	1.1472	1.1523	1.1578	1.1617	1.1658	(40)
HLP (average)												1.1597	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2871 (42)
Average daily hot water use (litres/day)	88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(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	30.6849	26.8372	27.6936	24.1439	23.1667	19.9911	18.5247	21.2573	21.5112	25.0693	27.3651	29.7167	(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	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	(66)

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

	18.0845	16.0625	13.0629	9.8894	7.3925	6.2410	6.7437	8.7657	11.7653	14.9387	17.4357	18.5871	(67)

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

	201.2777	203.3663	198.1030	186.8981	172.7539	159.4604	150.5795	148.4908	153.7541	164.9590	179.1032	192.3968	(68)

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

	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	(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)

	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)

Water heating gains (Table 5)

	41.2431	39.9363	37.2226	33.5332	31.1380	27.7654	24.8988	28.5717	29.8767	33.6952	38.0070	39.9418	(72)

Total internal gains

	317.9125	316.6723	305.6957	287.6280	268.5916	250.7740	239.5291	243.1354	252.7033	270.9002	291.8531	308.2328	(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	5.8600	10.6334	0.6300	0.7000	0.7700	19.0433	(74)
East	2.6000	19.6403	0.6300	0.7000	0.7700	15.6060	(76)
South	5.7800	46.7521	0.6300	0.7000	0.7700	82.5849	(78)

Solar gains	117.2342	202.1741	284.4044	367.3789	426.5838	430.5121	412.1133	366.6229	312.8004	225.4283	140.8424	100.0700	(83)
Total gains	435.1466	518.8464	590.1001	655.0069	695.1754	681.2861	651.6424	609.7583	565.5037	496.3285	432.6955	408.3028	(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	23.6518	23.6970	23.7414	23.9523	23.9922	24.1795	24.1795	24.2146	24.1070	23.9922	23.9116	23.8280	
alpha	2.5768	2.5798	2.5828	2.5968	2.5995	2.6120	2.6120	2.6143	2.6071	2.5995	2.5941	2.5885	
util living area													
	0.9659	0.9463	0.9141	0.8545	0.7590	0.6256	0.4957	0.5383	0.7258	0.8833	0.9498	0.9707	(86)
MIT	18.5636	18.8677	19.3244	19.8910	20.3923	20.7480	20.9015	20.8748	20.6023	19.9438	19.1464	18.5020	(87)
Th 2	19.9405	19.9423	19.9441	19.9524	19.9539	19.9612	19.9612	19.9625	19.9584	19.9539	19.9508	19.9475	(88)
util rest of house													
	0.9607	0.9382	0.9008	0.8308	0.7170	0.5554	0.3976	0.4411	0.6646	0.8592	0.9409	0.9662	(89)
MIT 2	17.7189	18.0195	18.4682	19.0211	19.4896	19.8034	19.9167	19.9023	19.6888	19.0838	18.3045	17.6629	(90)
Living area fraction									fLA = Living area / (4) =			0.3440	(91)
MIT	18.0095	18.3113	18.7627	19.3203	19.8001	20.1283	20.2554	20.2368	20.0030	19.3796	18.5941	17.9515	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0095	18.3113	18.7627	19.3203	19.8001	20.1283	20.2554	20.2368	20.0030	19.3796	18.5941	17.9515	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9480	0.9223	0.8825	0.8141	0.7102	0.5676	0.4269	0.4685	0.6675	0.8432	0.9259	0.9547	(94)
Useful gains	412.5266	478.5226	520.7822	533.2149	493.6861	386.6740	278.1904	285.6610	377.4910	418.5138	400.6471	389.7968	(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													
	1154.7651	1127.4969	1029.0078	866.7041	672.6026	455.4920	301.1824	315.6706	487.8289	729.0239	957.6439	1149.7425	(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													
	552.2254	436.1107	378.1199	240.1122	133.1139	0.0000	0.0000	0.0000	0.0000	231.0195	401.0377	565.3996	(98)
Space heating												2937.1390	(98)
Space heating per m2											(98) / (4) =	40.9529	(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	774.4930	609.7072	625.2802	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7681	0.8285	0.8045	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	594.8725	505.1431	503.0424	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	881.3175	844.9473	797.3872	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	206.2404	252.8143	218.9925	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												678.0472	(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	51.5601	63.2036	54.7481	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												169.5118	(107)
Space cooling per m2												2.3635	(108)
Energy for space heating												40.9529	(99)
Energy for space cooling												2.3635	(108)
Total												43.3164	(109)
Dwelling Fabric Energy Efficiency (DFEE)												43.3	(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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(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							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1561 (8)
Pressure test		Yes
Measured/design q50		5.0000
Infiltration rate		0.4061 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3756 (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	0.4789	0.4695	0.4601	0.4132	0.4038	0.3568	0.3568	0.3475	0.3756	0.4038	0.4226	0.4414	(22b)
Effective ac	0.6147	0.6102	0.6059	0.5854	0.5815	0.5637	0.5637	0.5604	0.5705	0.5815	0.5893	0.5974	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.3300	1.0000	2.3300			(26)
TER Opening Type (Uw = 1.40)			14.2400	1.3258	18.8788			(27)
Heat Loss Floor 1			39.2700	0.1300	5.1051			(28b)
External Wall 1	78.0400	16.5700	61.4700	0.1800	11.0646			(29a)
External Roof 1	9.0800		9.0800	0.1300	1.1804			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.5589			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.8899	(36)
Total fabric heat loss					(33) + (36) =		51.4488	(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	38.9888	38.7063	38.4294	37.1290	36.8857	35.7530	35.7530	35.5433	36.1893	36.8857	37.3779	37.8925	(38)
Heat transfer coeff	90.4376	90.1551	89.8782	88.5778	88.3345	87.2018	87.2018	86.9920	87.6381	88.3345	88.8267	89.3413	(39)
Average = Sum(39)m / 12 =												88.5766	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2610	1.2570	1.2532	1.2350	1.2317	1.2159	1.2159	1.2129	1.2219	1.2317	1.2385	1.2457	(40)
HLP (average)												1.2350	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2871	(42)
Average daily hot water use (litres/day)	88.5198	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(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	30.6849	26.8372	27.6936	24.1439	23.1667	19.9911	18.5247	21.2573	21.5112	25.0693	27.3651	29.7167	(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	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	114.3574	(66)

