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REPORT

Twickenham Rediscovered – Riverside Project, Twickenham

Energy Strategy Report

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Job Number: 25159.002

Date	Version	Notes/Amendments/Issue Purpose
November, 2017	v2	Update of roof values

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Acronyms	
ASHP	Air Source Heat Pumps
BRE	Building Research Establishment
CHP	Combined Heat and Power
GSHP	Ground Source Heat Pumps
LZC	Low and zero carbon
PV	Photovoltaic
SAP	Standard Assessment Procedure

Executive Summary

This report details the proposed energy strategy for the Twickenham Rediscovered – Riverside Project scheme. The Full planning application for the demolition and removal of all existing buildings and structures and redevelopment with a mixed use development of the site at 1A, 1B King Street and 2/4 Water Lane; the site of the remaining former swimming pool buildings at the corner of Water Lane and The Embankment; and the river-facing parcel of land on the Embankment in front of Diamond Jubilee Gardens.

The development proposals comprise: three seasonal units (201m2) at Lower Ground Floor level; 505m2 A3 floor space, 250m2 B1 floor space, 244m2 A1 floor space and 62m2 flexible commercial at ground floor level; 39 residential apartments at first, second and third floors (18 no. 1 bedroom, 19 no. 2 bedroom and 2 no. 3 bedroom, including six no. affordable homes); new public square / areas of public realm throughout the site; a Lower Ground Floor car park with new vehicular access from The Embankment consisting of 23 car parking spaces and cycle storage; reconfiguration of street parking in the roads immediately adjacent to the Site; amended pedestrian access and landscaping to the South of Diamond Jubilee Gardens; and amendment of service vehicle access to the service road at the rear of Diamond Jubilee Gardens The development is located in 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); and
- Low and zero carbon technologies (Be Green).

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

An energy assessment has been carried out based on design information to identify the most appropriate renewable strategy. The development will include PV panels for the residential units while an ASHP shall be provided for the commercial units.

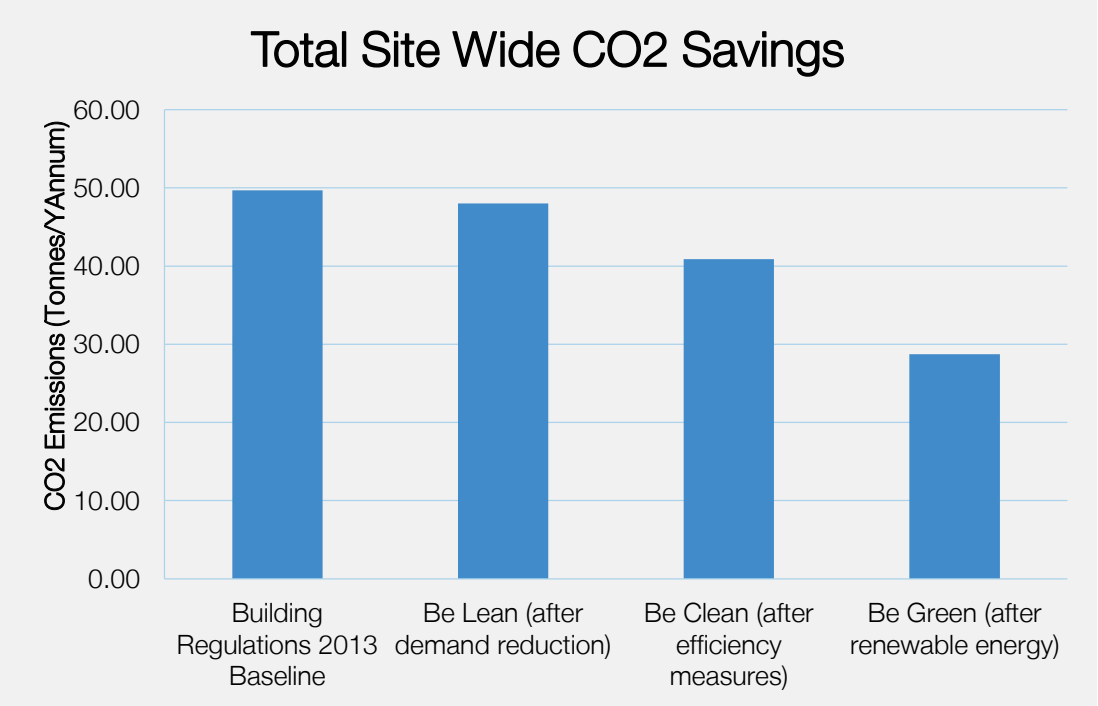

Figure 0.1: Summary of CO_2 savings for the proposed strategy over Building Regulations 2013 baseline.

The proposed strategy has the potential to provide a 42% and 15% improvement over the Building Regulations 2013 minimum target for the residential and non-residential parts of the development respectively; through passive design measures, energy efficient equipment and renewable technologies.

Renewable technologies have been specified to achieve a 20% reduction in site wide CO_2 emissions and generate 11.65% of the total energy consumption of the development.

1 Introduction

1.1 Site Analysis

Price & Myers have been commissioned by Slender Winter Partnership to produce an Energy Strategy Report for the proposed development at Twickenham Riverside. The development is in the London Borough of Richmond Upon Thames.

Full planning application for the demolition and removal of all existing buildings and structures and redevelopment with a mixed use development of the site at 1A, 1B King Street and 2/4 Water Lane; the site of the remaining former swimming pool buildings at the corner of Water Lane and The Embankment; and the river-facing parcel of land on the Embankment in front of Diamond Jubilee Gardens.

The development proposals comprise: three seasonal units (201m2) at Lower Ground Floor level; 505m2 A3 floor space, 250m2 B1 floor space, 244m2 A1 floor space and 62m2 flexible commercial at ground floor level; 39 residential apartments at first, second and third floors (18 no. 1 bedroom, 19 no. 2 bedroom and 2 no. 3 bedroom, including six no. affordable homes); new public square / areas of public realm throughout the site; a Lower Ground Floor car park with new vehicular access from The Embankment consisting of 23 car parking spaces and cycle storage; reconfiguration of street parking in the roads immediately adjacent to the Site; amended pedestrian access and landscaping to the South of Diamond Jubilee Gardens; and amendment of service vehicle access to the service road at the rear of Diamond Jubilee Gardens

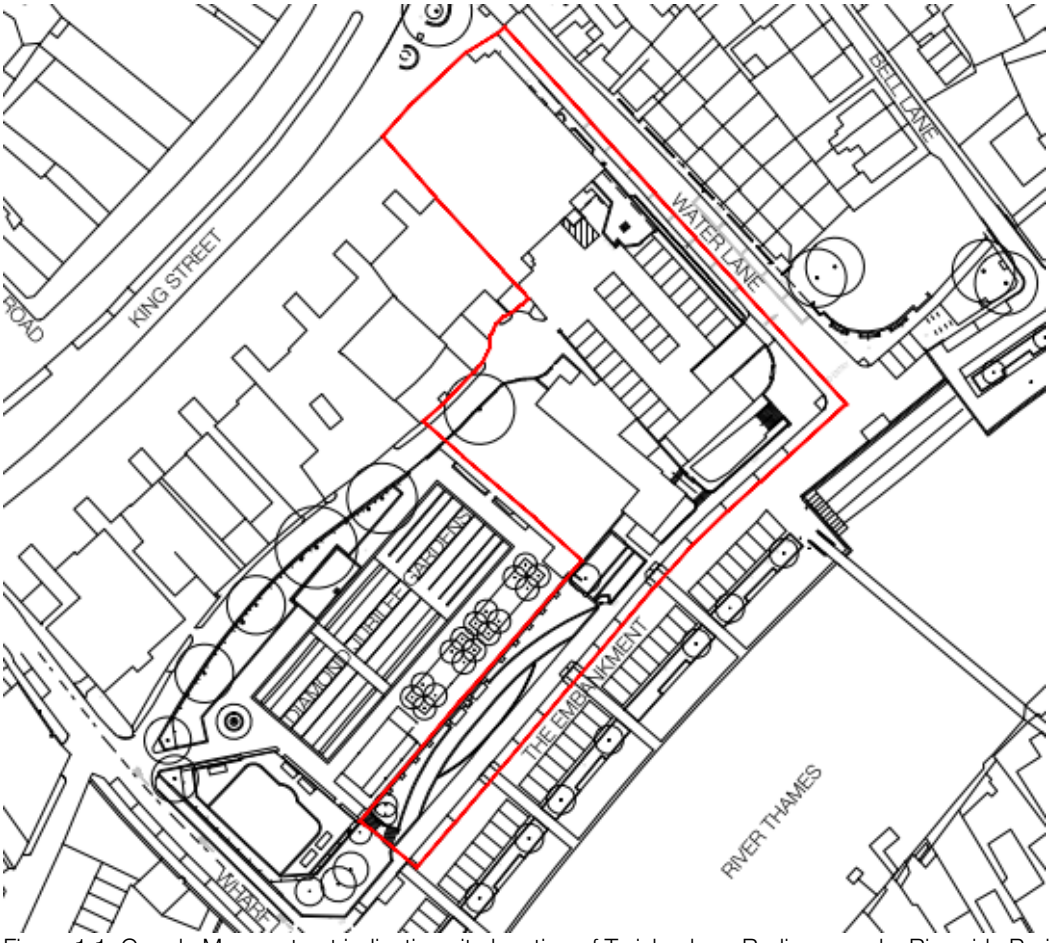

Figure 1.1: Google Maps extract indicating site location of Twickenham Rediscovered – Riverside Project

Our assessment has been based on drawings and details provided by SWP and the architect.

1.2 Objectives

This report summarises the work done to support the development of an energy strategy for the scheme. The strategy 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 allows 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 (March 2015)

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:

i. Be Lean: use less energy
ii. Be Clean: supply energy efficiently
iii. 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:

Residential 2016-2031: Zero Carbon
Non-residential 2016-2019: 35% improvement over Building Regulations

Major development proposals should include a detailed energy assessment to demonstrate how the targets for reducing carbon dioxide emissions are to be met within the framework of the energy hierarchy.

As a minimum, energy assessments should include the following details:

- Calculation of the energy demand and carbon dioxide emissions covered by Building Regulations
- Calculations of the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations at each stage of the energy hierarchy.
- Proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services
- Proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP).
- Proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.

The carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough. The contribution is to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

Policy 5.5 Decentralised Energy Networks
The Mayor expects 25 per cent of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025. In order to achieve this target the Mayor prioritises the development of decentralised heating and cooling networks at the development and area wide levels, including larger scale heat transmission networks.

As a minimum boroughs should require developers to prioritise connection to existing or planned decentralised energy networks where feasible.

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:

i. Connection to existing heating or cooling networks
ii. Site wide CHP network
iii. 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.

2.2 London Borough of Richmond Upon Thames Policies on Energy

Core Strategy CP1 Sustainable Development

BREEAM New Construction 2014 for non-domestic buildings will be required to meet BREEAM 'Excellent'.

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 CO2 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 CO2 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.

Development Management Plan Policy DM SD 3

Proposals for conversions and extensions will be encouraged to comply with the Sustainable Construction Checklist SPD as far as possible and opportunities for micro-generation of renewable energy will be supported.

2.3 Pre-Application Considerations

Sustainability

The applicant is required to demonstrate that new residential units would reduce adverse environmental impact by using resources efficiently. The application must conform to the Sustainable Construction Checklist and submit the document to the Council with any application and together with BREEAM New Construction 2014 scheme and Energy Report in order to demonstrate that the residential part of the development would achieve water efficiency by meeting the target for internal water consumption which is 105 litres per person per day.

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); and
- Utilise renewable energy sources to reduce carbon emissions (Be Green).

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

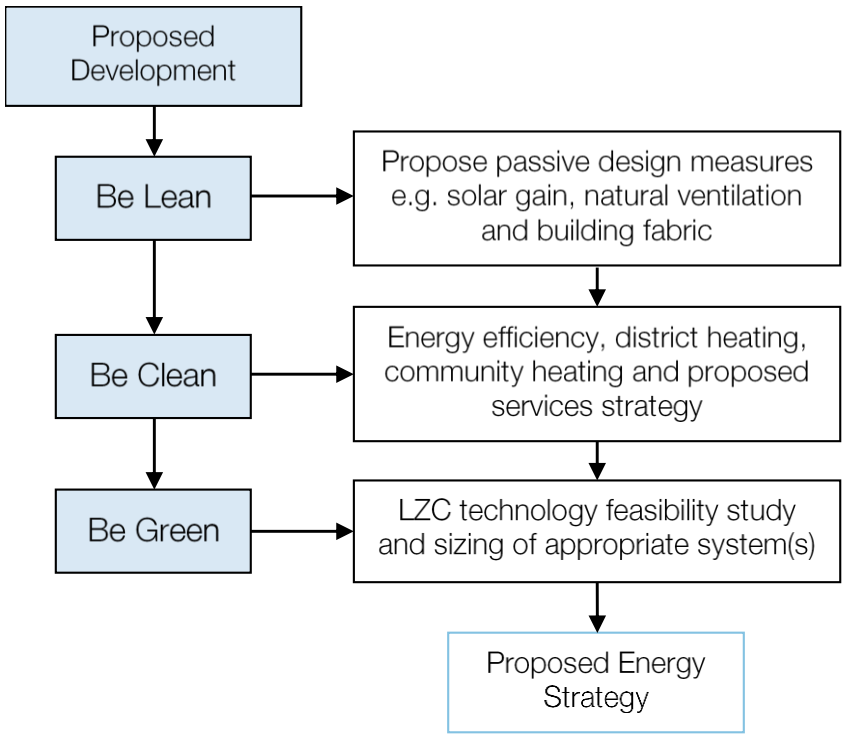

Figure 3.1 Energy Hierarchy Methodology

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 Deepika Singhal who is an accredited Low Carbon Energy Assessor and Fraser Wilson who is an On Construction Domestic Energy Assessor. The energy consumption and carbon emission figures within this report have been calculated using the approved Standard Assessment Procedure for the Energy Rating of Dwellings (SAP), current SAP 2012 version and Dynamic Simulation Modelling software by EDSL Tas.

4 Energy Targets

The target for the project is for the residential part to achieve zero carbon emissions to meet the London Plan and the London Borough of Richmond Upon Thames policy. The non-residential part of the development must demonstrate a 35% improvement over Part L of the building regulations. Table 4.1 details the energy broken down by fuel types and fuel use categories for the site. These values are the target energy and carbon calculations before any passive design and energy efficient measures.

Building Regulations Baseline Target Values: Regulated Energy Demand & CO_2 Emissions													
	Gas				Electricity								
	Demand (kWh/yr)			CO_2 (kg/yr)	Demand (kWh/yr)						CO_2 (kg/yr)	**Total Energy (kWh/yr)**	**Total CO_2 (kg/yr)**
Type	Space Heating	Hot Water	Total		Space Heating	Hot Water	Cooling	Pumps & Fans	Lighting	Total			
Residential	105,212	86,206	191,418	41,346	0	0	0	2,925	13,122	16,047	8,328	**207,464**	**49,674**
Commercial	14,473	4,657	19,131	4,132	0	0	7,800	4,257	24,877	36,934	19,169	**56,065**	**23,301**
Total	**119,685**	**90,864**	**210,548**	**45,478**	**0**	**0**	**7,800**	**7,182**	**37,999**	**52,981**	**27,497**	**263,529**	**72,975**

Table 4.1 Estimated regulated and unregulated energy demand and carbon emissions per energy source

Sections 5, 6 and 7 will show how the proposed passive design, energy efficiency measures and low and zero carbon technologies improve the design over these baseline figures.

The energy consumption calculations include regulated energy. Regulated energy is that used for space and water heating, lighting, pumps and fans. Energy consumption figures for these are calculated using SAP calculations & dynamic thermal modelling for the site. Energy consumption figures for these are based on the Building Research Establishment (BRE) methodology. Full details of assumptions are included in Appendix A.

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 glazing specifications used in the development are given in Table 5.1 below:

Glazing Parameters	Commercial	Residential
U-value	1.23 W/m^{2}K	1.20 W/m^{2}K
G-value (Solar Transmittance)	0.256	0.63

Table 5.1 Proposed glazing parameters for the commercial and residential windows

5.2 Overheating

The impact of solar gains has been incorporated into the SAP analysis for compliance with Part L and the risk of solar overheating has been concluded to be not significant to a slight risk for the residential part of the development. Risks of excessive solar gain for the non-residential areas have been checked and it can be confirmed that most areas comply with the minimum criteria.

5.3 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 5.2 shows the proposed U-values that will be considered for the development and have been assumed for the energy strategy analysis at this stage.

Measure	Element	Residential	Commercial
U Values	External Walls	0.15 W/m^{2}K	0.15 W/m^{2}K
	Corridor Shelter Walls*	0.00 W/m^{2}K* (corridors are to be heated)	N/A
	Lift/Stairwell Shelter Walls	0.15 W/m^{2}K	N/A
	Party Walls*	0.00 W/m^{2}K*	N/A
	Flat Roof	0.15 W/m^{2}K	0.13 W/m^{2}K
	Sloped Roof	0.15 W/m^{2}K	N/A
	Ground Floor	N/A	0.13 W/m^{2}K
	Internal Walls	N/A	0.89 W/m^{2}K
	Windows	1.20 W/m^{2}K	1.23 W/m^{2}K
	External/Flat Doors	1.00 W/m^{2}K	1.90 W/m^{2}K
Air Tightness		Pressure testing will be carried out to determine air tightness. This will be an assumed: 3 m^3/m^2/h	Pressure testing 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 Details to be calculated at the detailed design stage	

Table 5.2 Proposed Be Lean passive design measures

*Where party and corridor shelter 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

Thermal bridging

In order to further improve the thermal performance of the development, non-repeating thermal bridges at junctions, e.g. between walls and floors, will be designed carefully in order to ensure that they perform better than typical construction.