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

	18.0845	16.0625	13.0629	9.8894	7.3925	6.2410	6.7437	8.7657	11.7653	14.9387	17.4357	18.5871	(67)

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

	201.2777	203.3663	198.1030	186.8981	172.7539	159.4604	150.5795	148.4908	153.7541	164.9590	179.1032	192.3968	(68)

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

	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	34.4357	(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)

	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)

Water heating gains (Table 5)

	41.2431	39.9363	37.2226	33.5332	31.1380	27.7654	24.8988	28.5717	29.8767	33.6952	38.0070	39.9418	(72)

Total internal gains

	317.9125	316.6723	305.6957	287.6280	268.5916	250.7740	239.5291	243.1354	252.7033	270.9002	291.8531	308.2328	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	5.8600	10.6334	0.6300	0.7000	0.7700	19.0433 (74)
East	2.6000	19.6403	0.6300	0.7000	0.7700	15.6060 (76)
South	5.7800	46.7521	0.6300	0.7000	0.7700	82.5849 (78)

Solar gains	117.2342	202.1741	284.4044	367.3789	426.5838	430.5121	412.1133	366.6229	312.8004	225.4283	140.8424	100.0700	(83)
Total gains	435.1466	518.8464	590.1001	655.0069	695.1754	681.2861	651.6424	609.7583	565.5037	496.3285	432.6955	408.3028	(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	55.0718	55.2443	55.4145	56.2281	56.3829	57.1153	57.1153	57.2530	56.8310	56.3829	56.0705	55.7475	
alpha	4.6715	4.6830	4.6943	4.7485	4.7589	4.8077	4.8077	4.8169	4.7887	4.7589	4.7380	4.7165	
util living area	0.9979	0.9948	0.9866	0.9601	0.8875	0.7364	0.5689	0.6238	0.8538	0.9747	0.9955	0.9984	(86)
MIT	19.6188	19.7986	20.0732	20.4289	20.7361	20.9270	20.9832	20.9744	20.8424	20.4389	19.9639	19.5929	(87)
Th 2	19.8715	19.8746	19.8777	19.8921	19.8948	19.9073	19.9073	19.9097	19.9025	19.8948	19.8893	19.8836	(88)
util rest of house	0.9971	0.9930	0.9817	0.9445	0.8426	0.6413	0.4376	0.4916	0.7806	0.9619	0.9936	0.9979	(89)
MIT 2	18.6209	18.8023	19.0768	19.4343	19.7166	19.8739	19.9032	19.9025	19.8158	19.4513	18.9793	18.6046	(90)
Living area fraction										fLA = Living area / (4) =		0.3440	(91)
MIT	18.9642	19.1450	19.4196	19.7764	20.0673	20.2361	20.2747	20.2712	20.1689	19.7910	19.3180	18.9446	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9642	19.1450	19.4196	19.7764	20.0673	20.2361	20.2747	20.2712	20.1689	19.7910	19.3180	18.9446	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9963	0.9914	0.9791	0.9425	0.8507	0.6722	0.4834	0.5377	0.8009	0.9603	0.9923	0.9972	(94)
Useful gains	433.5402	514.3844	577.7403	617.3446	591.3666	457.9633	314.9825	327.8432	452.9375	476.6238	429.3435	407.1779	(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	1326.1912	1284.2620	1161.1869	963.4075	739.1183	491.4806	320.4386	336.7626	531.8681	811.8844	1085.2859	1317.2976	(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	664.1323	517.3578	434.0843	249.1653	109.9272	0.0000	0.0000	0.0000	0.0000	249.4339	472.2786	677.1291	(98)
Space heating												3373.5084	(98)
Space heating per m2											(98) / (4) =	47.0372	(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	819.6969	645.2933	661.1395	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8564	0.9183	0.8956	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	701.9709	592.5504	592.1216	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	881.3175	844.9473	797.3872	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	129.1296	187.7833	152.7176	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												469.6305	(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	32.2824	46.9458	38.1794	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												117.4076	(107)
Space cooling per m2												1.6370	(108)
Energy for space heating												47.0372	(99)
Energy for space cooling												1.6370	(108)
Total												48.6742	(109)
Target Fabric Energy Efficiency (TFEE)												56.0	(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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.5000	3.5000	3.3000	3.4000	3.1000	3.3000	3.0000	3.0000	3.1000	3.1000	3.5000	(22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8500	0.7750	0.8250	0.7500	0.7500	0.7750	0.7750	0.8750	(22a)
Adj infilt rate	0.1318	0.1214	0.1214	0.1145	0.1179	0.1075	0.1145	0.1041	0.1041	0.1075	0.1075	0.1214	(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	0.2493	0.2389	0.2389	0.2320	0.2354	0.2250	0.2320	0.2216	0.2216	0.2250	0.2250	0.2389	(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	
Windows (Uw = 1.20)			14.2400	1.1450	16.3053			(27)
Flat Door			2.3300	1.2000	2.7960			(26)
Heat Loss Floor 1			39.2700	0.1100	4.3197			(28b)
External Wall 1	78.0400	16.5700	61.4700	0.1500	9.2205			(29a)
External Roof 1	9.0800		9.0800	0.1100	0.9988			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		33.6403			(33)
Party Wall 1			22.6500	0.0000	0.0000			(32)
Party Floor 1			32.4500					(32d)
Party Ceilings 1			62.6400					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.7436	(36)
Total fabric heat loss (33) + (36) =	48.3839	(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	15.8137	15.1536	15.1536	14.7136	14.9336	14.2735	14.7136	14.0535	14.0535	14.2735	14.2735	15.1536	(38)
Heat transfer coeff	64.1976	63.5376	63.5376	63.0975	63.3175	62.6575	63.0975	62.4375	62.4375	62.6575	62.6575	63.5376	(39)

Average = Sum(39)m / 12 = 63.0975 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8951	0.8859	0.8859	0.8798	0.8828	0.8736	0.8798	0.8706	0.8706	0.8736	0.8736	0.8859	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

HLP (average) 0.8798 (40)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.2871 (42)
Average daily hot water use (litres/day) 88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6599	18.9439	19.5484	17.0428	16.3530	14.1114	13.0762	15.0052	15.1844	17.6959	19.3165	20.9765	(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	49.6196	43.1879	46.0109	42.7805	42.4022	39.2882	40.5978	42.4022	42.7805	46.0109	46.2728	49.6196	(61)

Total heat required for water heating calculated for each month

	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (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												
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
								Total per year (kWh/year) = Sum(64)m =				1923.7334 (64)
RHI water heating demand												1924 (64)
Heat gains from water heating, kWh/month												
	60.4177	52.7893	54.8350	48.4733	46.8496	41.1022	39.1351	43.8620	44.3539	50.7287	54.3865	58.9027 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	45.2112	40.1562	32.6572	24.7236	18.4812	15.6026	16.8592	21.9142	29.4131	37.3467	43.5892	46.4678	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	300.4144	303.5318	295.6761	278.9524	257.8417	238.0005	224.7455	221.6281	229.4837	246.2075	267.3182	287.1593	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	(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)													
	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)
Water heating gains (Table 5)													
	81.2066	78.5555	73.7030	67.3240	62.9699	57.0864	52.6010	58.9543	61.6026	68.1838	75.5367	79.1704	(72)
Total internal gains													
	526.5852	521.9965	501.7893	470.7530	439.0457	410.4425	393.9586	402.2496	420.2525	451.4910	486.1971	512.5504	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.8600	11.9672	0.6300	0.7000	0.7700	21.4320	(74)
East	2.6000	22.3142	0.6300	0.7000	0.7700	17.7307	(76)
South	5.7800	50.8329	0.6300	0.7000	0.7700	89.7933	(78)