Approved Thermal Bridging values have been used in calculations rather than default values.
In order to achieve the values required, either Accredited Construction Details (ACDs) must be used or the designs should be independently assessed by a qualified energy modeller at the appropriate stage. If using ACD checklists, they should be used by the Designer, Constructor and Building Control Body to demonstrate compliance.

5.4 Carbon savings

Based on the performance of development once the passive design measures proposed in Section 5 are incorporated, energy and carbon calculations have been undertaken.

Table 5.3 shows that the residential part of the development can achieve a 3.30% improvement over the Part L minimum baseline and the non-residential part can achieve an 8% improvement. This is before any energy efficiency or low or zero carbon technologies have been considered. The breakdown of energy use and carbon emissions have been calculated, as shown in Table 5.4.

	Residential			Non-Residential		
	CO_2 Emissions (T/yr)	CO_2 Savings (T/yr)	% Saving	CO_2 Emissions (T/yr)	CO_2 Savings (T/yr)	% Saving
Building Regulations 2013 Baseline	49.67			23.30		
Be Lean Case	48.02	1.65	3.3%	21.52	1.78	8%

Table 5.3 Carbon savings with passive design measures

Be Lean Case: Regulated Energy Demand & CO_2 Emissions													
	Gas				Electricity								
	Demand (kWh/yr)			CO_2 (kg/yr)	Demand (kWh/yr)						CO_2 (kg/yr)	**Total Energy (kWh/yr)**	**Total CO_2 (kg/yr)**
Type	Space Heating	Hot Water	Total		Space Heating	Hot Water	Cooling	Pumps & Fans	Lighting	Total			
Residential	106,851	81,135	187,985	40,605	0	0	0	1,170	13,122	14,292	7,417	**202,277**	**48,022**
Commercial	14,285	4,708	18,993	4,102	0	0	5,434	5,033	23,099	33,566	17,421	**52,559**	**21,523**
Total	**121,136**	**85,842**	**206,978**	**44,707**	**0**	**0**	**5,434**	**6,203**	**36,221**	**47,858**	**24,838**	**254,836**	**69,546**

Table 5.4 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 require their own boilers or chillers.

The map in Figure 6.1 shows the site and the London Heat Map Study. The map shows that there is no network or possible network within close enough proximity of the site to consider connecting at this time.

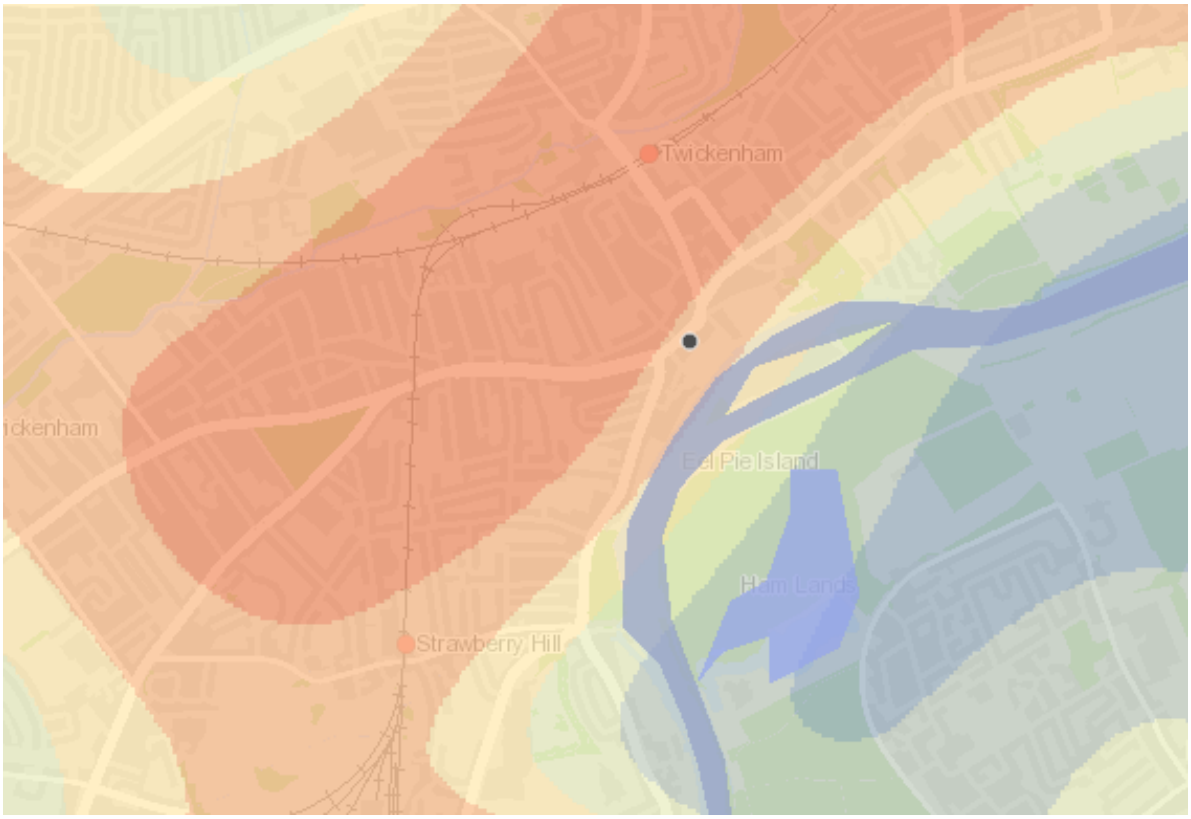

Figure 6.1: London Heat Map

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.

Given the size of this development, the installation of a community energy system would not be cost effective. The development is located in an air quality monitoring zone so a CHP system would not be deemed suitable in this area. 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	Residential	Commercial
Space Heating	Regular Condensing Gas Combi Boiler 90% efficient Space heating provided by both radiators and underfloor heating	VRF with Air Source Heat Pump COP 3.71
Heating Controls	Time and temperature zone control	Time and temperature zone control
Hot Water Heating	Gas Combi Condensing Boiler 90% efficient	Gas DHW Heaters 95% Efficiency
Hot Water Storage	N/A	N/A
Ventilation	MVHR 90% efficient 0.50 SFP Rigid Insulated Ducting Approved Installation	Mechanical Ventilation with Heat Recovery
Comfort Cooling	N/A	VRF Split /Multi Split cooling COP 3.6
Lighting & Controls	100% low energy lighting	95 lumens/circuit-watt Auto On/Auto Off Manual Daylight Control
Electricity power factor	N/A	<0.9

Table 6.1 Proposed energy efficient design measures

6.4 Carbon Savings

Based on the performance of the passive design and energy efficient measures proposed in Sections 5 and 6, Table 6.2 demonstrates the percentage improvement these have over the notional baseline levels. These shown for each type of building use on the development. They are calculated using SAP 2012 and EDSL Tas Dynamic Simulation Modelling software. These figures are for performance before incorporating any on-site renewables.

	Residential			Non-Residential		
	CO_2 Emissions (T/yr)	CO_2 Savings (T/yr)	% Saving	CO_2 Emissions (T/yr)	CO_2 Savings (T/yr)	% Saving
Building Regulations 2013 Baseline	49.67			23.30		
Be Lean Case	48.02	1.65	3.3%	21.52	1.78	8%
Be Clean Case	40.88	7.14	14.4%	19.88	1.58	7%
Total Cumulative Savings		8.79	18%		3.42	15%

Table 6.2 Carbon savings at Be Clean Stage

The breakdown of energy use and carbon emissions have been calculated, as shown in Table 6.3.

Be Clean Case: Regulated Energy Demand & CO_2 Emissions													
	Gas				Electricity								
	Demand (kWh/yr)			CO_2 (kg/yr)	Demand (kWh/yr)						CO_2 (kg/yr)	**Total Energy (kWh/yr)**	**Total CO_2 (kg/yr)**
Type	Space Heating	Hot Water	Total		Space Heating	Hot Water	Cooling	Pumps & Fans	Lighting	Total			
Residential	58,435	81,135	139,569	30,147	0	0	0	7,562	13,122	20,683	10,735	**160,253**	**40,882**
Commercial	0	4,457	4,457	963	2,892	0	5,434	5,033	23,099	36,458	18,922	**40,915**	**19,885**
Total	**58,435**	**85,592**	**144,026**	**31,110**	**2,892**	**0**	**5,434**	**12,595**	**36,221**	**57,142**	**29,657**	**201,168**	**60,766**

Table 6.3 Estimated regulated and unregulated energy demand and carbon emissions per energy source

7 Be Green: Low and Zero Carbon 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 (LZC) technologies and their feasibility on this development to contribute to meeting the relevant London Plan and Borough's sustainability targets.

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

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

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

LZC Technologies	Description	Advantages	Disadvantages	Feasibility	
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 to provide heating and cooling to the commercial area.	✓

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 panels, which would most suitably be installed on the roof space. For the commercial part of the development, an ASHP system has been identified as the most appropriate system to meet the heat demands required. The chosen system should be accurately sized during the detailed design stages and MCS (Microgeneration Certification Scheme) approved equipment and installers used.

7.1 Summary of CO_2 Emission Savings

The most appropriate LZC technology for the development has been identified as solar PV panels in order to meet the London Plan and the London Borough's target for on-site renewables.

Table 7.2 shows the proposed system size and the estimated energy and carbon emissions savings and financial feasibility for this development. The breakdown of energy use and carbon emissions for the final case have been calculated, as shown in Table 7.3.

	Energy & CO_2				Life Cycle Carbon and Cost Analysis
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 = 27.3kWp 30 deg, South facing 84 high efficiency panels (137.07m^2)	23,434	11.65%	12,162	20.0%	304,060

Table 7.2 Energy, carbon and financial performance of the proposed LZC technologies

Be Green Case: Regulated Energy Demand & CO_2 Emissions														
	Gas				Electricity									
	Demand (kWh/yr)			CO_2 (kg/yr)	Demand (kWh/yr)							CO_2 (kg/yr)	**Total Energy (kWh/yr)**	**Total CO_2 (kg/yr)**
Type	Space Heating	Hot Water	Total		Space Heating	Hot Water	Cooling	Pumps & Fans	Lighting	PV Generation	Total			
Residential	58,435	81,135	139,569	30,147	0	0	0	7,562	13,122	-23,434	-2,751	-1,428	**136,818**	**28,719**
Commercial	0	4,457	4,457	963	2,892	0	5,434	5,033	23,099	0	36,458	18,922	**40,915**	**19,885**
Total	**58,435**	**85,592**	**144,026**	**31,110**	**2,892**	**0**	**5,434**	**12,595**	**36,221**	**-23,434**	**33,707**	**17,494**	177,734	48,604

Table 7.3 Estimated regulated and unregulated energy demand and carbon emissions per energy source

7.2 Carbon Savings

Table 7.4 demonstrates the percentage improvement over the notional baseline levels for the development incorporating all three stages of the energy hierarchy.

	Residential			Non-Residential		
	CO_2 Emissions (T/yr)	CO_2 Savings (T/yr)	% Saving	CO_2 Emissions (T/yr)	CO_2 Savings (T/yr)	% Saving
Building Regulations 2013 Baseline	49.67			23.30		
Be Lean stage	48.02	1.65	3.3%	21.52	1.78	8%
Be Clean stage	40.88	7.14	14.4%	19.88	1.64	7%
Be Green stage	28.72	12.16	24%	19.88	0.00	0%
Total Cumulative Savings		20.96	42%		3.41	15%

Table 7.4 Carbon savings at the be Green stage

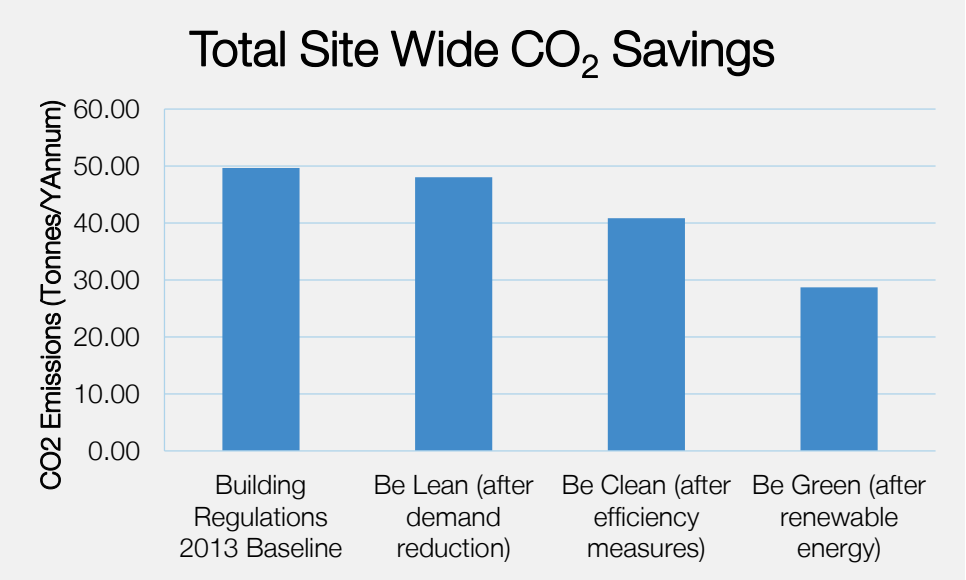

Figure 7.1: Summary of CO2 savings (tonnes CO2/annum) over Building Regulations 2013 baseline

The overall target for the development is for the non-residential part of the development to achieve 35% above the requirements of Part L, and the residential part to achieve zero carbon. The target for the non-residential part of the development has not been met. As such the remaining emissions from the non-residential part of the development have been factored into our offset payment calculations to reach the required 35%.

The development has followed the energy hierarchy and all feasible measures are incorporated to achieve the targets. To achieve the zero carbon target, carbon offsetting must be applied to the residential units.

Renewable energy systems have been incorporated into the non-residential part of the development. However, we have maximised the potential of the non-residential part of the building through the proposed thermal build ups as well as M&E systems. Subsequently to meet the 35% improvement required an offset payment has to be provided for the non-residential part of the building, this has been included in our calculations below. Beyond this, carbon savings can be made through an offset payment to achieve 'zero carbon' for the residential part of the development, in line with the London Plan requirements. The calculations are detailed below.

	Shortfall on zero carbon for Residential			
	Carbon emissions (tonnes / annum)	Resulting carbon emissions	30 year carbon emissions	Offset payment (£60/tonne)
Residential emissions	28.72			
Remaining commercial emissions	4.74			
Offset		33.46	1004	£60,225

Table 7.5 Carbon offset payment

8 Conclusion

Following the energy hierarchy, passive design measures, energy efficient equipment and provision of LZCs have shown an improvement of 42% over the Building Regulations Part L 2013 target emissions rate for the residential units and a 15% improvement for the non-residential units. The remaining emissions from the non-residential part of the development have been factored into our offset payment calculations to reach the required 35%. This is in line with the London Plan and the London Borough of Richmond Upon Thames policy criteria for the reduction in carbon emissions.

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 energy hierarchy has been followed, fabric U-Values have been specified to far exceed current Building Regulations, a high efficiency heating has been specified. PV panels and an ASHP system have incorporated into the design to reduce carbon emissions from the site. In order to achieve the zero carbon target, offsetting measures are included and a carbon offset payment will be made.

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

Figures used in Calculations

1 Figures used in Low and Zero Carbon Technology Calculations

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 B.1

Energy & Renewable Technology Outputs	
PV energy produced per kWp	858.4 kWh/kWp
PV kWp per m^2 panel	0.20 kWp/m^2
COP of ASHP	3.6
Electricity efficiency	100%
Gas boiler efficiency	90%

Table B.2

Fuel Prices (as of May 2017 – figures from Energy Saving Trust)	
Natural Gas	3.8 p/kWh
Electricity (Grid)	14.37 p/kWh

Table B.3

Appendix B

BRUKL and SAP Calculations

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

Design SAP
elmhurst energy

Property Reference	25159.002 - A301	**Issued on Date**	16/11/2017
Survey Reference	Be Lean v3 AB	**Prop Type Ref**	
Property	TW1 3SD		

SAP Rating	81 B	**DER**	23.40	**TER**	23.65
Environmental	84 B	**% DER<TER**	1.05		
CO_2 Emissions (t/year)	1.05	**DFEE**	58.94	**TFEE**	69.27
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.92		

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

SAP2012 - 9.92 input data (DesignData) -

```
SAP2012 Input Data (Flat)      16/11/2017

FullRefNo:                     Be Lean v3 AB

Regs Region:                   England
SAP Region:                    Thames Valley
Postcode:                      TW1 3SD
DwellingOrientation:           South West
Property Type:                 Flat, Mid-Terrace
Storeys:                       1
Date Built:                    2017
Sheltered Sides:               1
Sunlight Shade:                Average or unknown
Measurements                   Perimeter, Floor Area, Storey Height
     1st Storey:               12.96, 56.49, 3.15
Living Area:                   27.86 m2, fraction: 49.3%
Thermal Mass:                  Simple calculation
Thermal Mass Simple:           Medium
Thermal MassValue:             250
External Walls                 Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1                68.33, 77.96, 0, Other, Cavity, 0, 0.15, Gross
Party Walls                    Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                   37.14, 0, Other, FilledWithEdge, 0, 0
External Roofs                 Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
     External Roof 1           56.49, 56.49, 0, Other, 0.15
Heat Loss Floors               Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
Party Floors                   Area, Kappa, Construction, Element
     Party Floor 1             56.49, 0
Description                    Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
     Flat Door                 Manufacturer, Solid Door, , , , , , ,
     Windows                   Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
     French Doors              Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
Openings                       Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
     Flat Door                 Solid Door, External Wall 1, South West, , , , , 0, 0, 0, 2.30,
     SW F Windows              Window, External Wall 1, South West, , None, 0, , 0, 0, 0, 2.27,
     NE F FDoors               Window, External Wall 1, North East, , None, 0, , 0, 0, 0, 5.06,
Conservatory:                  None
Draught Proofing:              100
Draught Lobby:                 No
Thermal Bridges
     Bridging:                 Calculate Bridges
     Y                         0.104
     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, 4.23, 0.3, 0.3, 1.27,
     1.                        External wall, E3 Sill, Table K1 - Approved, Yes, 3.23, 0.04, 0.04, 0.13,
     2.                        External wall, E4 Jamb, Table K1 - Approved, Yes, 13.6, 0.05, 0.05, 0.68,
     3.                        External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Approved, Yes, 12.96, 0.07, 0.07, 0.91,
     4.                        External wall, E23 Balcony within or between dwellings, balcony support penetrates wall insulation , Table K1 - Default, No, 2.2,
1, 1, 2.20,
     5.                        External wall, E15 Flat roof with parapet, Table K1 - Default, Yes, 12.96, 0.56, 0.56, 7.26,
     6.                        External wall, E16 Corner (normal), Table K1 - Approved, No, 9.45, 0.09, 0.09, 0.85,
     7.                        External wall, E18 Party wall between dwellings, Table K1 - Approved, Yes, 12.6, 0.06, 0.06, 0.76,
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:             2
Passive Vents:                 0
Flueless Gas Fires:            0
Cooling System                 None
Light Fittings:                20
LEL Fittings:                  20
Percentage of LEL Fittings:    100
External Lights Fitted:        Yes
External LELs Fitted:          Yes
Electricity Tariff:            Standard
Main Heating 1
     Description
     Percentage                100
     MHS                       Mains gas BGW Post 98 Combi condens. with auto ign.
     SAP Code                  104
```

SAP2012 - 9.92 input data (DesignData) -

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

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 56 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) 23.65 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 23.40 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)69.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)58.9 kWh/m²/yrOK

---

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.15 (max. 0.20)	0.15 (max. 0.35)	OK
Openings	1.15 (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

SAP2012 - 9.92 input data (DesignData) -

---

8 Mechanical ventilation
Not applicable

---

9 Summertime temperature

Overheating risk (Thames Valley):	Not significant	OK
Based on:		
Overshading:	Average	
Windows facing North East:	5.06 m², No overhang	
Windows facing South West:	2.27 m², No overhang	
Air change rate:	6.00 ach	
Blinds/curtains:	None	

---

10 Key features

Party wall U-value	0.00 W/m²K
Door U-value	1.00 W/m²K
Air permeability	3.0 m³/m²h

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1124	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2624	(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) =	0.2427	(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	0.3095	0.3034	0.2973	0.2670	0.2609	0.2306	0.2306	0.2245	0.2427	0.2609	0.2731	0.2852	(22b)
Effective ac	0.5479	0.5460	0.5442	0.5356	0.5340	0.5266	0.5266	0.5252	0.5295	0.5340	0.5373	0.5407	(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	
Flat Door			2.3000	1.0000	2.3000			(26)
Windows (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
French Doors (Uw = 1.20)			5.0600	1.1450	5.7939			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1500	10.2495			(29a)
External Roof 1	56.4900		56.4900	0.1500	8.4735			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.4161			(33)
Party Wall 1			37.1400	0.0000	0.0000			(32)
Party Floor 1			56.4900					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.0495	(36)
Total fabric heat loss (33) + (36) =	43.4656	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	32.1725	32.0633	31.9563	31.4536	31.3595	30.9217	30.9217	30.8406	31.0903	31.3595	31.5498	31.7487	(38)
Heat transfer coeff	75.6381	75.5289	75.4219	74.9192	74.8251	74.3873	74.3873	74.3062	74.5560	74.8251	75.0154	75.2143	(39)
Average = Sum(39)m / 12 =												74.9187	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3390	1.3370	1.3351	1.3262	1.3246	1.3168	1.3168	1.3154	1.3198	1.3246	1.3279	1.3315	(40)
HLP (average)												1.3262	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8809 (42)
Average daily hot water use (litres/day)	78.8705 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(45)
Distribution loss (46)m = 0.15 x (45)m	19.2988	16.8789	17.4175	15.1850	14.5704	12.5731	11.6508	13.3695	13.5292	15.7670	17.2109	18.6899	(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)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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	(57)
Combi loss	44.2107	38.4802	40.9954	38.1171	37.7801	35.0055	36.1724	37.7801	38.1171	40.9954	41.2288	44.2107 (61)
Total heat required for water heating calculated for each month												
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100 (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												
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100 (64)
								Total per year (kWh/year) = Sum(64)m =				1714.0337 (64)
Heat gains from water heating, kWh/month												
	53.8318	47.0349	48.8576	43.1894	41.7427	36.6218	34.8691	39.0808	39.5190	45.1990	48.4580	52.4820 (65)

---

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.9512	14.1677	11.5219	8.7228	6.5204	5.5048	5.9482	7.7316	10.3774	13.1765	15.3789	16.3945	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.0163	165.7182	161.4293	152.2987	140.7729	129.9404	122.7035	121.0016	125.2905	134.4211	145.9468	156.7794	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	(71)
Water heating gains (Table 5)													
	72.3545	69.9924	65.6689	59.9852	56.1057	50.8636	46.8671	52.5279	54.8875	60.7513	67.3027	70.5403	(72)
Total internal gains													
	306.5349	304.0913	292.8331	275.2198	257.6121	240.5218	229.7318	235.4741	244.7683	262.5618	282.8414	297.9272	(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	
Southwest	2.2700	36.7938	0.6300	0.7000	0.7700	25.5254	(79)
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)

Solar gains	42.9734	78.9950	123.4784	178.7982	223.8203	232.5612	219.9027	184.7304	142.3859	91.4570	52.5276	36.0933 (83)
Total gains	349.5083	383.0864	416.3115	454.0180	481.4324	473.0830	449.6344	420.2045	387.1542	354.0188	335.3690	334.0205 (84)

---

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.8643	51.9393	52.0130	52.3620	52.4278	52.7364	52.7364	52.7939	52.6171	52.4278	52.2948	52.1565	
alpha	4.4576	4.4626	4.4675	4.4908	4.4952	4.5158	4.5158	4.5196	4.5078	4.4952	4.4863	4.4771	
util living area	0.9976	0.9960	0.9917	0.9771	0.9322	0.8213	0.6708	0.7257	0.9132	0.9840	0.9958	0.9981	(86)
MIT	19.8369	19.9331	20.1182	20.3804	20.6411	20.8340	20.9089	20.8954	20.7453	20.4203	20.0836	19.8167	(87)
Th 2	19.8104	19.8119	19.8134	19.8203	19.8216	19.8277	19.8277	19.8288	19.8253	19.8216	19.8190	19.8163	(88)
util rest of house	0.9968	0.9946	0.9884	0.9671	0.8990	0.7306	0.5189	0.5798	0.8560	0.9751	0.9940	0.9974	(89)
MIT 2	18.2653	18.4068	18.6776	19.0612	19.4238	19.6632	19.7277	19.7212	19.5682	19.1231	18.6325	18.2402	(90)
Living area fraction									fLA = Living area / (4) =			0.4932	(91)
MIT	19.0404	19.1596	19.3881	19.7118	20.0242	20.2406	20.3103	20.3003	20.1487	19.7628	19.3482	19.0177	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0404	19.1596	19.3881	19.7118	20.0242	20.2406	20.3103	20.3003	20.1487	19.7628	19.3482	19.0177	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9961	0.9936	0.9869	0.9659	0.9058	0.7664	0.5858	0.6439	0.8749	0.9745	0.9931	0.9968	(94)
Useful gains	348.1432	380.6285	410.8717	438.5504	436.0702	362.5848	263.3785	270.5617	338.7062	345.0061	333.0444	332.9570	(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	1114.9337	1077.0086	972.0433	810.0139	622.8563	419.5912	275.9973	289.8164	450.9675	685.6097	918.8001	1114.5026	(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	570.4921	467.9674	417.5117	267.4537	138.9688	0.0000	0.0000	0.0000	0.0000	253.4091	421.7441	581.4700	(98)
Space heating												3119.0170	(98)
Space heating per m2											(98) / (4) =	55.2136	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3465.5744	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	570.4921	467.9674	417.5117	267.4537	138.9688	0.0000	0.0000	0.0000	0.0000	253.4091	421.7441	581.4700	(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)													
	633.8802	519.9638	463.9019	297.1708	154.4098	0.0000	0.0000	0.0000	0.0000	281.5656	468.6046	646.0777	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	192.0774	167.7846	174.5690	154.8339	149.9065	132.0293	126.4941	141.0113	142.5686	162.3428	173.2977	187.5667	(219)
Water heating fuel used												1904.4819	(219)
Annual totals kWh/year													
Space heating fuel - main system												3465.5744	(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)												281.7027	(232)
Total delivered energy for all uses												5681.7590	(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	3465.5744	0.2160	748.5641	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1904.4819	0.2160	411.3681	(264)
Space and water heating			1159.9322	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	281.7027	0.5190	146.2037	(268)
Total CO2, kg/year			1321.7059	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			23.4000	(273)

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

DER		23.4000	ZC1
Total Floor Area	TFA	56.4900	
Assumed number of occupants	N	1.8809	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.2053	ZC2
CO2 emissions from cooking, equation (L16)		2.9057	ZC3
Total CO2 emissions		43.5109	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		43.5109	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1124	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3624	(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) =	0.3352	(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	0.4274	0.4190	0.4106	0.3687	0.3604	0.3185	0.3185	0.3101	0.3352	0.3604	0.3771	0.3939	(22b)
Effective ac	0.5913	0.5878	0.5843	0.5680	0.5649	0.5507	0.5507	0.5481	0.5562	0.5649	0.5711	0.5776	(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			2.3000	1.0000	2.3000			(26)
TER Opening Type (Uw = 1.40)			7.3300	1.3258	9.7178			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1800	12.2994			(29a)
External Roof 1	56.4900		56.4900	0.1300	7.3437			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.6609			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.8683	(36)
Total fabric heat loss					(33) + (36) =		42.5292	(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	34.7240	34.5157	34.3116	33.3528	33.1734	32.3382	32.3382	32.1836	32.6599	33.1734	33.5363	33.9157	(38)
Heat transfer coeff	77.2532	77.0449	76.8408	75.8820	75.7026	74.8674	74.8674	74.7128	75.1891	75.7026	76.0655	76.4449	(39)
Average = Sum(39)m / 12 =												75.8811	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3676	1.3639	1.3603	1.3433	1.3401	1.3253	1.3253	1.3226	1.3310	1.3401	1.3465	1.3532	(40)
HLP (average)												1.3433	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.8809 (42)
Average daily hot water use (litres/day)		78.8705 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(45)
Distribution loss (46)m = 0.15 x (45)m	19.2988	16.8789	17.4175	15.1850	14.5704	12.5731	11.6508	13.3695	13.5292	15.7670	17.2109	18.6899	(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	44.2107	38.4802	40.9954	38.1171	37.7801	35.0055	36.1724	37.7801	38.1171	40.9954	41.2288	44.2107	(61)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total heat required for water heating calculated for each month

	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(64)
								Total per year (kWh/year) = Sum(64)m =				1714.0337	(64)
Heat gains from water heating, kWh/month													
	53.8318	47.0349	48.8576	43.1894	41.7427	36.6218	34.8691	39.0808	39.5190	45.1990	48.4580	52.4820	(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	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.9512	14.1677	11.5219	8.7228	6.5204	5.5048	5.9482	7.7316	10.3774	13.1765	15.3789	16.3945	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.0163	165.7182	161.4293	152.2987	140.7729	129.9404	122.7035	121.0016	125.2905	134.4211	145.9468	156.7794	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	(71)
Water heating gains (Table 5)													
	72.3545	69.9924	65.6689	59.9852	56.1057	50.8636	46.8671	52.5279	54.8875	60.7513	67.3027	70.5403	(72)
Total internal gains													
	306.5349	304.0913	292.8331	275.2198	257.6121	240.5218	229.7318	235.4741	244.7683	262.5618	282.8414	297.9272	(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	
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)
Southwest	2.2700	36.7938	0.6300	0.7000	0.7700	25.5254	(79)

Solar gains	42.9734	78.9950	123.4784	178.7982	223.8203	232.5612	219.9027	184.7304	142.3859	91.4570	52.5276	36.0933	(83)
Total gains	349.5083	383.0864	416.3115	454.0180	481.4324	473.0830	449.6344	420.2045	387.1542	354.0188	335.3690	334.0205	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	50.7800	50.9172	51.0525	51.6976	51.8201	52.3982	52.3982	52.5066	52.1740	51.8201	51.5729	51.3169	
alpha	4.3853	4.3945	4.4035	4.4465	4.4547	4.4932	4.4932	4.5004	4.4783	4.4547	4.4382	4.4211	
util living area													
	0.9976	0.9960	0.9918	0.9774	0.9335	0.8231	0.6735	0.7278	0.9144	0.9842	0.9958	0.9981	(86)
MIT	19.4945	19.6257	19.8771	20.2381	20.5908	20.8554	20.9572	20.9390	20.7347	20.2947	19.8390	19.4755	(87)
Th 2	19.7883	19.7911	19.7939	19.8071	19.8096	19.8211	19.8211	19.8232	19.8166	19.8096	19.8046	19.7994	(88)
util rest of house													
	0.9968	0.9946	0.9885	0.9675	0.9005	0.7325	0.5207	0.5814	0.8575	0.9753	0.9940	0.9974	(89)
MIT 2	17.8018	17.9952	18.3634	18.8935	19.3850	19.7164	19.8045	19.7961	19.5859	18.9814	18.3164	17.7816	(90)
Living area fraction									fLA = Living area / (4) =			0.4932	(91)
MIT	18.6366	18.7993	19.1099	19.5567	19.9797	20.2781	20.3730	20.3598	20.1525	19.6291	19.0673	18.6170	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6366	18.7993	19.1099	19.5567	19.9797	20.2781	20.3730	20.3598	20.1525	19.6291	19.0673	18.6170	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9956	0.9930	0.9860	0.9648	0.9062	0.7717	0.5969	0.6538	0.8768	0.9735	0.9925	0.9964	(94)
Useful gains	347.9842	380.3897	410.4968	438.0390	436.2533	365.0836	268.3686	274.7332	339.4660	344.6544	332.8387	332.8306	(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													
	1107.5482	1070.8740	968.9562	808.6482	626.7953	425.1077	282.4720	295.8453	455.0829	683.5258	910.3010	1102.1068	(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													
	565.1156	464.0055	415.4938	266.8386	141.7632	0.0000	0.0000	0.0000	0.0000	252.1204	415.7729	572.3415	(98)
Space heating												3093.4515	(98)
Space heating per m2											(98) / (4) =	54.7610	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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												3312.0466	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	565.1156	464.0055	415.4938	266.8386	141.7632	0.0000	0.0000	0.0000	0.0000	252.1204	415.7729	572.3415	(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)	605.0489	496.7939	444.8542	285.6945	151.7808	0.0000	0.0000	0.0000	0.0000	269.9361	445.1530	612.7853	(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	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8128	87.6918	87.3843	86.6606	85.1759	80.3000	80.3000	80.3000	80.3000	86.4123	87.4011	87.8823	(217)
Fuel for water heating, kWh/month	196.8616	172.2009	179.7945	160.8004	158.3967	147.9780	141.7742	158.0450	159.7905	169.0830	178.4507	192.0864	(219)
Water heating fuel used												2015.2621	(219)
Annual totals kWh/year													
Space heating fuel - main system												3312.0466	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												281.7027	(232)
Total delivered energy for all uses												5684.0114	(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	3312.0466	0.2160	715.4021	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2015.2621	0.2160	435.2966	(264)
Space and water heating			1150.6987	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	281.7027	0.5190	146.2037	(268)
Total CO2, kg/m2/year			1335.8274	(272)
Emissions per m2 for space and water heating			20.3700	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.5881	(272b)
Emissions per m2 for pumps and fans			0.6891	(272c)
Target Carbon Dioxide Emission Rate (TER) = (20.3700 * 1.00) + 2.5881 + 0.6891, rounded to 2 d.p.			23.6500	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1124	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2624	(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) =	0.2427	(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	0.3095	0.3034	0.2973	0.2670	0.2609	0.2306	0.2306	0.2245	0.2427	0.2609	0.2731	0.2852	(22b)
Effective ac	0.5479	0.5460	0.5442	0.5356	0.5340	0.5266	0.5266	0.5252	0.5295	0.5340	0.5373	0.5407	(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	
Flat Door			2.3000	1.0000	2.3000			(26)
Windows (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
French Doors (Uw = 1.20)			5.0600	1.1450	5.7939			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1500	10.2495			(29a)
External Roof 1	56.4900		56.4900	0.1500	8.4735			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.4161			(33)
Party Wall 1			37.1400	0.0000	0.0000			(32)
Party Floor 1			56.4900					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.0495	(36)
Total fabric heat loss (33) + (36) =	43.4656	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	32.1725	32.0633	31.9563	31.4536	31.3595	30.9217	30.9217	30.8406	31.0903	31.3595	31.5498	31.7487	(38)
Heat transfer coeff	75.6381	75.5289	75.4219	74.9192	74.8251	74.3873	74.3873	74.3062	74.5560	74.8251	75.0154	75.2143	(39)
Average = Sum(39)m / 12 =												74.9187	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3390	1.3370	1.3351	1.3262	1.3246	1.3168	1.3168	1.3154	1.3198	1.3246	1.3279	1.3315	(40)
HLP (average)												1.3262	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8809 (42)
Average daily hot water use (litres/day)	78.8705 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(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)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	(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	(59)

Heat gains from water heating, kWh/month

	27.3400	23.9118	24.6748	21.5121	20.6414	17.8119	16.5054	18.9401	19.1664	22.3365	24.3821	26.4774 (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	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	(66)

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

	15.9512	14.1677	11.5219	8.7228	6.5204	5.5048	5.9482	7.7316	10.3774	13.1765	15.3789	16.3945 (67)

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

	164.0163	165.7182	161.4293	152.2987	140.7729	129.9404	122.7035	121.0016	125.2905	134.4211	145.9468	156.7794 (68)