Solar gains	128.9560	196.7935	279.6086	372.4523	424.2574	457.3603	434.5422	393.2326	331.5858	242.1091	154.6840	108.9976	(83)
Total gains	655.5412	718.7899	781.3979	843.2053	863.3031	867.8028	828.5008	795.4822	751.8383	693.6001	640.8812	621.5480	(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	31.0326	31.3550	31.3550	31.5737	31.4640	31.7954	31.5737	31.9075	31.9075	31.7954	31.7954	31.3550	
alpha	3.0688	3.0903	3.0903	3.1049	3.0976	3.1197	3.1049	3.1272	3.1272	3.1197	3.1197	3.0903	
util living area													
	0.8840	0.8479	0.7816	0.6630	0.5075	0.3183	0.1895	0.2183	0.4345	0.6741	0.8296	0.8951	(86)
MIT	20.0607	20.2194	20.4441	20.6870	20.8375	20.9018	20.9118	20.9114	20.8792	20.7146	20.3811	20.0317	(87)
Th 2	20.1717	20.1795	20.1795	20.1847	20.1821	20.1900	20.1847	20.1926	20.1926	20.1900	20.1900	20.1795	(88)
util rest of house													
	0.8704	0.8310	0.7580	0.6290	0.4611	0.2633	0.1281	0.1560	0.3770	0.6341	0.8081	0.8825	(89)
MIT 2	18.9287	19.1566	19.4668	19.7950	19.9793	20.0552	20.0573	20.0655	20.0374	19.8416	19.3953	18.8947	(90)
Living area fraction									fLA = Living area / (4) =			0.3440	(91)
MIT	19.3181	19.5221	19.8030	20.1018	20.2745	20.3464	20.3512	20.3565	20.3270	20.1419	19.7344	19.2858	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3181	19.5221	19.8030	20.1018	20.2745	20.3464	20.3512	20.3565	20.3270	20.1419	19.7344	19.2858	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8543	0.8158	0.7463	0.6254	0.4665	0.2740	0.1407	0.1687	0.3868	0.6316	0.7946	0.8666	(94)
Useful gains	560.0111	586.4081	583.1301	527.3036	402.7270	237.7926	116.5761	134.2125	290.7869	438.0675	509.2644	538.6457	(95)
Ext temp.	5.5000	6.1000	7.8000	10.4000	13.5000	16.5000	18.5000	18.2000	15.5000	12.0000	8.4000	5.5000	(96)
Heat loss rate W													
	887.0863	852.8106	762.6385	612.1617	428.9457	241.0076	116.8051	134.6455	301.3857	510.1511	710.1839	875.9180	(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													
	243.3440	179.0225	133.5542	61.0978	19.5067	0.0000	0.0000	0.0000	0.0000	53.6302	144.6620	250.9306	(98)
Space heating												1085.7480	(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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

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

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 76.5000 (23c)

Effective ac	0.2944	0.2909	0.2875	0.2701	0.2667	0.2493	0.2493	0.2458	0.2563	0.2667	0.2736	0.2805	(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	
Windows (Uw = 1.20)			14.2400	1.1450	16.3053			(27)
Flat Door			2.3300	1.2000	2.7960			(26)
Heat Loss Floor 1			39.2700	0.1100	4.3197			(28b)
External Wall 1	78.0400	16.5700	61.4700	0.1500	9.2205			(29a)
External Roof 1	9.0800		9.0800	0.1100	0.9988			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	33.6403			(33)
Party Wall 1			22.6500	0.0000	0.0000			(32)
Party Floor 1			32.4500					(32d)
Party Ceilings 1			62.6400					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		14.7436 (36)
Total fabric heat loss	(33) + (36) =	48.3839 (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	18.6739	18.4539	18.2339	17.1338	16.9138	15.8137	15.8137	15.5937	16.2537	16.9138	17.3538	17.7939	(38)
Heat transfer coeff	67.0579	66.8379	66.6178	65.5177	65.2977	64.1976	64.1976	63.9776	64.6377	65.2977	65.7378	66.1778	(39)

Average = Sum(39)m / 12 = 65.4627 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9350	0.9319	0.9289	0.9135	0.9105	0.8951	0.8951	0.8920	0.9013	0.9105	0.9166	0.9227	(40)

HLP (average) 0.9128 (40)

Days in month													
	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.2871 (42)
Average daily hot water use (litres/day) 88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6599	18.9439	19.5484	17.0428	16.3530	14.1114	13.0762	15.0052	15.1844	17.6959	19.3165	20.9765	(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	49.6196	43.1879	46.0109	42.7805	42.4022	39.2882	40.5978	42.4022	42.7805	46.0109	46.2728	49.6196	(61)

Total heat required for water heating calculated for each month

	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627	(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													
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627	(64)
								Total per year (kWh/year) = Sum(64)m =				1923.7334	(64)
Heat gains from water heating, kWh/month													
	60.4177	52.7893	54.8350	48.4733	46.8496	41.1022	39.1351	43.8620	44.3539	50.7287	54.3865	58.9027	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	45.2112	40.1562	32.6572	24.7236	18.4812	15.6026	16.8592	21.9142	29.4131	37.3467	43.5892	46.4678	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	300.4144	303.5318	295.6761	278.9524	257.8417	238.0005	224.7455	221.6281	229.4837	246.2075	267.3182	287.1593	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	(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)													
	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)
Water heating gains (Table 5)													
	81.2066	78.5555	73.7030	67.3240	62.9699	57.0864	52.6010	58.9543	61.6026	68.1838	75.5367	79.1704	(72)
Total internal gains													
	526.5852	521.9965	501.7893	470.7530	439.0457	410.4425	393.9586	402.2496	420.2525	451.4910	486.1971	512.5504	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.8600	10.6334	0.6300	0.7000	0.7700	19.0433	(74)
East	2.6000	19.6403	0.6300	0.7000	0.7700	15.6060	(76)
South	5.7800	46.7521	0.6300	0.7000	0.7700	82.5849	(78)

Solar gains	117.2342	202.1741	284.4044	367.3789	426.5838	430.5121	412.1133	366.6229	312.8004	225.4283	140.8424	100.0700	(83)
Total gains	643.8194	724.1705	786.1937	838.1319	865.6295	840.9547	806.0719	768.8725	733.0529	676.9193	627.0395	612.6204	(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	29.7090	29.8068	29.9052	30.4074	30.5098	31.0326	31.0326	31.1394	30.8214	30.5098	30.3056	30.1041	
alpha	2.9806	2.9871	2.9937	3.0272	3.0340	3.0688	3.0688	3.0760	3.0548	3.0340	3.0204	3.0069	
util living area													
	0.9082	0.8738	0.8208	0.7304	0.6076	0.4592	0.3412	0.3702	0.5482	0.7533	0.8710	0.9176	(86)
MIT	19.8295	20.0140	20.2613	20.5436	20.7457	20.8618	20.8970	20.8927	20.8216	20.5667	20.1637	19.7959	(87)
Th 2	20.1379	20.1404	20.1430	20.1560	20.1586	20.1717	20.1717	20.1743	20.1664	20.1586	20.1534	20.1482	(88)
util rest of house													
	0.8974	0.8597	0.8011	0.7017	0.5675	0.4070	0.2801	0.3079	0.4950	0.7208	0.8543	0.9078	(89)
MIT 2	18.5739	18.8361	19.1844	19.5808	19.8463	19.9970	20.0327	20.0319	19.9497	19.6222	19.0631	18.5342	(90)
Living area fraction										fLA = Living area / (4) =		0.3440	(91)
MIT	19.0058	19.2413	19.5549	19.9119	20.1557	20.2945	20.3300	20.3280	20.2496	19.9471	19.4417	18.9682	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0058	19.2413	19.5549	19.9119	20.1557	20.2945	20.3300	20.3280	20.2496	19.9471	19.4417	18.9682	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8808	0.8428	0.7861	0.6928	0.5673	0.4150	0.2920	0.3197	0.5005	0.7119	0.8383	0.8917	(94)
Useful gains	567.0468	610.3166	618.0064	580.6979	491.0814	348.9816	235.3710	245.8181	366.8824	481.9109	525.6479	546.2901	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	986.1384	958.5413	869.6863	721.4778	552.1379	365.5710	239.4594	251.3011	397.4964	610.3426	811.3152	977.3286	(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													
	311.8042	234.0070	187.2498	101.3615	45.4261	0.0000	0.0000	0.0000	0.0000	95.5532	205.6805	320.6927	(98)
Space heating												1501.7750	(98)
Space heating per m2											(98) / (4) =	20.9394	(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 %)												90.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1668.6389	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	311.8042	234.0070	187.2498	101.3615	45.4261	0.0000	0.0000	0.0000	0.0000	95.5532	205.6805	320.6927	(98)
Space heating efficiency (main heating system 1)													