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

	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345 (71)

Water heating gains (Table 5)

	36.7474	35.5830	33.1651	29.8779	27.7438	24.7388	22.1846	25.4572	26.6199	30.0222	33.8640	35.5878 (72)

Total internal gains

	267.9277	266.6819	257.3293	242.1124	226.2501	211.3969	202.0493	205.4033	213.5008	228.8328	246.4027	259.9747 (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	
Southwest	2.2700	36.7938	0.6300	0.7000	0.7700	25.5254	(79)
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)

Solar gains	42.9734	78.9950	123.4784	178.7982	223.8203	232.5612	219.9027	184.7304	142.3859	91.4570	52.5276	36.0933 (83)
Total gains	310.9011	345.6769	380.8076	420.9106	450.0704	443.9581	421.9520	390.1338	355.8867	320.2897	298.9303	296.0681 (84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.8643	51.9393	52.0130	52.3620	52.4278	52.7364	52.7364	52.7939	52.6171	52.4278	52.2948	52.1565	
alpha	4.4576	4.4626	4.4675	4.4908	4.4952	4.5158	4.5158	4.5196	4.5078	4.4952	4.4863	4.4771	
util living area	0.9985	0.9974	0.9941	0.9827	0.9452	0.8461	0.7024	0.7609	0.9326	0.9890	0.9974	0.9988	(86)
MIT	19.4688	19.5993	19.8500	20.2060	20.5642	20.8379	20.9501	20.9274	20.7056	20.2565	19.8010	19.4424	(87)
Th 2	19.8104	19.8119	19.8134	19.8203	19.8216	19.8277	19.8277	19.8288	19.8253	19.8216	19.8190	19.8163	(88)
util rest of house	0.9980	0.9964	0.9918	0.9748	0.9168	0.7607	0.5489	0.6166	0.8842	0.9827	0.9962	0.9984	(89)
MIT 2	18.4236	18.5549	18.8059	19.1634	19.5073	19.7451	19.8140	19.8058	19.6444	19.2170	18.7621	18.4017	(90)
Living area fraction									fLA = Living area / (4) =			0.4932	(91)
MIT	18.9391	19.0700	19.3208	19.6776	20.0285	20.2841	20.3743	20.3590	20.1678	19.7297	19.2745	18.9150	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9391	19.0700	19.3208	19.6776	20.0285	20.2841	20.3743	20.3590	20.1678	19.7297	19.2745	18.9150	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9975	0.9956	0.9905	0.9736	0.9228	0.7982	0.6258	0.6885	0.9014	0.9821	0.9955	0.9980	(94)
Useful gains	310.1232	344.1638	377.1941	409.7927	415.3052	354.3596	264.0701	268.5913	320.7826	314.5508	297.5865	295.4756	(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	1107.2714	1070.2429	966.9721	807.4484	623.1835	422.8227	280.7593	294.1773	452.3913	683.1301	913.2734	1106.7753	(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	593.0783	487.9252	438.7948	286.3121	154.6614	0.0000	0.0000	0.0000	0.0000	274.2231	443.2946	603.6070	(98)
Space heating												3281.8964	(98)
Space heating per m2											(98) / (4) =	58.0969	(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	699.2409	550.4662	564.7275	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7432	0.8278	0.7895	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	519.6523	455.6754	445.8519	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	590.0498	563.0070	527.0876	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	50.6862	79.8547	60.4394	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												190.9803	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   12.6715   19.9637   15.1099    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                          47.7451 (107)
Space cooling per m2                                                                                                    0.8452 (108)
Energy for space heating                                                                                               58.0969 (99)
Energy for space cooling                                                                                                0.8452 (108)
Total                                                                                                                  58.9421 (109)
Dwelling Fabric Energy Efficiency (DFEE)                                                                                  58.9 (109)


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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1124	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3624	(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) =	0.3352	(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	0.4274	0.4190	0.4106	0.3687	0.3604	0.3185	0.3185	0.3101	0.3352	0.3604	0.3771	0.3939	(22b)
Effective ac	0.5913	0.5878	0.5843	0.5680	0.5649	0.5507	0.5507	0.5481	0.5562	0.5649	0.5711	0.5776	(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			2.3000	1.0000	2.3000			(26)
TER Opening Type (Uw = 1.40)			7.3300	1.3258	9.7178			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1800	12.2994			(29a)
External Roof 1	56.4900		56.4900	0.1300	7.3437			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.6609			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.8683	(36)
Total fabric heat loss					(33) + (36) =		42.5292	(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	34.7240	34.5157	34.3116	33.3528	33.1734	32.3382	32.3382	32.1836	32.6599	33.1734	33.5363	33.9157	(38)
Heat transfer coeff	77.2532	77.0449	76.8408	75.8820	75.7026	74.8674	74.8674	74.7128	75.1891	75.7026	76.0655	76.4449	(39)
Average = Sum(39)m / 12 =												75.8811	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3676	1.3639	1.3603	1.3433	1.3401	1.3253	1.3253	1.3226	1.3310	1.3401	1.3465	1.3532	(40)
HLP (average)												1.3433	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.8809 (42)
Average daily hot water use (litres/day)		78.8705 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month

	27.3400	23.9118	24.6748	21.5121	20.6414	17.8119	16.5054	18.9401	19.1664	22.3365	24.3821	26.4774 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	(66)

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

	15.9512	14.1677	11.5219	8.7228	6.5204	5.5048	5.9482	7.7316	10.3774	13.1765	15.3789	16.3945	(67)

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

	164.0163	165.7182	161.4293	152.2987	140.7729	129.9404	122.7035	121.0016	125.2905	134.4211	145.9468	156.7794	(68)

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

	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	(71)

Water heating gains (Table 5)

	36.7474	35.5830	33.1651	29.8779	27.7438	24.7388	22.1846	25.4572	26.6199	30.0222	33.8640	35.5878	(72)

Total internal gains

	267.9277	266.6819	257.3293	242.1124	226.2501	211.3969	202.0493	205.4033	213.5008	228.8328	246.4027	259.9747	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)
Southwest	2.2700	36.7938	0.6300	0.7000	0.7700	25.5254	(79)

Solar gains	42.9734	78.9950	123.4784	178.7982	223.8203	232.5612	219.9027	184.7304	142.3859	91.4570	52.5276	36.0933	(83)
Total gains	310.9011	345.6769	380.8076	420.9106	450.0704	443.9581	421.9520	390.1338	355.8867	320.2897	298.9303	296.0681	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	50.7800	50.9172	51.0525	51.6976	51.8201	52.3982	52.3982	52.5066	52.1740	51.8201	51.5729	51.3169	
alpha	4.3853	4.3945	4.4035	4.4465	4.4547	4.4932	4.4932	4.5004	4.4783	4.4547	4.4382	4.4211	
util living area	0.9985	0.9974	0.9942	0.9829	0.9462	0.8477	0.7050	0.7628	0.9335	0.9891	0.9974	0.9988	(86)
MIT	19.4333	19.5668	19.8221	20.1898	20.5530	20.8344	20.9485	20.9257	20.6997	20.2440	19.7815	19.4152	(87)
Th 2	19.7883	19.7911	19.7939	19.8071	19.8096	19.8211	19.8211	19.8232	19.8166	19.8096	19.8046	19.7994	(88)
util rest of house	0.9980	0.9964	0.9918	0.9751	0.9180	0.7624	0.5507	0.6181	0.8854	0.9828	0.9962	0.9984	(89)
MIT 2	18.3711	18.5064	18.7630	19.1370	19.4869	19.7366	19.8069	19.7996	19.6320	19.1951	18.7314	18.3615	(90)
Living area fraction									fLA = Living area / (4) =			0.4932	(91)
MIT	18.8949	19.0294	19.2854	19.6562	20.0127	20.2780	20.3699	20.3550	20.1586	19.7124	19.2493	18.8811	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8949	19.0294	19.2854	19.6562	20.0127	20.2780	20.3699	20.3550	20.1586	19.7124	19.2493	18.8811	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9974	0.9956	0.9905	0.9738	0.9238	0.7998	0.6281	0.6902	0.9023	0.9822	0.9955	0.9980	(94)
Useful gains	310.1080	344.1482	377.1948	409.8851	415.7609	355.0632	265.0101	269.2766	321.1249	314.5772	297.5772	295.4653	(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	1127.5067	1088.5971	982.4385	816.2049	629.2922	425.0978	282.2458	295.4909	455.5374	689.8305	924.1430	1122.2988	(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	608.1447	500.2696	450.3013	292.5503	158.8673	0.0000	0.0000	0.0000	0.0000	279.1885	451.1274	615.1641	(98)
Space heating												3355.6132	(98)
Space heating per m2											(98) / (4) =	59.4019	(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	703.7540	554.0191	567.8173	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7395	0.8245	0.7865	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	520.4096	456.7757	446.5838	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	590.0498	563.0070	527.0876	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	50.1409	79.0361	59.8948	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												189.0719	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Space cooling kWh
                0.0000     0.0000     0.0000     0.0000     0.0000    12.5352    19.7590    14.9737     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                          47.2680 (107)
Space cooling per m2                                                                                                                    0.8367 (108)
Energy for space heating                                                                                                               59.4019 (99)
Energy for space cooling                                                                                                                0.8367 (108)
Total                                                                                                                                  60.2386 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                    69.3 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

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	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1124	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2624	(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) =	0.2427	(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	0.2306	0.2124	0.2124	0.2002	0.2063	0.1881	0.2002	0.1820	0.1820	0.1881	0.1881	0.2124	(22b)
Effective ac	0.5266	0.5226	0.5226	0.5200	0.5213	0.5177	0.5200	0.5166	0.5166	0.5177	0.5177	0.5226	(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	
Flat Door			2.3000	1.0000	2.3000			(26)
Windows (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
French Doors (Uw = 1.20)			5.0600	1.1450	5.7939			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1500	10.2495			(29a)
External Roof 1	56.4900		56.4900	0.1500	8.4735			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.4161			(33)
Party Wall 1			37.1400	0.0000	0.0000			(32)
Party Floor 1			56.4900					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.0495	(36)
Total fabric heat loss (33) + (36) =	43.4656	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	30.9217	30.6850	30.6850	30.5379	30.6104	30.3996	30.5379	30.3336	30.3336	30.3996	30.3996	30.6850	(38)
Heat transfer coeff	74.3873	74.1506	74.1506	74.0036	74.0760	73.8652	74.0036	73.7992	73.7992	73.8652	73.8652	74.1506	(39)
Average = Sum(39)m / 12 =												74.0097	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3168	1.3126	1.3126	1.3100	1.3113	1.3076	1.3100	1.3064	1.3064	1.3076	1.3076	1.3126	(40)
HLP (average)												1.3101	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8809 (42)
Average daily hot water use (litres/day)	78.8705 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(45)
Distribution loss (46)m = 0.15 x (45)m	19.2988	16.8789	17.4175	15.1850	14.5704	12.5731	11.6508	13.3695	13.5292	15.7670	17.2109	18.6899	(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)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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	(57)
Combi loss	44.2107	38.4802	40.9954	38.1171	37.7801	35.0055	36.1724	37.7801	38.1171	40.9954	41.2288	44.2107 (61)
Total heat required for water heating calculated for each month												
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100 (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												
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100 (64)
								Total per year (kWh/year) = Sum(64)m =				1714.0337 (64)
RHI water heating demand												1714 (64)
Heat gains from water heating, kWh/month												
	53.8318	47.0349	48.8576	43.1894	41.7427	36.6218	34.8691	39.0808	39.5190	45.1990	48.4580	52.4820 (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	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	39.8779	35.4192	28.8048	21.8071	16.3011	13.7621	14.8704	19.3291	25.9435	32.9412	38.4472	40.9863	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	244.8004	247.3407	240.9393	227.3115	210.1089	193.9408	183.1396	180.5993	187.0007	200.6285	217.8311	233.9992	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	(71)
Water heating gains (Table 5)													
	72.3545	69.9924	65.6689	59.9852	56.1057	50.8636	46.8671	52.5279	54.8875	60.7513	67.3027	70.5403	(72)
Total internal gains													
	445.8162	441.5356	424.1963	397.8872	371.2990	347.3498	333.6604	341.2397	356.6150	383.1043	412.3644	434.3090	(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	
Southwest	2.2700	40.3681	0.6300	0.7000	0.7700	28.0050	(79)
Northeast	5.0600	12.9191	0.6300	0.7000	0.7700	19.9782	(75)

Solar gains	47.9832	78.2908	123.8676	184.5883	225.7708	250.0283	234.8840	201.4529	153.9691	100.1288	58.6159	39.8674 (83)
Total gains	493.7994	519.8265	548.0639	582.4755	597.0698	597.3782	568.5445	542.6926	510.5841	483.2331	470.9803	474.1764 (84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.7364	52.9047	52.9047	53.0098	52.9580	53.1091	53.0098	53.1566	53.1566	53.1091	53.1091	52.9047	
alpha	4.5158	4.5270	4.5270	4.5340	4.5305	4.5406	4.5340	4.5438	4.5438	4.5406	4.5406	4.5270	
util living area													
	0.9875	0.9823	0.9668	0.9173	0.7885	0.5385	0.3241	0.3778	0.7151	0.9226	0.9771	0.9892	(86)
MIT	20.1348	20.2205	20.3965	20.6372	20.8375	20.9273	20.9393	20.9384	20.8909	20.6749	20.3700	20.1163	(87)
Th 2	19.8277	19.8310	19.8310	19.8330	19.8320	19.8349	19.8330	19.8358	19.8358	19.8349	19.8349	19.8310	(88)
util rest of house													
	0.9831	0.9761	0.9544	0.8848	0.7090	0.4080	0.1735	0.2223	0.5964	0.8848	0.9675	0.9855	(89)
MIT 2	18.7112	18.8373	19.0887	19.4213	19.6632	19.7428	19.7454	19.7483	19.7210	19.4792	19.0570	18.6873	(90)
Living area fraction									fLA = Living area / (4) =			0.4932	(91)
MIT	19.4133	19.5195	19.7337	20.0209	20.2423	20.3270	20.3342	20.3352	20.2980	20.0689	19.7045	19.3921	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4133	19.5195	19.7337	20.0209	20.2423	20.3270	20.3342	20.3352	20.2980	20.0689	19.7045	19.3921	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9812	0.9740	0.9532	0.8909	0.7394	0.4647	0.2385	0.2896	0.6471	0.8938	0.9662	0.9837	(94)
Useful gains	484.5079	506.3209	522.3975	518.9144	441.4822	277.6201	135.5812	157.1723	330.4025	431.8990	455.0644	466.4362	(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													
	1034.9724	995.0629	884.8901	711.9837	499.4459	282.6830	135.7375	157.5785	354.0890	596.0099	835.0112	1030.1046	(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													
	409.5456	328.4347	269.6945	139.0099	43.1250	0.0000	0.0000	0.0000	0.0000	122.0985	273.5617	419.3693	(98)
Space heating												2004.8390	(98)
RHI space heating demand												2005	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1124	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2624	(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) =	0.2427	(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	0.3095	0.3034	0.2973	0.2670	0.2609	0.2306	0.2306	0.2245	0.2427	0.2609	0.2731	0.2852	(22b)
Effective ac	0.5479	0.5460	0.5442	0.5356	0.5340	0.5266	0.5266	0.5252	0.5295	0.5340	0.5373	0.5407	(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	
Flat Door			2.3000	1.0000	2.3000			(26)
Windows (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
French Doors (Uw = 1.20)			5.0600	1.1450	5.7939			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1500	10.2495			(29a)
External Roof 1	56.4900		56.4900	0.1500	8.4735			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.4161			(33)
Party Wall 1			37.1400	0.0000	0.0000			(32)
Party Floor 1			56.4900					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.0495	(36)
Total fabric heat loss (33) + (36) =	43.4656	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	32.1725	32.0633	31.9563	31.4536	31.3595	30.9217	30.9217	30.8406	31.0903	31.3595	31.5498	31.7487	(38)
Heat transfer coeff	75.6381	75.5289	75.4219	74.9192	74.8251	74.3873	74.3873	74.3062	74.5560	74.8251	75.0154	75.2143	(39)
Average = Sum(39)m / 12 =												74.9187	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3390	1.3370	1.3351	1.3262	1.3246	1.3168	1.3168	1.3154	1.3198	1.3246	1.3279	1.3315	(40)
HLP (average)												1.3262	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8809 (42)
Average daily hot water use (litres/day)	78.8705 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(45)
Distribution loss (46)m = 0.15 x (45)m	19.2988	16.8789	17.4175	15.1850	14.5704	12.5731	11.6508	13.3695	13.5292	15.7670	17.2109	18.6899	(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)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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	(57)
Combi loss	44.2107	38.4802	40.9954	38.1171	37.7801	35.0055	36.1724	37.7801	38.1171	40.9954	41.2288	44.2107 (61)
Total heat required for water heating calculated for each month												
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100 (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												
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100 (64)
								Total per year (kWh/year) = Sum(64)m =				1714.0337 (64)
Heat gains from water heating, kWh/month												
	53.8318	47.0349	48.8576	43.1894	41.7427	36.6218	34.8691	39.0808	39.5190	45.1990	48.4580	52.4820 (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	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	39.8779	35.4192	28.8048	21.8071	16.3011	13.7621	14.8704	19.3291	25.9435	32.9412	38.4472	40.9863	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	244.8004	247.3407	240.9393	227.3115	210.1089	193.9408	183.1396	180.5993	187.0007	200.6285	217.8311	233.9992	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	(71)
Water heating gains (Table 5)													
	72.3545	69.9924	65.6689	59.9852	56.1057	50.8636	46.8671	52.5279	54.8875	60.7513	67.3027	70.5403	(72)
Total internal gains													
	445.8162	441.5356	424.1963	397.8872	371.2990	347.3498	333.6604	341.2397	356.6150	383.1043	412.3644	434.3090	(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	
Southwest	2.2700	36.7938	0.6300	0.7000	0.7700	25.5254	(79)
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)

Solar gains	42.9734	78.9950	123.4784	178.7982	223.8203	232.5612	219.9027	184.7304	142.3859	91.4570	52.5276	36.0933	(83)
Total gains	488.7896	520.5307	547.6747	576.6854	595.1193	579.9110	553.5631	525.9701	499.0009	474.5612	464.8920	470.4023	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.8643	51.9393	52.0130	52.3620	52.4278	52.7364	52.7364	52.7939	52.6171	52.4278	52.2948	52.1565	
alpha	4.4576	4.4626	4.4675	4.4908	4.4952	4.5158	4.5158	4.5196	4.5078	4.4952	4.4863	4.4771	
util living area													
	0.9910	0.9869	0.9767	0.9479	0.8757	0.7300	0.5674	0.6141	0.8307	0.9548	0.9850	0.9924	(86)
MIT	20.0005	20.0924	20.2655	20.5049	20.7286	20.8762	20.9240	20.9173	20.8190	20.5469	20.2333	19.9778	(87)
Th 2	19.8104	19.8119	19.8134	19.8203	19.8216	19.8277	19.8277	19.8288	19.8253	19.8216	19.8190	19.8163	(88)
util rest of house													
	0.9881	0.9826	0.9686	0.9281	0.8265	0.6297	0.4280	0.4748	0.7494	0.9335	0.9792	0.9900	(89)
MIT 2	18.5029	18.6372	18.8878	19.2313	19.5283	19.6978	19.7342	19.7320	19.6436	19.2961	18.8481	18.4744	(90)
Living area fraction										fLA = Living area / (4) =		0.4932	(91)
MIT	19.2415	19.3549	19.5672	19.8594	20.1202	20.2790	20.3210	20.3166	20.2233	19.9130	19.5313	19.2159	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2415	19.3549	19.5672	19.8594	20.1202	20.2790	20.3210	20.3166	20.2233	19.9130	19.5313	19.2159	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9863	0.9805	0.9665	0.9289	0.8405	0.6712	0.4888	0.5356	0.7803	0.9355	0.9774	0.9883	(94)
Useful gains	482.1067	510.3623	529.3043	535.6713	500.2259	389.2229	270.6085	281.7111	389.3508	443.9321	454.3974	464.9183	(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													
	1130.1458	1091.7619	985.5543	821.0726	630.0459	422.4419	276.7947	291.0254	456.5272	696.8436	932.5354	1129.4086	(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													
	482.1411	390.7005	339.4500	205.4890	96.5861	0.0000	0.0000	0.0000	0.0000	188.1661	344.2594	494.3808	(98)
Space heating												2541.1730	(98)
Space heating per m2											(98) / (4) =	44.9845	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2823.5256	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	482.1411	390.7005	339.4500	205.4890	96.5861	0.0000	0.0000	0.0000	0.0000	188.1661	344.2594	494.3808	(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)													
	535.7123	434.1117	377.1667	228.3211	107.3178	0.0000	0.0000	0.0000	0.0000	209.0735	382.5104	549.3120	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	192.0774	167.7846	174.5690	154.8339	149.9065	132.0293	126.4941	141.0113	142.5686	162.3428	173.2977	187.5667	(219)
Water heating fuel used												1904.4819	(219)
Annual totals kWh/year													
Space heating fuel - main system												2823.5256	(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)												281.7027	(232)
Total delivered energy for all uses												5039.7101	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2823.5256	3.4800	98.2587	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1904.4819	3.4800	66.2760	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	281.7027	13.1900	37.1566	(250)
Additional standing charges			120.0000	(251)
Total energy cost			325.6482	(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] =	1.3476	(257)
SAP value		81.2004	
SAP rating (Section 12)		81	(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	2823.5256	0.2160	609.8815	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1904.4819	0.2160	411.3681	(264)
Space and water heating			1021.2496	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	281.7027	0.5190	146.2037	(268)
Total kg/year			1183.0233	(272)
CO2 emissions per m2			20.9400	(273)
EI value			84.3802	
EI rating			84	(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

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1124	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2624	(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) =	0.2427	(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	0.2306	0.2124	0.2124	0.2002	0.2063	0.1881	0.2002	0.1820	0.1820	0.1881	0.1881	0.2124	(22b)
Effective ac	0.5266	0.5226	0.5226	0.5200	0.5213	0.5177	0.5200	0.5166	0.5166	0.5177	0.5177	0.5226	(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	
Flat Door			2.3000	1.0000	2.3000			(26)
Windows (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
French Doors (Uw = 1.20)			5.0600	1.1450	5.7939			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1500	10.2495			(29a)
External Roof 1	56.4900		56.4900	0.1500	8.4735			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.4161			(33)
Party Wall 1			37.1400	0.0000	0.0000			(32)
Party Floor 1			56.4900					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.0495	(36)
Total fabric heat loss (33) + (36) =	43.4656	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	30.9217	30.6850	30.6850	30.5379	30.6104	30.3996	30.5379	30.3336	30.3336	30.3996	30.3996	30.6850	(38)
Heat transfer coeff	74.3873	74.1506	74.1506	74.0036	74.0760	73.8652	74.0036	73.7992	73.7992	73.8652	73.8652	74.1506	(39)
Average = Sum(39)m / 12 =												74.0097	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3168	1.3126	1.3126	1.3100	1.3113	1.3076	1.3100	1.3064	1.3064	1.3076	1.3076	1.3126	(40)
HLP (average)												1.3101	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8809 (42)
Average daily hot water use (litres/day)	78.8705 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(45)
Distribution loss (46)m = 0.15 x (45)m	19.2988	16.8789	17.4175	15.1850	14.5704	12.5731	11.6508	13.3695	13.5292	15.7670	17.2109	18.6899	(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)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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	(57)
Combi loss	44.2107	38.4802	40.9954	38.1171	37.7801	35.0055	36.1724	37.7801	38.1171	40.9954	41.2288	44.2107 (61)
Total heat required for water heating calculated for each month												
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100 (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												
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100 (64)
								Total per year (kWh/year) = Sum(64)m =				1714.0337 (64)
Heat gains from water heating, kWh/month												
	53.8318	47.0349	48.8576	43.1894	41.7427	36.6218	34.8691	39.0808	39.5190	45.1990	48.4580	52.4820 (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	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	39.8779	35.4192	28.8048	21.8071	16.3011	13.7621	14.8704	19.3291	25.9435	32.9412	38.4472	40.9863	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	244.8004	247.3407	240.9393	227.3115	210.1089	193.9408	183.1396	180.5993	187.0007	200.6285	217.8311	233.9992	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	(71)
Water heating gains (Table 5)													
	72.3545	69.9924	65.6689	59.9852	56.1057	50.8636	46.8671	52.5279	54.8875	60.7513	67.3027	70.5403	(72)
Total internal gains													
	445.8162	441.5356	424.1963	397.8872	371.2990	347.3498	333.6604	341.2397	356.6150	383.1043	412.3644	434.3090	(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	
Southwest	2.2700	40.3681	0.6300	0.7000	0.7700	28.0050	(79)
Northeast	5.0600	12.9191	0.6300	0.7000	0.7700	19.9782	(75)

Solar gains	47.9832	78.2908	123.8676	184.5883	225.7708	250.0283	234.8840	201.4529	153.9691	100.1288	58.6159	39.8674	(83)
Total gains	493.7994	519.8265	548.0639	582.4755	597.0698	597.3782	568.5445	542.6926	510.5841	483.2331	470.9803	474.1764	(84)

---

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.7364	52.9047	52.9047	53.0098	52.9580	53.1091	53.0098	53.1566	53.1566	53.1091	53.1091	52.9047	
alpha	4.5158	4.5270	4.5270	4.5340	4.5305	4.5406	4.5340	4.5438	4.5438	4.5406	4.5406	4.5270	
util living area													
	0.9875	0.9823	0.9668	0.9173	0.7885	0.5385	0.3241	0.3778	0.7151	0.9226	0.9771	0.9892	(86)
MIT	20.1348	20.2205	20.3965	20.6372	20.8375	20.9273	20.9393	20.9384	20.8909	20.6749	20.3700	20.1163	(87)
Th 2	19.8277	19.8310	19.8310	19.8330	19.8320	19.8349	19.8330	19.8358	19.8358	19.8349	19.8349	19.8310	(88)
util rest of house													
	0.9831	0.9761	0.9544	0.8848	0.7090	0.4080	0.1735	0.2223	0.5964	0.8848	0.9675	0.9855	(89)
MIT 2	18.7112	18.8373	19.0887	19.4213	19.6632	19.7428	19.7454	19.7483	19.7210	19.4792	19.0570	18.6873	(90)
Living area fraction										fLA = Living area / (4) =		0.4932	(91)
MIT	19.4133	19.5195	19.7337	20.0209	20.2423	20.3270	20.3342	20.3352	20.2980	20.0689	19.7045	19.3921	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4133	19.5195	19.7337	20.0209	20.2423	20.3270	20.3342	20.3352	20.2980	20.0689	19.7045	19.3921	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9812	0.9740	0.9532	0.8909	0.7394	0.4647	0.2385	0.2896	0.6471	0.8938	0.9662	0.9837	(94)
Useful gains	484.5079	506.3209	522.3975	518.9144	441.4822	277.6201	135.5812	157.1723	330.4025	431.8990	455.0644	466.4362	(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													
	1034.9724	995.0629	884.8901	711.9837	499.4459	282.6830	135.7375	157.5785	354.0890	596.0099	835.0112	1030.1046	(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													
	409.5456	328.4347	269.6945	139.0099	43.1250	0.0000	0.0000	0.0000	0.0000	122.0985	273.5617	419.3693	(98)
Space heating												2004.8390	(98)
Space heating per m2											(98) / (4) =	35.4902	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2227.5989	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	409.5456	328.4347	269.6945	139.0099	43.1250	0.0000	0.0000	0.0000	0.0000	122.0985	273.5617	419.3693	(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)													
	455.0506	364.9274	299.6606	154.4554	47.9166	0.0000	0.0000	0.0000	0.0000	135.6650	303.9574	465.9659	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	192.0774	167.7846	174.5690	154.8339	149.9065	132.0293	126.4941	141.0113	142.5686	162.3428	173.2977	187.5667	(219)
Water heating fuel used												1904.4819	(219)
Annual totals kWh/year													
Space heating fuel - main system												2227.5989	(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)												281.7027	(232)
Total delivered energy for all uses												4443.7835	(238)

10a. Fuel costs - using BEDF prices (419)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2227.5989	4.1000	91.3316	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1904.4819	4.1000	78.0838	(247)
Pumps and fans for heating	30.0000	15.7000	4.7100	(249)
Energy for lighting	281.7027	15.7000	44.2273	(250)
Additional standing charges			89.0000	(251)
Total energy cost			307.3526	(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	2227.5989	0.2160	481.1614	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1904.4819	0.2160	411.3681	(264)
Space and water heating			892.5295	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	281.7027	0.5190	146.2037	(268)
Total kg/year			1054.3032	(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	2227.5989	1.2200	2717.6707	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1904.4819	1.2200	2323.4679	(264)
Space and water heating			5041.1386	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	281.7027	3.0700	864.8272	(268)
Primary energy kWh/year			5998.0659	(272)
Primary energy kWh/m2/year			106.1793	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 81
Current environmental impact rating:	B 84

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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 81
Potential environmental impact rating: B 84

Fuel prices for cost data on this page from database revision number 419 TEST (30 Oct 2017)
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	£49	£49	£0
Mains gas	£258	£258	£0
Space heating	£185	£185	£0
Water heating	£78	£78	£0
Lighting	£44	£44	£0
Total cost of fuels	£307	£307	£0
Total cost of uses	£307	£307	£0
Delivered energy	79 kWh/m²	79 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.1 tonnes	1.1 tonnes	0.0 tonnes
CO2 emissions per m²	19 kg/m²	19 kg/m²	0 kg/m²
Primary energy	106 kWh/m²	106 kWh/m²	0 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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	MidTerrace Flat
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South West
Oversha ding	Average or unknown
Thermal mass parameter	250.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	352.33 (P1)
Transmission heat loss coefficient	43.47 (37)
Summer heat loss coefficient	395.79 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South West	2.2700	119.9223	0.6300	0.7000	0.9000	97.2410
North East	5.0600	98.8453	0.6300	0.7000	0.9000	178.6611
total:						275.9021

	Jun	Jul	Aug	
Solar gains	295	276	237	(P3)
Internal gains	344	331	338	
Total summer gains	639	607	575	(P5)
Summer gain/loss ratio	1.62	1.53	1.45	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	17.87	19.68	19.50	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature: Not significant

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

Design SAP
elmhurst energy

Property Reference	25159.002 - A301	**Issued on Date**	16/11/2017
Survey Reference	Be Clean v3 AB	**Prop Type Ref**	
Property	TW1 3SD		

SAP Rating	82 B	**DER**	20.48	**TER**	23.48
Environmental	86 B	**% DER<TER**	12.79		
CO_2 Emissions (t/year)	0.91	**DFEE**	58.55	**TFEE**	68.42
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.43		

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

SAP2012 - 9.92 input data (DesignData) -

SAP2012 Input Data (Flat)	16/11/2017
FullRefNo:	Be Clean v3 AB
Regs Region:	England
SAP Region:	Thames Valley
Postcode:	TW1 3SD
DwellingOrientation:	South West
Property Type:	Flat, Mid-Terrace
Storeys:	1
Date Built:	2017
Sheltered Sides:	2
Sunlight Shade:	Average or unknown
Measurements	Perimeter, Floor Area, Storey Height
1st Storey:	12.96, 56.49, 3.15
Living Area:	27.86 m2, fraction: 49.3%
Thermal Mass:	Simple calculation
Thermal Mass Simple:	Medium
Thermal MassValue:	250
External Walls	Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1	68.33, 77.96, 0, Other, Cavity, 0, 0.15, Gross
Party Walls	Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1	37.14, 0, Other, FilledWithEdge, 0, 0
External Roofs	Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
External Roof 1	56.49, 56.49, 0, Other, 0.15
Heat Loss Floors	Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
Party Floors	Area, Kappa, Construction, Element
Party Floor 1	56.49, 0
Description	Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
Flat Door	Manufacturer, Solid Door, , , , , , ,
Windows	Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
French Doors	Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
Openings	Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
Flat Door	Solid Door, External Wall 1, South West, , , , , 0, 0, 0, 2.30,
SW F Windows	Window, External Wall 1, South West, , None, 0, , 0, 0, 0, 0, 2.27,
NE F FDoors	Window, External Wall 1, North East, , None, 0, , 0, 0, 0, 0, 5.06,
Conservatory:	None
Draught Proofing:	100
Draught Lobby:	No
Thermal Bridges	
Bridging:	Calculate Bridges
Y	0.104
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, 4.23, 0.3, 0.3, 1.27,
1.	External wall, E3 Sill, Table K1 - Approved, Yes, 3.23, 0.04, 0.04, 0.13,
2.	External wall, E4 Jamb, Table K1 - Approved, Yes, 13.6, 0.05, 0.05, 0.68,
3.	External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Approved, Yes, 12.96, 0.07, 0.07, 0.91,
4.	External wall, E23 Balcony within or between dwellings, balcony support penetrates wall insulation , Table K1 - Default, No, 2.2, 1, 1, 2.20,
5.	External wall, E15 Flat roof with parapet, Table K1 - Default, Yes, 12.96, 0.56, 0.56, 7.26,
6.	External wall, E16 Corner (normal), Table K1 - Approved, No, 9.45, 0.09, 0.09, 0.85,
7.	External wall, E18 Party wall between dwellings, Table K1 - Approved, Yes, 12.6, 0.06, 0.06, 0.76,
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	2
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