	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000 (210)
Space heating fuel (main heating system)												
	346.4491	260.0078	208.0554	112.6239	50.4734	0.0000	0.0000	0.0000	0.0000	106.1702	228.5338	356.3252 (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												
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
Efficiency of water heater												90.0000 (216)
(217)m	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000 (217)
Fuel for water heating, kWh/month												
	215.5767	188.3118	195.9262	173.7767	168.2465	148.1821	141.9698	158.2630	160.0109	182.2043	194.4994	210.5142 (219)
Water heating fuel used												2137.4816 (219)
Annual totals kWh/year												
Space heating fuel - main system												1668.6389 (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)												146.5598 (230a)
central heating pump												30.0000 (230c)
Total electricity for the above, kWh/year												176.5598 (231)
Electricity for lighting (calculated in Appendix L)												319.3775 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
Total delivered energy for all uses												4302.0578 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1668.6389	3.4800	58.0686	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2137.4816	3.4800	74.3844	(247)
Mechanical ventilation fans	146.5598	13.1900	19.3312	(249)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	319.3775	13.1900	42.1259	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-901.0000	13.1900	-118.8419	(252)
Total energy cost			199.0252	(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] =	0.7162 (257)
SAP value		90.0095
SAP rating (Section 12)		90 (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	1668.6389	0.2160	360.4260	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2137.4816	0.2160	461.6960	(264)
Space and water heating			822.1220	(265)
Pumps and fans	176.5598	0.5190	91.6345	(267)
Energy for lighting	319.3775	0.5190	165.7569	(268)
Energy saving/generation technologies				
PV Unit	-901.0000	0.5190	-467.6190	(269)
Total kg/year			611.8945	(272)
CO2 emissions per m2			8.5300	(273)
EI value			92.9752	
EI rating			93	(274)
EI band			A	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.25) / 0.9000 = 4.147, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.25) / 0.9000 = 0.2574, stars = 4
Water heating energy efficiency	3.48 / 0.9000 = 3.867, stars = 4
Water heating environmental impact	0.216 / 0.9000 = 0.2400, 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	71.7200 (1b)	x	2.6800 (2b)	=	192.2096 (1b) - (3b)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	192.2096	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.8000	3.5000	3.5000	3.3000	3.4000	3.1000	3.3000	3.0000	3.0000	3.1000	3.1000	3.5000	(22)
Wind factor	0.9500	0.8750	0.8750	0.8250	0.8500	0.7750	0.8250	0.7500	0.7500	0.7750	0.7750	0.8750	(22a)
Adj infilt rate	0.1318	0.1214	0.1214	0.1145	0.1179	0.1075	0.1145	0.1041	0.1041	0.1075	0.1075	0.1214	(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	0.2493	0.2389	0.2389	0.2320	0.2354	0.2250	0.2320	0.2216	0.2216	0.2250	0.2250	0.2389	(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	
Windows (Uw = 1.20)			14.2400	1.1450	16.3053			(27)
Flat Door			2.3300	1.2000	2.7960			(26)
Heat Loss Floor 1			39.2700	0.1100	4.3197			(28b)
External Wall 1	78.0400	16.5700	61.4700	0.1500	9.2205			(29a)
External Roof 1	9.0800		9.0800	0.1100	0.9988			(30)
Total net area of external elements Aum(A, m2)			126.3900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		33.6403			(33)
Party Wall 1			22.6500	0.0000	0.0000			(32)
Party Floor 1			32.4500					(32d)
Party Ceilings 1			62.6400					(32b)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.7436	(36)
Total fabric heat loss (33) + (36) =	48.3839	(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	15.8137	15.1536	15.1536	14.7136	14.9336	14.2735	14.7136	14.0535	14.0535	14.2735	14.2735	15.1536	(38)
Heat transfer coeff	64.1976	63.5376	63.5376	63.0975	63.3175	62.6575	63.0975	62.4375	62.4375	62.6575	62.6575	63.5376	(39)

Average = Sum(39)m / 12 = 63.0975 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8951	0.8859	0.8859	0.8798	0.8828	0.8736	0.8798	0.8706	0.8706	0.8736	0.8736	0.8859	(40)
HLP (average)												0.8798	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2871 (42)
Average daily hot water use (litres/day)	88.5198 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	97.3717	93.8309	90.2902	86.7494	83.2086	79.6678	79.6678	83.2086	86.7494	90.2902	93.8309	97.3717	(44)
Energy conte	144.3995	126.2927	130.3227	113.6185	109.0197	94.0757	87.1750	100.0345	101.2293	117.9730	128.7767	139.8432	(45)
Energy content (annual)										Total = Sum(45)m =		1392.7604	(45)
Distribution loss (46)m = 0.15 x (45)m	21.6599	18.9439	19.5484	17.0428	16.3530	14.1114	13.0762	15.0052	15.1844	17.6959	19.3165	20.9765	(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	49.6196	43.1879	46.0109	42.7805	42.4022	39.2882	40.5978	42.4022	42.7805	46.0109	46.2728	49.6196	(61)

Total heat required for water heating calculated for each month

	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (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												
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
								Total per year (kWh/year) = Sum(64)m =				1923.7334 (64)
Heat gains from water heating, kWh/month												
	60.4177	52.7893	54.8350	48.4733	46.8496	41.1022	39.1351	43.8620	44.3539	50.7287	54.3865	58.9027 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	137.2289	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	45.2112	40.1562	32.6572	24.7236	18.4812	15.6026	16.8592	21.9142	29.4131	37.3467	43.5892	46.4678	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	300.4144	303.5318	295.6761	278.9524	257.8417	238.0005	224.7455	221.6281	229.4837	246.2075	267.3182	287.1593	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	51.0100	(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)													
	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	-91.4859	(71)
Water heating gains (Table 5)													
	81.2066	78.5555	73.7030	67.3240	62.9699	57.0864	52.6010	58.9543	61.6026	68.1838	75.5367	79.1704	(72)
Total internal gains													
	526.5852	521.9965	501.7893	470.7530	439.0457	410.4425	393.9586	402.2496	420.2525	451.4910	486.1971	512.5504	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.8600	11.9672	0.6300	0.7000	0.7700	21.4320	(74)
East	2.6000	22.3142	0.6300	0.7000	0.7700	17.7307	(76)
South	5.7800	50.8329	0.6300	0.7000	0.7700	89.7933	(78)

Solar gains	128.9560	196.7935	279.6086	372.4523	424.2574	457.3603	434.5422	393.2326	331.5858	242.1091	154.6840	108.9976	(83)
Total gains	655.5412	718.7899	781.3979	843.2053	863.3031	867.8028	828.5008	795.4822	751.8383	693.6001	640.8812	621.5480	(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	31.0326	31.3550	31.3550	31.5737	31.4640	31.7954	31.5737	31.9075	31.9075	31.7954	31.7954	31.3550	
alpha	3.0688	3.0903	3.0903	3.1049	3.0976	3.1197	3.1049	3.1272	3.1272	3.1197	3.1197	3.0903	
util living area													
	0.8840	0.8479	0.7816	0.6630	0.5075	0.3183	0.1895	0.2183	0.4345	0.6741	0.8296	0.8951	(86)
MIT	20.0607	20.2194	20.4441	20.6870	20.8375	20.9018	20.9118	20.9114	20.8792	20.7146	20.3811	20.0317	(87)
Th 2	20.1717	20.1795	20.1795	20.1847	20.1821	20.1900	20.1847	20.1926	20.1926	20.1900	20.1900	20.1795	(88)
util rest of house													
	0.8704	0.8310	0.7580	0.6290	0.4611	0.2633	0.1281	0.1560	0.3770	0.6341	0.8081	0.8825	(89)
MIT 2	18.9287	19.1566	19.4668	19.7950	19.9793	20.0552	20.0573	20.0655	20.0374	19.8416	19.3953	18.8947	(90)
Living area fraction									fLA = Living area / (4) =			0.3440	(91)
MIT	19.3181	19.5221	19.8030	20.1018	20.2745	20.3464	20.3512	20.3565	20.3270	20.1419	19.7344	19.2858	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3181	19.5221	19.8030	20.1018	20.2745	20.3464	20.3512	20.3565	20.3270	20.1419	19.7344	19.2858	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8543	0.8158	0.7463	0.6254	0.4665	0.2740	0.1407	0.1687	0.3868	0.6316	0.7946	0.8666	(94)
Useful gains	560.0111	586.4081	583.1301	527.3036	402.7270	237.7926	116.5761	134.2125	290.7869	438.0675	509.2644	538.6457	(95)
Ext temp.	5.5000	6.1000	7.8000	10.4000	13.5000	16.5000	18.5000	18.2000	15.5000	12.0000	8.4000	5.5000	(96)
Heat loss rate W													
	887.0863	852.8106	762.6385	612.1617	428.9457	241.0076	116.8051	134.6455	301.3857	510.1511	710.1839	875.9180	(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													
	243.3440	179.0225	133.5542	61.0978	19.5067	0.0000	0.0000	0.0000	0.0000	53.6302	144.6620	250.9306	(98)
Space heating												1085.7480	(98)
Space heating per m2											(98) / (4) =	15.1387	(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 %)	90.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1206.3867	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	243.3440	179.0225	133.5542	61.0978	19.5067	0.0000	0.0000	0.0000	0.0000	53.6302	144.6620	250.9306	(98)
Space heating efficiency (main heating system 1)													