SAP2012 - 9.92 input data (DesignData) -

```
Passive Vents:                  0
Flueless Gas Fires:             0
Cooling System                  None
Light Fittings:                 20
LEL Fittings:                   20
Percentage of LEL Fittings:     100
External Lights Fitted:         Yes
External LELs Fitted:           Yes
Electricity Tariff:             Standard
Main Heating 1
     Description
     Percentage                 100
     MHS                        Mains gas BGW Post 98 Combi condens. with auto ign.
     SAP Code                   104
     Boiler Efficiency Type     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

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DWELLING AS DESIGNED

Mid-floor flat, total floor area 56 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) 23.48 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 20.48 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)68.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)58.6 kWh/m²/yrOK

---

2 Fabric U-values

Element	Average	Highest	
External wall	0.15 (max. 0.30)	0.15 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	(no floor)		
Roof	0.15 (max. 0.20)	0.15 (max. 0.35)	OK
Openings	1.15 (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

SAP2012 - 9.92 input data (DesignData) -

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):	Not significant	OK
Based on:		
Overshading:	Average	
Windows facing North East:	5.06 m², No overhang	
Windows facing South West:	2.27 m², No overhang	
Air change rate:	6.00 ach	
Blinds/curtains:	None	
10 Key features		
Party wall U-value	0.00 W/m²K	
Door U-value	1.00 W/m²K	
Air permeability	3.0 m³/m²h	

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2801	0.2769	0.2737	0.2578	0.2546	0.2386	0.2386	0.2354	0.2450	0.2546	0.2609	0.2673	(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	
Flat Door			2.3000	1.0000	2.3000			(26)
Windows (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
French Doors (Uw = 1.20)			5.0600	1.1450	5.7939			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1500	10.2495			(29a)
External Roof 1	56.4900		56.4900	0.1500	8.4735			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.4161			(33)
Party Wall 1			37.1400	0.0000	0.0000			(32)
Party Floor 1			56.4900					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.0495	(36)
Total fabric heat loss (33) + (36) =	43.4656	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	16.4456	16.2585	16.0713	15.1354	14.9483	14.0124	14.0124	13.8252	14.3867	14.9483	15.3226	15.6970	(38)
Heat transfer coeff	59.9113	59.7241	59.5369	58.6011	58.4139	57.4780	57.4780	57.2908	57.8524	58.4139	58.7882	59.1626	(39)
Average = Sum(39)m / 12 =												58.5543	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0606	1.0573	1.0539	1.0374	1.0341	1.0175	1.0175	1.0142	1.0241	1.0341	1.0407	1.0473	(40)
HLP (average)												1.0365	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8809	(42)
Average daily hot water use (litres/day)	78.8705	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(45)

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	19.2988	16.8789	17.4175	15.1850	14.5704	12.5731	11.6508	13.3695	13.5292	15.7670	17.2109	18.6899	(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	44.2107	38.4802	40.9954	38.1171	37.7801	35.0055	36.1724	37.7801	38.1171	40.9954	41.2288	44.2107	(61)
Total heat required for water heating calculated for each month													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(64)
								Total per year (kWh/year) = Sum(64)m =				1714.0337	(64)
Heat gains from water heating, kWh/month													
	53.8318	47.0349	48.8576	43.1894	41.7427	36.6218	34.8691	39.0808	39.5190	45.1990	48.4580	52.4820	(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	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.9512	14.1677	11.5219	8.7228	6.5204	5.5048	5.9482	7.7316	10.3774	13.1765	15.3789	16.3945	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.0163	165.7182	161.4293	152.2987	140.7729	129.9404	122.7035	121.0016	125.2905	134.4211	145.9468	156.7794	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	(71)
Water heating gains (Table 5)													
	72.3545	69.9924	65.6689	59.9852	56.1057	50.8636	46.8671	52.5279	54.8875	60.7513	67.3027	70.5403	(72)
Total internal gains													
	306.5349	304.0913	292.8331	275.2198	257.6121	240.5218	229.7318	235.4741	244.7683	262.5618	282.8414	297.9272	(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	
Southwest	2.2700	36.7938	0.6300	0.7000	0.7700	25.5254	(79)
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)

Solar gains	42.9734	78.9950	123.4784	178.7982	223.8203	232.5612	219.9027	184.7304	142.3859	91.4570	52.5276	36.0933	(83)
Total gains	349.5083	383.0864	416.3115	454.0180	481.4324	473.0830	449.6344	420.2045	387.1542	354.0188	335.3690	334.0205	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.4788	65.6840	65.8905	66.9428	67.1573	68.2507	68.2507	68.4737	67.8091	67.1573	66.7296	66.3074	
alpha	5.3653	5.3789	5.3927	5.4629	5.4772	5.5500	5.5500	5.5649	5.5206	5.4772	5.4486	5.4205	
util living area													
	0.9977	0.9957	0.9898	0.9666	0.8918	0.7246	0.5521	0.6089	0.8593	0.9777	0.9954	0.9982	(86)
MIT	20.1232	20.2137	20.3770	20.6063	20.8053	20.9190	20.9451	20.9413	20.8659	20.6174	20.3352	20.1106	(87)
Th 2	20.0332	20.0359	20.0386	20.0523	20.0550	20.0688	20.0688	20.0715	20.0633	20.0550	20.0496	20.0441	(88)
util rest of house													
	0.9969	0.9943	0.9861	0.9539	0.8513	0.6397	0.4407	0.4952	0.7939	0.9667	0.9935	0.9976	(89)
MIT 2	18.8560	18.9902	19.2296	19.5684	19.8365	19.9752	19.9948	19.9958	19.9209	19.5905	19.1789	18.8463	(90)
Living area fraction									fLA = Living area / (4) =			0.4932	(91)
MIT	19.4809	19.5936	19.7955	20.0803	20.3143	20.4406	20.4635	20.4621	20.3870	20.0970	19.7492	19.4698	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4809	19.5936	19.7955	20.0803	20.3143	20.4406	20.4635	20.4621	20.3870	20.0970	19.7492	19.4698	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9934	0.9849	0.9543	0.8637	0.6753	0.4888	0.5444	0.8190	0.9673	0.9928	0.9971	(94)
Useful gains	348.2337	380.5742	410.0380	433.2828	415.7997	319.4662	219.8018	228.7657	317.0837	342.4459	332.9516	333.0615	(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													
	909.5088	877.5651	791.5725	655.1766	503.1951	335.7084	222.0644	232.7223	363.7155	554.7539	743.6223	903.4030	(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													
	417.5887	333.9779	283.8617	159.7635	65.0221	0.0000	0.0000	0.0000	0.0000	157.9572	295.6829	424.3340	(98)
Space heating												2138.1881	(98)
Space heating per m2											(98) / (4) =	37.8507	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2375.7645	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	417.5887	333.9779	283.8617	159.7635	65.0221	0.0000	0.0000	0.0000	0.0000	157.9572	295.6829	424.3340	(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)													
	463.9874	371.0865	315.4019	177.5151	72.2468	0.0000	0.0000	0.0000	0.0000	175.5080	328.5366	471.4823	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	192.0774	167.7846	174.5690	154.8339	149.9065	132.0293	126.4941	141.0113	142.5686	162.3428	173.2977	187.5667	(219)
Water heating fuel used												1904.4819	(219)
Annual totals kWh/year													
Space heating fuel - main system												2375.7645	(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)	135.6819	(230a)
central heating pump	30.0000	(230c)
Total electricity for the above, kWh/year	165.6819	(231)
Electricity for lighting (calculated in Appendix L)	281.7027	(232)
Total delivered energy for all uses	4727.6310	(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	2375.7645	0.2160	513.1651	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1904.4819	0.2160	411.3681	(264)
Space and water heating			924.5332	(265)
Pumps and fans	165.6819	0.5190	85.9889	(267)
Energy for lighting	281.7027	0.5190	146.2037	(268)
Total CO2, kg/year			1156.7258	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			20.4800	(273)

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

DER		20.4800	ZC1
Total Floor Area	TFA	56.4900	
Assumed number of occupants	N	1.8809	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.2053	ZC2
CO2 emissions from cooking, equation (L16)		2.9057	ZC3
Total CO2 emissions		40.5909	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		40.5909	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1124	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3624	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3080	(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	0.3927	0.3850	0.3773	0.3388	0.3311	0.2926	0.2926	0.2849	0.3080	0.3311	0.3465	0.3619	(22b)
Effective ac	0.5771	0.5741	0.5712	0.5574	0.5548	0.5428	0.5428	0.5406	0.5474	0.5548	0.5600	0.5655	(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			2.3000	1.0000	2.3000			(26)
TER Opening Type (Uw = 1.40)			7.3300	1.3258	9.7178			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1800	12.2994			(29a)
External Roof 1	56.4900		56.4900	0.1300	7.3437			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.6609			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.8683	(36)
Total fabric heat loss					(33) + (36) =		42.5292	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.8895	33.7137	33.5413	32.7316	32.5802	31.8750	31.8750	31.7444	32.1466	32.5802	32.8866	33.2070	(38)
Heat transfer coeff	76.4187	76.2429	76.0705	75.2608	75.1094	74.4042	74.4042	74.2736	74.6758	75.1094	75.4158	75.7362	(39)
Average = Sum(39)m / 12 =												75.2601	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3528	1.3497	1.3466	1.3323	1.3296	1.3171	1.3171	1.3148	1.3219	1.3296	1.3350	1.3407	(40)
HLP (average)												1.3323	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.8809 (42)
Average daily hot water use (litres/day)		78.8705 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(45)
Distribution loss (46)m = 0.15 x (45)m	19.2988	16.8789	17.4175	15.1850	14.5704	12.5731	11.6508	13.3695	13.5292	15.7670	17.2109	18.6899	(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	44.2107	38.4802	40.9954	38.1171	37.7801	35.0055	36.1724	37.7801	38.1171	40.9954	41.2288	44.2107	(61)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total heat required for water heating calculated for each month

	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(64)
								Total per year (kWh/year) = Sum(64)m =				1714.0337	(64)
Heat gains from water heating, kWh/month													
	53.8318	47.0349	48.8576	43.1894	41.7427	36.6218	34.8691	39.0808	39.5190	45.1990	48.4580	52.4820	(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	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.9512	14.1677	11.5219	8.7228	6.5204	5.5048	5.9482	7.7316	10.3774	13.1765	15.3789	16.3945	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.0163	165.7182	161.4293	152.2987	140.7729	129.9404	122.7035	121.0016	125.2905	134.4211	145.9468	156.7794	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	(71)
Water heating gains (Table 5)													
	72.3545	69.9924	65.6689	59.9852	56.1057	50.8636	46.8671	52.5279	54.8875	60.7513	67.3027	70.5403	(72)
Total internal gains													
	306.5349	304.0913	292.8331	275.2198	257.6121	240.5218	229.7318	235.4741	244.7683	262.5618	282.8414	297.9272	(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	
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)
Southwest	2.2700	36.7938	0.6300	0.7000	0.7700	25.5254	(79)

Solar gains	42.9734	78.9950	123.4784	178.7982	223.8203	232.5612	219.9027	184.7304	142.3859	91.4570	52.5276	36.0933	(83)
Total gains	349.5083	383.0864	416.3115	454.0180	481.4324	473.0830	449.6344	420.2045	387.1542	354.0188	335.3690	334.0205	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.3345	51.4529	51.5695	52.1243	52.2294	52.7244	52.7244	52.8171	52.5326	52.2294	52.0172	51.7971	
alpha	4.4223	4.4302	4.4380	4.4750	4.4820	4.5150	4.5150	4.5211	4.5022	4.4820	4.4678	4.4531	
util living area													
	0.9976	0.9960	0.9917	0.9772	0.9326	0.8213	0.6709	0.7255	0.9134	0.9840	0.9958	0.9981	(86)
MIT	19.5129	19.6430	19.8923	20.2486	20.5983	20.8586	20.9585	20.9406	20.7394	20.3033	19.8512	19.4913	(87)
Th 2	19.7997	19.8021	19.8045	19.8156	19.8177	19.8274	19.8274	19.8293	19.8237	19.8177	19.8135	19.8091	(88)
util rest of house													
	0.9968	0.9946	0.9885	0.9672	0.8995	0.7307	0.5189	0.5796	0.8563	0.9752	0.9940	0.9974	(89)
MIT 2	17.8364	18.0278	18.3927	18.9145	19.4011	19.7252	19.8114	19.8029	19.5972	18.9993	18.3402	17.8111	(90)
Living area fraction									fLA = Living area / (4) =			0.4932	(91)
MIT	18.6632	18.8244	19.1323	19.5724	19.9916	20.2842	20.3771	20.3640	20.1605	19.6424	19.0854	18.6398	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6632	18.8244	19.1323	19.5724	19.9916	20.2842	20.3771	20.3640	20.1605	19.6424	19.0854	18.6398	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9957	0.9930	0.9860	0.9646	0.9053	0.7700	0.5947	0.6518	0.8758	0.9734	0.9925	0.9965	(94)
Useful gains	347.9948	380.3981	410.4874	437.9432	435.8484	364.2887	267.3862	273.8956	339.0840	344.6143	332.8439	332.8391	(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													
	1097.6192	1061.6357	960.9418	803.2164	622.7741	422.9277	281.0337	294.4216	452.5761	679.1698	903.8874	1093.6132	(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													
	557.7206	457.7917	409.5380	262.9967	139.0727	0.0000	0.0000	0.0000	0.0000	248.9093	411.1513	566.0160	(98)
Space heating												3053.1963	(98)
Space heating per m2											(98) / (4) =	54.0484	(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)

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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												3268.9468	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	557.7206	457.7917	409.5380	262.9967	139.0727	0.0000	0.0000	0.0000	0.0000	248.9093	411.1513	566.0160	(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)	597.1312	490.1410	438.4776	281.5811	148.9001	0.0000	0.0000	0.0000	0.0000	266.4982	440.2048	606.0128	(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	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7873	87.6650	87.3536	86.6263	85.1276	80.3000	80.3000	80.3000	80.3000	86.3813	87.3775	87.8613	(217)
Fuel for water heating, kWh/month	196.9187	172.2536	179.8575	160.8639	158.4866	147.9780	141.7742	158.0450	159.7905	169.1437	178.4990	192.1325	(219)
Water heating fuel used												2015.7431	(219)
Annual totals kWh/year													
Space heating fuel - main system												3268.9468	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												281.7027	(232)
Total delivered energy for all uses												5641.3926	(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	3268.9468	0.2160	706.0925	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2015.7431	0.2160	435.4005	(264)
Space and water heating			1141.4930	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	281.7027	0.5190	146.2037	(268)
Total CO2, kg/m2/year			1326.6217	(272)
Emissions per m2 for space and water heating			20.2070	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.5881	(272b)
Emissions per m2 for pumps and fans			0.6891	(272c)
Target Carbon Dioxide Emission Rate (TER) = (20.2070 * 1.00) + 2.5881 + 0.6891, rounded to 2 d.p.			23.4800	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1124	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2624	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2230	(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	0.2844	0.2788	0.2732	0.2453	0.2398	0.2119	0.2119	0.2063	0.2230	0.2398	0.2509	0.2621	(22b)
Effective ac	0.5404	0.5389	0.5373	0.5301	0.5287	0.5224	0.5224	0.5213	0.5249	0.5287	0.5315	0.5343	(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	
Flat Door			2.3000	1.0000	2.3000			(26)
Windows (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
French Doors (Uw = 1.20)			5.0600	1.1450	5.7939			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1500	10.2495			(29a)
External Roof 1	56.4900		56.4900	0.1500	8.4735			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.4161			(33)
Party Wall 1			37.1400	0.0000	0.0000			(32)
Party Floor 1			56.4900					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.0495	(36)
Total fabric heat loss (33) + (36) =	43.4656	(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	31.7350	31.6428	31.5524	31.1279	31.0485	30.6788	30.6788	30.6104	30.8212	31.0485	31.2092	31.3771	(38)
Heat transfer coeff	75.2006	75.1084	75.0180	74.5936	74.5142	74.1445	74.1445	74.0760	74.2869	74.5142	74.6748	74.8428	(39)
Average = Sum(39)m / 12 =												74.5932	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3312	1.3296	1.3280	1.3205	1.3191	1.3125	1.3125	1.3113	1.3150	1.3191	1.3219	1.3249	(40)
HLP (average)												1.3205	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8809 (42)
Average daily hot water use (litres/day)	78.8705 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(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)

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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	(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	(59)

Heat gains from water heating, kWh/month

	27.3400	23.9118	24.6748	21.5121	20.6414	17.8119	16.5054	18.9401	19.1664	22.3365	24.3821	26.4774 (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	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	(66)

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

	15.9512	14.1677	11.5219	8.7228	6.5204	5.5048	5.9482	7.7316	10.3774	13.1765	15.3789	16.3945 (67)

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

	164.0163	165.7182	161.4293	152.2987	140.7729	129.9404	122.7035	121.0016	125.2905	134.4211	145.9468	156.7794 (68)

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

	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345 (71)

Water heating gains (Table 5)

	36.7474	35.5830	33.1651	29.8779	27.7438	24.7388	22.1846	25.4572	26.6199	30.0222	33.8640	35.5878 (72)

Total internal gains

	267.9277	266.6819	257.3293	242.1124	226.2501	211.3969	202.0493	205.4033	213.5008	228.8328	246.4027	259.9747 (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	
Southwest	2.2700	36.7938	0.6300	0.7000	0.7700	25.5254	(79)
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)

Solar gains	42.9734	78.9950	123.4784	178.7982	223.8203	232.5612	219.9027	184.7304	142.3859	91.4570	52.5276	36.0933 (83)
Total gains	310.9011	345.6769	380.8076	420.9106	450.0704	443.9581	421.9520	390.1338	355.8867	320.2897	298.9303	296.0681 (84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.1660	52.2301	52.2930	52.5905	52.6466	52.9091	52.9091	52.9580	52.8077	52.6466	52.5333	52.4154	
alpha	4.4777	4.4820	4.4862	4.5060	4.5098	4.5273	4.5273	4.5305	4.5205	4.5098	4.5022	4.4944	
util living area	0.9985	0.9974	0.9941	0.9826	0.9448	0.8452	0.7010	0.7598	0.9322	0.9890	0.9974	0.9988	(86)
MIT	19.4785	19.6083	19.8580	20.2115	20.5682	20.8397	20.9509	20.9284	20.7082	20.2610	19.8074	19.4506	(87)
Th 2	19.8165	19.8177	19.8190	19.8248	19.8259	19.8310	19.8310	19.8320	19.8291	19.8259	19.8237	19.8214	(88)
util rest of house	0.9980	0.9964	0.9918	0.9747	0.9163	0.7598	0.5480	0.6157	0.8837	0.9827	0.9962	0.9984	(89)
MIT 2	18.4379	18.5685	18.8182	19.1723	19.5145	19.7494	19.8176	19.8093	19.6498	19.2248	18.7721	18.4139	(90)
Living area fraction									fLA = Living area / (4) =			0.4932	(91)
MIT	18.9511	19.0813	19.3310	19.6848	20.0342	20.2871	20.3765	20.3612	20.1717	19.7358	19.2827	18.9252	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9511	19.0813	19.3310	19.6848	20.0342	20.2871	20.3765	20.3612	20.1717	19.7358	19.2827	18.9252	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9975	0.9956	0.9905	0.9735	0.9224	0.7974	0.6247	0.6875	0.9009	0.9821	0.9955	0.9980	(94)
Useful gains	310.1272	344.1680	377.1934	409.7599	415.1382	353.9979	263.5896	268.1989	320.6335	314.5408	297.5895	295.4787	(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	1101.7717	1065.1356	962.5561	804.4795	621.0125	421.6695	280.0055	293.4317	451.0510	680.7496	909.7391	1102.0759	(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	588.9835	484.4902	435.5099	284.1981	153.1705	0.0000	0.0000	0.0000	0.0000	272.4594	440.7478	600.1083	(98)
Space heating												3259.6675	(98)
Space heating per m2											(98) / (4) =	57.7034	(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	696.9578	548.6689	562.9775	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7450	0.8295	0.7912	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	519.2624	455.1105	445.4313	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	590.0498	563.0070	527.0876	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	50.9669	80.2750	60.7523	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												191.9943	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   12.7417   20.0688   15.1881    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                          47.9986 (107)
Space cooling per m2                                                                                                    0.8497 (108)
Energy for space heating                                                                                               57.7034 (99)
Energy for space cooling                                                                                                0.8497 (108)
Total                                                                                                                  58.5531 (109)
Dwelling Fabric Energy Efficiency (DFEE)                                                                                  58.6 (109)


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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1124	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3624	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3080	(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	0.3927	0.3850	0.3773	0.3388	0.3311	0.2926	0.2926	0.2849	0.3080	0.3311	0.3465	0.3619	(22b)
Effective ac	0.5771	0.5741	0.5712	0.5574	0.5548	0.5428	0.5428	0.5406	0.5474	0.5548	0.5600	0.5655	(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			2.3000	1.0000	2.3000			(26)
TER Opening Type (Uw = 1.40)			7.3300	1.3258	9.7178			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1800	12.2994			(29a)
External Roof 1	56.4900		56.4900	0.1300	7.3437			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.6609			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.8683	(36)
Total fabric heat loss					(33) + (36) =		42.5292	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.8895	33.7137	33.5413	32.7316	32.5802	31.8750	31.8750	31.7444	32.1466	32.5802	32.8866	33.2070	(38)
Heat transfer coeff	76.4187	76.2429	76.0705	75.2608	75.1094	74.4042	74.4042	74.2736	74.6758	75.1094	75.4158	75.7362	(39)
Average = Sum(39)m / 12 =												75.2601	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3528	1.3497	1.3466	1.3323	1.3296	1.3171	1.3171	1.3148	1.3219	1.3296	1.3350	1.3407	(40)
HLP (average)												1.3323	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.8809 (42)
Average daily hot water use (litres/day)		78.8705 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(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)

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Heat gains from water heating, kWh/month

	27.3400	23.9118	24.6748	21.5121	20.6414	17.8119	16.5054	18.9401	19.1664	22.3365	24.3821	26.4774 (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	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.9512	14.1677	11.5219	8.7228	6.5204	5.5048	5.9482	7.7316	10.3774	13.1765	15.3789	16.3945	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.0163	165.7182	161.4293	152.2987	140.7729	129.9404	122.7035	121.0016	125.2905	134.4211	145.9468	156.7794	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	(71)
Water heating gains (Table 5)													
	36.7474	35.5830	33.1651	29.8779	27.7438	24.7388	22.1846	25.4572	26.6199	30.0222	33.8640	35.5878	(72)
Total internal gains													
	267.9277	266.6819	257.3293	242.1124	226.2501	211.3969	202.0493	205.4033	213.5008	228.8328	246.4027	259.9747	(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	
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)
Southwest	2.2700	36.7938	0.6300	0.7000	0.7700	25.5254	(79)

Solar gains	42.9734	78.9950	123.4784	178.7982	223.8203	232.5612	219.9027	184.7304	142.3859	91.4570	52.5276	36.0933	(83)
Total gains	310.9011	345.6769	380.8076	420.9106	450.0704	443.9581	421.9520	390.1338	355.8867	320.2897	298.9303	296.0681	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.3345	51.4529	51.5695	52.1243	52.2294	52.7244	52.7244	52.8171	52.5326	52.2294	52.0172	51.7971	
alpha	4.4223	4.4302	4.4380	4.4750	4.4820	4.5150	4.5150	4.5211	4.5022	4.4820	4.4678	4.4531	
util living area													
	0.9985	0.9974	0.9941	0.9827	0.9455	0.8461	0.7025	0.7607	0.9328	0.9891	0.9974	0.9988	(86)
MIT	19.4516	19.5839	19.8372	20.2003	20.5606	20.8378	20.9500	20.9276	20.7045	20.2525	19.7935	19.4308	(87)
Th 2	19.7997	19.8021	19.8045	19.8156	19.8177	19.8274	19.8274	19.8293	19.8237	19.8177	19.8135	19.8091	(88)
util rest of house													
	0.9980	0.9964	0.9918	0.9749	0.9172	0.7607	0.5490	0.6164	0.8844	0.9828	0.9962	0.9984	(89)
MIT 2	18.3981	18.5320	18.7863	19.1540	19.5007	19.7448	19.8137	19.8063	19.6421	19.2099	18.7504	18.3846	(90)
Living area fraction										fLA = Living area / (4) =		0.4932	(91)
MIT	18.9177	19.0508	19.3046	19.6700	20.0234	20.2839	20.3741	20.3593	20.1661	19.7241	19.2649	18.9006	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9177	19.0508	19.3046	19.6700	20.0234	20.2839	20.3741	20.3593	20.1661	19.7241	19.2649	18.9006	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9975	0.9956	0.9905	0.9737	0.9231	0.7982	0.6259	0.6883	0.9015	0.9821	0.9955	0.9980	(94)
Useful gains	310.1159	344.1566	377.1948	409.8263	415.4553	354.3845	264.1033	268.5359	320.8483	314.5596	297.5830	295.4713	(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													
	1117.0655	1078.8984	974.0516	810.5594	625.1649	422.9027	280.8115	294.0716	452.9876	685.3031	917.4228	1113.3663	(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													
	600.3705	493.7465	444.0615	288.5279	156.0239	0.0000	0.0000	0.0000	0.0000	275.8332	446.2847	608.5139	(98)
Space heating												3313.3620	(98)
Space heating per m2											(98) / (4) =	58.6540	(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	699.3992	550.5909	564.4792	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7430	0.8277	0.7897	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	519.6792	455.7144	445.7925	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	590.0498	563.0070	527.0876	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	50.6668	79.8257	60.4836	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												190.9761	(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)

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Space cooling kWh
                0.0000     0.0000     0.0000     0.0000     0.0000    12.6667    19.9564    15.1209     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                              47.7440 (107)
Space cooling per m2                                                                                                                        0.8452 (108)
Energy for space heating                                                                                                                   58.6540 (99)
Energy for space cooling                                                                                                                    0.8452 (108)
Total                                                                                                                                      59.4991 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                        68.4 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

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	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	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	0.1211	0.1116	0.1116	0.1052	0.1084	0.0988	0.1052	0.0956	0.0956	0.0988	0.0988	0.1116	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2386	0.2291	0.2291	0.2227	0.2259	0.2163	0.2227	0.2131	0.2131	0.2163	0.2163	0.2291	(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	
Flat Door			2.3000	1.0000	2.3000			(26)
Windows (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
French Doors (Uw = 1.20)			5.0600	1.1450	5.7939			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1500	10.2495			(29a)
External Roof 1	56.4900		56.4900	0.1500	8.4735			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.4161			(33)
Party Wall 1			37.1400	0.0000	0.0000			(32)
Party Floor 1			56.4900					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.0495	(36)
Total fabric heat loss (33) + (36) =	43.4656	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	14.0124	13.4509	13.4509	13.0765	13.2637	12.7022	13.0765	12.5150	12.5150	12.7022	12.7022	13.4509	(38)
Heat transfer coeff	57.4780	56.9165	56.9165	56.5421	56.7293	56.1678	56.5421	55.9806	55.9806	56.1678	56.1678	56.9165	(39)
Average = Sum(39)m / 12 =												56.5421	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0175	1.0075	1.0075	1.0009	1.0042	0.9943	1.0009	0.9910	0.9910	0.9943	0.9943	1.0075	(40)
HLP (average)												1.0009	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8809 (42)
Average daily hot water use (litres/day)	78.8705 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(45)

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

CALCULATION OF HEAT DEMAND 09 Jan 2014

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                19.2988    16.8789    17.4175    15.1850    14.5704    12.5731    11.6508    13.3695    13.5292    15.7670    17.2109    18.6899 (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      44.2107    38.4802    40.9954    38.1171    37.7801    35.0055    36.1724    37.7801    38.1171    40.9954    41.2288    44.2107 (61)
Total heat required for water heating calculated for each month
               172.8697   151.0061   157.1121   139.3505   134.9159   118.8264   113.8447   126.9102   128.3118   146.1085   155.9679   168.8100 (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
               172.8697   151.0061   157.1121   139.3505   134.9159   118.8264   113.8447   126.9102   128.3118   146.1085   155.9679   168.8100 (64)
                                                                                            Total per year (kWh/year) = Sum(64)m =   1714.0337 (64)
RHI water heating demand                                                                                                                1714 (64)
Heat gains from water heating, kWh/month
                53.8318    47.0349    48.8576    43.1894    41.7427    36.6218    34.8691    39.0808    39.5190    45.1990    48.4580    52.4820 (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	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	(66)

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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                39.8779    35.4192    28.8048    21.8071    16.3011    13.7621    14.8704    19.3291    25.9435    32.9412    38.4472    40.9863 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               244.8004   247.3407   240.9393   227.3115   210.1089   193.9408   183.1396   180.5993   187.0007   200.6285   217.8311   233.9992 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                48.1660    48.1660    48.1660    48.1660    48.1660    48.1660    48.1660    48.1660    48.1660    48.1660    48.1660    48.1660 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -75.2345   -75.2345   -75.2345   -75.2345   -75.2345   -75.2345   -75.2345   -75.2345   -75.2345   -75.2345   -75.2345   -75.2345 (71)
Water heating gains (Table 5)
                72.3545    69.9924    65.6689    59.9852    56.1057    50.8636    46.8671    52.5279    54.8875    60.7513    67.3027    70.5403 (72)
Total internal gains
               445.8162   441.5356   424.1963   397.8872   371.2990   347.3498   333.6604   341.2397   356.6150   383.1043   412.3644   434.3090 (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	
Southwest	2.2700	40.3681	0.6300	0.7000	0.7700	28.0050	(79)
Northeast	5.0600	12.9191	0.6300	0.7000	0.7700	19.9782	(75)

Solar gains	47.9832	78.2908	123.8676	184.5883	225.7708	250.0283	234.8840	201.4529	153.9691	100.1288	58.6159	39.8674	(83)
Total gains	493.7994	519.8265	548.0639	582.4755	597.0698	597.3782	568.5445	542.6926	510.5841	483.2331	470.9803	474.1764	(84)

---

7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                             21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	68.2507	68.9241	68.9241	69.3804	69.1515	69.8428	69.3804	70.0763	70.0763	69.8428	69.8428	68.9241	
alpha	5.5500	5.5949	5.5949	5.6254	5.6101	5.6562	5.6254	5.6718	5.6718	5.6562	5.6562	5.5949	

```
util living area
                 0.9828     0.9739     0.9471     0.8609     0.6783     0.4212     0.2486     0.2887     0.5890     0.8682     0.9642     0.9854 (86)
```

MIT	20.4328	20.5139	20.6541	20.8262	20.9254	20.9505	20.9516	20.9520	20.9429	20.8416	20.6265	20.4203	(87)
Th 2	20.0688	20.0770	20.0770	20.0826	20.0798	20.0881	20.0826	20.0909	20.0909	20.0881	20.0881	20.0770	(88)

```
util rest of house
                 0.9774     0.9659     0.9306     0.8215     0.6076     0.3369     0.1574     0.1950     0.4982     0.8223     0.9515     0.9808 (89)
```

MIT 2	19.3332	19.4557	19.6521	19.8824	19.9891	20.0172	20.0118	20.0206	20.0157	19.9107	19.6261	19.3223	(90)

```
Living area fraction                                                                                  fLA = Living area / (4) =      0.4932 (91)
```

MIT	19.8755	19.9776	20.1463	20.3479	20.4509	20.4775	20.4753	20.4800	20.4730	20.3698	20.1195	19.8638	(92)

```
Temperature adjustment                                                                                                                  0.0000
```

adjusted MIT	19.8755	19.9776	20.1463	20.3479	20.4509	20.4775	20.4753	20.4800	20.4730	20.3698	20.1195	19.8638	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9761	0.9649	0.9320	0.8338	0.6370	0.3731	0.1964	0.2351	0.5371	0.8378	0.9520	0.9795	(94)
Useful gains	481.9824	501.5630	510.8079	485.6915	380.3583	222.8686	111.6788	127.6067	274.2587	404.8649	448.3748	464.4551	(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
               826.2749   789.8654   702.7061   562.4741   394.3184   223.4059   111.6883   127.6332   278.3899   470.1154   658.2572   817.5368 (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
               256.1536   193.7392   142.7723    55.2835    10.3863     0.0000     0.0000     0.0000     0.0000    48.5464   151.1153   262.6928 (98)
Space heating                                                                                                                  1120.6894 (98)
RHI space heating demand                                                                                                          1121 (98)
```

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2801	0.2769	0.2737	0.2578	0.2546	0.2386	0.2386	0.2354	0.2450	0.2546	0.2609	0.2673	(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	
Flat Door			2.3000	1.0000	2.3000			(26)
Windows (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
French Doors (Uw = 1.20)			5.0600	1.1450	5.7939			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1500	10.2495			(29a)
External Roof 1	56.4900		56.4900	0.1500	8.4735			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.4161			(33)
Party Wall 1			37.1400	0.0000	0.0000			(32)
Party Floor 1			56.4900					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.0495	(36)
Total fabric heat loss (33) + (36) =	43.4656	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	16.4456	16.2585	16.0713	15.1354	14.9483	14.0124	14.0124	13.8252	14.3867	14.9483	15.3226	15.6970	(38)
Heat transfer coeff	59.9113	59.7241	59.5369	58.6011	58.4139	57.4780	57.4780	57.2908	57.8524	58.4139	58.7882	59.1626	(39)
Average = Sum(39)m / 12 =												58.5543	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0606	1.0573	1.0539	1.0374	1.0341	1.0175	1.0175	1.0142	1.0241	1.0341	1.0407	1.0473	(40)
HLP (average)												1.0365	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8809	(42)
Average daily hot water use (litres/day)	78.8705	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(45)

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

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	19.2988	16.8789	17.4175	15.1850	14.5704	12.5731	11.6508	13.3695	13.5292	15.7670	17.2109	18.6899	(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	44.2107	38.4802	40.9954	38.1171	37.7801	35.0055	36.1724	37.7801	38.1171	40.9954	41.2288	44.2107	(61)
Total heat required for water heating calculated for each month													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(64)
								Total per year (kWh/year) = Sum(64)m =				1714.0337	(64)
Heat gains from water heating, kWh/month													
	53.8318	47.0349	48.8576	43.1894	41.7427	36.6218	34.8691	39.0808	39.5190	45.1990	48.4580	52.4820	(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	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	39.8779	35.4192	28.8048	21.8071	16.3011	13.7621	14.8704	19.3291	25.9435	32.9412	38.4472	40.9863	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	244.8004	247.3407	240.9393	227.3115	210.1089	193.9408	183.1396	180.5993	187.0007	200.6285	217.8311	233.9992	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	(71)
Water heating gains (Table 5)													
	72.3545	69.9924	65.6689	59.9852	56.1057	50.8636	46.8671	52.5279	54.8875	60.7513	67.3027	70.5403	(72)
Total internal gains													
	445.8162	441.5356	424.1963	397.8872	371.2990	347.3498	333.6604	341.2397	356.6150	383.1043	412.3644	434.3090	(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	
Southwest	2.2700	36.7938	0.6300	0.7000	0.7700	25.5254	(79)
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)

Solar gains	42.9734	78.9950	123.4784	178.7982	223.8203	232.5612	219.9027	184.7304	142.3859	91.4570	52.5276	36.0933	(83)
Total gains	488.7896	520.5307	547.6747	576.6854	595.1193	579.9110	553.5631	525.9701	499.0009	474.5612	464.8920	470.4023	(84)

---

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.4788	65.6840	65.8905	66.9428	67.1573	68.2507	68.2507	68.4737	67.8091	67.1573	66.7296	66.3074	
alpha	5.3653	5.3789	5.3927	5.4629	5.4772	5.5500	5.5500	5.5649	5.5206	5.4772	5.4486	5.4205	
util living area													
	0.9889	0.9828	0.9668	0.9181	0.8046	0.6148	0.4536	0.4956	0.7391	0.9291	0.9795	0.9908	(86)
MIT	20.2939	20.3788	20.5260	20.7216	20.8683	20.9366	20.9488	20.9475	20.9120	20.7382	20.4899	20.2792	(87)
Th 2	20.0332	20.0359	20.0386	20.0523	20.0550	20.0688	20.0688	20.0715	20.0633	20.0550	20.0496	20.0441	(88)
util rest of house													
	0.9856	0.9776	0.9564	0.8929	0.7513	0.5336	0.3594	0.3985	0.6608	0.9020	0.9724	0.9880	(89)
MIT 2	19.1034	19.2279	19.4402	19.7210	19.9060	19.9879	19.9962	19.9986	19.9627	19.7506	19.4003	19.0911	(90)
Living area fraction									fLA = Living area / (4) =			0.4932	(91)
MIT	19.6905	19.7955	19.9757	20.2145	20.3806	20.4558	20.4660	20.4666	20.4309	20.2377	19.9377	19.6770	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6905	19.7955	19.9757	20.2145	20.3806	20.4558	20.4660	20.4666	20.4309	20.2377	19.9377	19.6770	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9841	0.9760	0.9556	0.8977	0.7708	0.5682	0.3999	0.4403	0.6931	0.9080	0.9713	0.9867	(94)
Useful gains	481.0279	508.0325	523.3822	517.7035	458.7149	329.4811	221.3693	231.5744	345.8754	430.8784	451.5663	464.1295	(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													
	922.0673	889.6200	802.3027	663.0418	507.0672	336.5780	222.2105	232.9781	366.2564	562.9729	754.7032	915.6612	(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													
	328.1333	256.4268	207.5168	104.6436	35.9741	0.0000	0.0000	0.0000	0.0000	98.2783	218.2586	335.9396	(98)
Space heating												1585.1710	(98)
Space heating per m2											(98) / (4) =	28.0611	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1761.3011	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	328.1333	256.4268	207.5168	104.6436	35.9741	0.0000	0.0000	0.0000	0.0000	98.2783	218.2586	335.9396	(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)													
	364.5926	284.9186	230.5742	116.2706	39.9712	0.0000	0.0000	0.0000	0.0000	109.1981	242.5095	373.2662	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	192.0774	167.7846	174.5690	154.8339	149.9065	132.0293	126.4941	141.0113	142.5686	162.3428	173.2977	187.5667	(219)
Water heating fuel used												1904.4819	(219)
Annual totals kWh/year													
Space heating fuel - main system												1761.3011	(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)												135.6819	(230a)
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												165.6819	(231)
Electricity for lighting (calculated in Appendix L)												281.7027	(232)
Total delivered energy for all uses												4113.1676	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1761.3011	3.4800	61.2933	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1904.4819	3.4800	66.2760	(247)
Mechanical ventilation fans	135.6819	13.1900	17.8964	(249)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	281.7027	13.1900	37.1566	(250)
Additional standing charges			120.0000	(251)
Total energy cost			306.5793	(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] =	1.2687	(257)
SAP value		82.3012	
SAP rating (Section 12)		82	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1761.3011	0.2160	380.4410	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1904.4819	0.2160	411.3681	(264)
Space and water heating			791.8091	(265)
Pumps and fans	165.6819	0.5190	85.9889	(267)
Energy for lighting	281.7027	0.5190	146.2037	(268)
Total kg/year			1024.0017	(272)
CO2 emissions per m2			18.1300	(273)
EI value			86.4798	
EI rating			86	(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

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	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	0.1211	0.1116	0.1116	0.1052	0.1084	0.0988	0.1052	0.0956	0.0956	0.0988	0.0988	0.1116	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2386	0.2291	0.2291	0.2227	0.2259	0.2163	0.2227	0.2131	0.2131	0.2163	0.2163	0.2291	(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	
Flat Door			2.3000	1.0000	2.3000			(26)
Windows (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
French Doors (Uw = 1.20)			5.0600	1.1450	5.7939			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1500	10.2495			(29a)
External Roof 1	56.4900		56.4900	0.1500	8.4735			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.4161			(33)
Party Wall 1			37.1400	0.0000	0.0000			(32)
Party Floor 1			56.4900					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.0495	(36)
Total fabric heat loss (33) + (36) =	43.4656	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	14.0124	13.4509	13.4509	13.0765	13.2637	12.7022	13.0765	12.5150	12.5150	12.7022	12.7022	13.4509	(38)
Heat transfer coeff	57.4780	56.9165	56.9165	56.5421	56.7293	56.1678	56.5421	55.9806	55.9806	56.1678	56.1678	56.9165	(39)
Average = Sum(39)m / 12 =												56.5421	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0175	1.0075	1.0075	1.0009	1.0042	0.9943	1.0009	0.9910	0.9910	0.9943	0.9943	1.0075	(40)
HLP (average)												1.0009	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8809	(42)
Average daily hot water use (litres/day)	78.8705	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(45)

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

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	19.2988	16.8789	17.4175	15.1850	14.5704	12.5731	11.6508	13.3695	13.5292	15.7670	17.2109	18.6899	(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	44.2107	38.4802	40.9954	38.1171	37.7801	35.0055	36.1724	37.7801	38.1171	40.9954	41.2288	44.2107	(61)
Total heat required for water heating calculated for each month													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(64)
								Total per year (kWh/year) = Sum(64)m =				1714.0337	(64)
Heat gains from water heating, kWh/month													
	53.8318	47.0349	48.8576	43.1894	41.7427	36.6218	34.8691	39.0808	39.5190	45.1990	48.4580	52.4820	(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	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	39.8779	35.4192	28.8048	21.8071	16.3011	13.7621	14.8704	19.3291	25.9435	32.9412	38.4472	40.9863	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	244.8004	247.3407	240.9393	227.3115	210.1089	193.9408	183.1396	180.5993	187.0007	200.6285	217.8311	233.9992	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	(71)
Water heating gains (Table 5)													
	72.3545	69.9924	65.6689	59.9852	56.1057	50.8636	46.8671	52.5279	54.8875	60.7513	67.3027	70.5403	(72)
Total internal gains													
	445.8162	441.5356	424.1963	397.8872	371.2990	347.3498	333.6604	341.2397	356.6150	383.1043	412.3644	434.3090	(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	
Southwest	2.2700	40.3681	0.6300	0.7000	0.7700	28.0050	(79)
Northeast	5.0600	12.9191	0.6300	0.7000	0.7700	19.9782	(75)

Solar gains	47.9832	78.2908	123.8676	184.5883	225.7708	250.0283	234.8840	201.4529	153.9691	100.1288	58.6159	39.8674	(83)
Total gains	493.7994	519.8265	548.0639	582.4755	597.0698	597.3782	568.5445	542.6926	510.5841	483.2331	470.9803	474.1764	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	68.2507	68.9241	68.9241	69.3804	69.1515	69.8428	69.3804	70.0763	70.0763	69.8428	69.8428	68.9241	
alpha	5.5500	5.5949	5.5949	5.6254	5.6101	5.6562	5.6254	5.6718	5.6718	5.6562	5.6562	5.5949	
util living area													
	0.9828	0.9739	0.9471	0.8609	0.6783	0.4212	0.2486	0.2887	0.5890	0.8682	0.9642	0.9854	(86)
MIT	20.4328	20.5139	20.6541	20.8262	20.9254	20.9505	20.9516	20.9520	20.9429	20.8416	20.6265	20.4203	(87)
Th 2	20.0688	20.0770	20.0770	20.0826	20.0798	20.0881	20.0826	20.0909	20.0909	20.0881	20.0881	20.0770	(88)
util rest of house													
	0.9774	0.9659	0.9306	0.8215	0.6076	0.3369	0.1574	0.1950	0.4982	0.8223	0.9515	0.9808	(89)
MIT 2	19.3332	19.4557	19.6521	19.8824	19.9891	20.0172	20.0118	20.0206	20.0157	19.9107	19.6261	19.3223	(90)
Living area fraction									fLA = Living area / (4) =			0.4932	(91)
MIT	19.8755	19.9776	20.1463	20.3479	20.4509	20.4775	20.4753	20.4800	20.4730	20.3698	20.1195	19.8638	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8755	19.9776	20.1463	20.3479	20.4509	20.4775	20.4753	20.4800	20.4730	20.3698	20.1195	19.8638	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9761	0.9649	0.9320	0.8338	0.6370	0.3731	0.1964	0.2351	0.5371	0.8378	0.9520	0.9795	(94)
Useful gains	481.9824	501.5630	510.8079	485.6915	380.3583	222.8686	111.6788	127.6067	274.2587	404.8649	448.3748	464.4551	(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													
	826.2749	789.8654	702.7061	562.4741	394.3184	223.4059	111.6883	127.6332	278.3899	470.1154	658.2572	817.5368	(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													
	256.1536	193.7392	142.7723	55.2835	10.3863	0.0000	0.0000	0.0000	0.0000	48.5464	151.1153	262.6928	(98)
Space heating												1120.6894	(98)
Space heating per m2											(98) / (4) =	19.8387	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1245.2104	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	256.1536	193.7392	142.7723	55.2835	10.3863	0.0000	0.0000	0.0000	0.0000	48.5464	151.1153	262.6928	(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)													
	284.6152	215.2658	158.6359	61.4261	11.5403	0.0000	0.0000	0.0000	0.0000	53.9404	167.9059	291.8809	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	192.0774	167.7846	174.5690	154.8339	149.9065	132.0293	126.4941	141.0113	142.5686	162.3428	173.2977	187.5667	(219)
Water heating fuel used												1904.4819	(219)
Annual totals kWh/year													
Space heating fuel - main system												1245.2104	(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)												135.6819	(230a)
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												165.6819	(231)
Electricity for lighting (calculated in Appendix L)												281.7027	(232)
Total delivered energy for all uses												3597.0769	(238)

10a. Fuel costs - using BEDF prices (419)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1245.2104	4.1000	51.0536	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1904.4819	4.1000	78.0838	(247)
Mechanical ventilation fans	135.6819	15.7000	21.3021	(249)
Pumps and fans for heating	30.0000	15.7000	4.7100	(249)
Energy for lighting	281.7027	15.7000	44.2273	(250)
Additional standing charges			89.0000	(251)
Total energy cost			288.3768	(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	1245.2104	0.2160	268.9655	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1904.4819	0.2160	411.3681	(264)
Space and water heating			680.3335	(265)
Pumps and fans	165.6819	0.5190	85.9889	(267)
Energy for lighting	281.7027	0.5190	146.2037	(268)
Total kg/year			912.5262	(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	1245.2104	1.2200	1519.1567	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1904.4819	1.2200	2323.4679	(264)
Space and water heating			3842.6246	(265)
Pumps and fans	165.6819	3.0700	508.6435	(267)
Energy for lighting	281.7027	3.0700	864.8272	(268)
Primary energy kWh/year			5216.0954	(272)
Primary energy kWh/m2/year			92.3366	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 82
Current environmental impact rating:	B 86

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

(For testing purposes):

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

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

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

Potential energy efficiency rating: B 82
Potential environmental impact rating: B 86

Fuel prices for cost data on this page from database revision number 419 TEST (30 Oct 2017)
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	£70	£70	£0
Mains gas	£218	£218	£0
Space heating	£166	£166	£0
Water heating	£78	£78	£0
Lighting	£44	£44	£0
Total cost of fuels	£288	£288	£0
Total cost of uses	£288	£288	£0
Delivered energy	64 kWh/m²	64 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.9 tonnes	0.0 tonnes
CO2 emissions per m²	16 kg/m²	16 kg/m²	0 kg/m²
Primary energy	92 kWh/m²	92 kWh/m²	0 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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

Overheating Calculation

Summer ventilation heat loss coefficient	352.33 (P1)
Transmission heat loss coefficient	43.47 (37)
Summer heat loss coefficient	395.79 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South West	2.2700	119.9223	0.6300	0.7000	0.9000	97.2410
North East	5.0600	98.8453	0.6300	0.7000	0.9000	178.6611
total:						275.9021

	Jun	Jul	Aug	
Solar gains	295	276	237	(P3)
Internal gains	344	331	338	
Total summer gains	639	607	575	(P5)
Summer gain/loss ratio	1.62	1.53	1.45	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	17.87	19.68	19.50	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature: Not significant

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

Design SAP
elmhurst energy

Property Reference	25159.002 - A301	**Issued on Date**	21/11/2017
Survey Reference	Be Green v3 AB	**Prop Type Ref**	
Property	TW1 3SD		

SAP Rating	86 B	**DER**	15.99	**TER**	23.48
Environmental	90 B	**% DER<TER**	31.91		
CO_2 Emissions (t/year)	0.66	**DFEE**	58.55	**TFEE**	68.42
General Requirements Compliance	Pass	**% DFEE<TFEE**	14.43		

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

SAP2012 - 9.92 input data (DesignData) -

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SAP2012 Input Data (Flat)      21/11/2017

FullRefNo:                     Be Green v3 AB

Regs Region:                   England
SAP Region:                    Thames Valley
Postcode:                      TW1 3SD
DwellingOrientation:           South West
Property Type:                 Flat, Mid-Terrace
Storeys:                       1
Date Built:                    2017
Sheltered Sides:               2
Sunlight Shade:                Average or unknown
Measurements                   Perimeter, Floor Area, Storey Height
     1st Storey:               12.96, 56.49, 3.15
Living Area:                   27.86 m2, fraction: 49.3%
Thermal Mass:                  Simple calculation
Thermal Mass Simple:           Medium
Thermal MassValue:             250
External Walls                 Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
External Wall 1                68.33, 77.96, 0, Other, Cavity, 0, 0.15, Gross
Party Walls                    Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                   37.14, 0, Other, FilledWithEdge, 0, 0
External Roofs                 Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
     External Roof 1           56.49, 56.49, 0, Other, 0.15
Heat Loss Floors               Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
Party Floors                   Area, Kappa, Construction, Element
     Party Floor 1             56.49, 0
Description                    Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
     Flat Door                 Manufacturer, Solid Door, , , , , , ,
     Windows                   Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
     French Doors              Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
Openings                       Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
     Flat Door                 Solid Door, External Wall 1, South West, , , , , 0, 0, 0, 2.30,
     SW F Windows              Window, External Wall 1, South West, , None, 0, , 0, 0, 0, 2.27,
     NE F FDoors               Window, External Wall 1, North East, , None, 0, , 0, 0, 0, 5.06,
Conservatory:                  None
Draught Proofing:              100
Draught Lobby:                 No
Thermal Bridges
     Bridging:                 Calculate Bridges
     Y                         0.104
     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, 4.23, 0.3, 0.3, 1.27,
     1.                        External wall, E3 Sill, Table K1 - Approved, Yes, 3.23, 0.04, 0.04, 0.13,
     2.                        External wall, E4 Jamb, Table K1 - Approved, Yes, 13.6, 0.05, 0.05, 0.68,
     3.                        External wall, E7 Party floor between dwellings (in blocks of flats), Table K1 - Approved, Yes, 12.96, 0.07, 0.07, 0.91,
     4.                        External wall, E23 Balcony within or between dwellings, balcony support penetrates wall insulation , Table K1 - Default, No, 2.2,
1, 1, 2.20,
     5.                        External wall, E15 Flat roof with parapet, Table K1 - Default, Yes, 12.96, 0.56, 0.56, 7.26,
     6.                        External wall, E16 Corner (normal), Table K1 - Approved, No, 9.45, 0.09, 0.09, 0.85,
     7.                        External wall, E18 Party wall between dwellings, Table K1 - Approved, Yes, 12.6, 0.06, 0.06, 0.76,
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                 2
     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
```

SAP2012 - 9.92 input data (DesignData) -

Passive Vents:	0
Flueless Gas Fires:	0
Cooling System	None
Light Fittings:	20
LEL Fittings:	20
Percentage of LEL Fittings:	100
External Lights Fitted:	Yes
External LELs Fitted:	Yes
Electricity Tariff:	Standard
Main Heating 1	
Description	
Percentage	100
MHS	Mains gas BGW Post 98 Combi condens. with auto ign.
SAP Code	104
Boiler Efficiency Type	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	488
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 56 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) 23.48 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.99 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)68.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)58.6 kWh/m²/yrOK

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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	(no floor)		
Roof	0.15 (max. 0.20)	0.15 (max. 0.35)	OK
Openings	1.15 (max. 2.00)	1.20 (max. 3.30)	OK

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

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

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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

SAP2012 - 9.92 input data (DesignData) -

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):	Not significant	OK
Based on:		
Overshading:	Average	
Windows facing North East:	5.06 m², No overhang	
Windows facing South West:	2.27 m², No overhang	
Air change rate:	6.00 ach	
Blinds/curtains:	None	
10 Key features		
Party wall U-value	0.00 W/m²K	
Door U-value	1.00 W/m²K	
Air permeability	3.0 m³/m²h	
Photovoltaic array		

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2801	0.2769	0.2737	0.2578	0.2546	0.2386	0.2386	0.2354	0.2450	0.2546	0.2609	0.2673	(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	
Flat Door			2.3000	1.0000	2.3000			(26)
Windows (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
French Doors (Uw = 1.20)			5.0600	1.1450	5.7939			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1500	10.2495			(29a)
External Roof 1	56.4900		56.4900	0.1500	8.4735			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.4161			(33)
Party Wall 1			37.1400	0.0000	0.0000			(32)
Party Floor 1			56.4900					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.0495	(36)
Total fabric heat loss (33) + (36) =	43.4656	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	16.4456	16.2585	16.0713	15.1354	14.9483	14.0124	14.0124	13.8252	14.3867	14.9483	15.3226	15.6970	(38)
Heat transfer coeff	59.9113	59.7241	59.5369	58.6011	58.4139	57.4780	57.4780	57.2908	57.8524	58.4139	58.7882	59.1626	(39)
Average = Sum(39)m / 12 =												58.5543	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0606	1.0573	1.0539	1.0374	1.0341	1.0175	1.0175	1.0142	1.0241	1.0341	1.0407	1.0473	(40)
HLP (average)												1.0365	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8809	(42)
Average daily hot water use (litres/day)	78.8705	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(45)

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	19.2988	16.8789	17.4175	15.1850	14.5704	12.5731	11.6508	13.3695	13.5292	15.7670	17.2109	18.6899	(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	44.2107	38.4802	40.9954	38.1171	37.7801	35.0055	36.1724	37.7801	38.1171	40.9954	41.2288	44.2107	(61)
Total heat required for water heating calculated for each month													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(64)
								Total per year (kWh/year) = Sum(64)m =				1714.0337	(64)
Heat gains from water heating, kWh/month													
	53.8318	47.0349	48.8576	43.1894	41.7427	36.6218	34.8691	39.0808	39.5190	45.1990	48.4580	52.4820	(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	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.9512	14.1677	11.5219	8.7228	6.5204	5.5048	5.9482	7.7316	10.3774	13.1765	15.3789	16.3945	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.0163	165.7182	161.4293	152.2987	140.7729	129.9404	122.7035	121.0016	125.2905	134.4211	145.9468	156.7794	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	(71)
Water heating gains (Table 5)													
	72.3545	69.9924	65.6689	59.9852	56.1057	50.8636	46.8671	52.5279	54.8875	60.7513	67.3027	70.5403	(72)
Total internal gains													
	306.5349	304.0913	292.8331	275.2198	257.6121	240.5218	229.7318	235.4741	244.7683	262.5618	282.8414	297.9272	(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	
Southwest	2.2700	36.7938	0.6300	0.7000	0.7700	25.5254	(79)
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)

Solar gains	42.9734	78.9950	123.4784	178.7982	223.8203	232.5612	219.9027	184.7304	142.3859	91.4570	52.5276	36.0933	(83)
Total gains	349.5083	383.0864	416.3115	454.0180	481.4324	473.0830	449.6344	420.2045	387.1542	354.0188	335.3690	334.0205	