	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000 (210)
Space heating fuel (main heating system)												
	270.3822	198.9139	148.3936	67.8865	21.6741	0.0000	0.0000	0.0000	0.0000	59.5891	160.7356	278.8118 (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												
	194.0190	169.4806	176.3336	156.3990	151.4219	133.3639	127.7728	142.4367	144.0098	163.9838	175.0495	189.4627 (64)
Efficiency of water heater												90.0000 (216)
(217)m	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000	90.0000 (217)
Fuel for water heating, kWh/month												
	215.5767	188.3118	195.9262	173.7767	168.2465	148.1821	141.9698	158.2630	160.0109	182.2043	194.4994	210.5142 (219)
Water heating fuel used												2137.4816 (219)
Annual totals kWh/year												
Space heating fuel - main system												1206.3867 (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)	146.5598 (230a)
central heating pump	30.0000 (230c)
Total electricity for the above, kWh/year	176.5598 (231)
Electricity for lighting (calculated in Appendix L)	319.3775 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
Total delivered energy for all uses	3839.8056 (238)

10a. Fuel costs - using BEDF prices (396)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1206.3867	4.2800	51.6333	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2137.4816	4.2800	91.4842	(247)
Mechanical ventilation fans	146.5598	15.4400	22.6288	(249)
Pumps and fans for heating	30.0000	15.4400	4.6320	(249)
Energy for lighting	319.3775	15.4400	49.3119	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit	-901.0000	15.4400	-139.1144	(252)
Total energy cost			172.5759	(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	1206.3867	0.2160	260.5795	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2137.4816	0.2160	461.6960	(264)
Space and water heating			722.2755	(265)
Pumps and fans	176.5598	0.5190	91.6345	(267)
Energy for lighting	319.3775	0.5190	165.7569	(268)
Energy saving/generation technologies				
PV Unit	-901.0000	0.5190	-467.6190	(269)
Total kg/year			512.0480	(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	1206.3867	1.2200	1471.7917	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2137.4816	1.2200	2607.7276	(264)
Space and water heating			4079.5193	(265)
Pumps and fans	176.5598	3.0700	542.0386	(267)
Energy for lighting	319.3775	3.0700	980.4890	(268)
Energy saving/generation technologies				
PV Unit	-901.0000	3.0700	-2766.0700	(269)
Primary energy kWh/year			2835.9769	(272)
Primary energy kWh/m2/year			39.5423	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 90
Current environmental impact rating:	A 93

(For testing purposes):	
A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered

N	Solar water heating	Not applicable
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Not applicable
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

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

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

Potential energy efficiency rating: B 90
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 396 TEST (25 Jul 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	£77	£77	£0
Mains gas	£235	£235	£0
Space heating	£171	£171	£0
Water heating	£91	£91	£0
Lighting	£49	£49	£0
Generated (PV)	-£139	-£139	£0
Total cost of fuels	£173	£173	£0
Total cost of uses	£172	£172	£0
Delivered energy	54 kWh/m²	54 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.5 tonnes	0.0 tonnes
CO2 emissions per m²	7 kg/m²	7 kg/m²	0 kg/m²
Primary energy	40 kWh/m²	40 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	East
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	380.58 (P1)
Transmission heat loss coefficient	48.38 (37)
Summer heat loss coefficient	428.96 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	0.000	1.000	None
South	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)
East	1.000	0.90	1.000	0.900 (P8)
South	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	5.8600	81.1852	0.6300	0.7000	0.9000	169.9409
East	2.6000	117.5071	0.6300	0.7000	0.9000	109.1342
South	5.7800	112.2060	0.6300	0.7000	0.9000	231.6688
total:						510.7439

	Jun	Jul	Aug	
Solar gains	540	511	463	(P3)
Internal gains	407	391	399	
Total summer gains	947	902	862	(P5)
Summer gain/loss ratio	2.21	2.10	2.01	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	19.51	21.30	21.11	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight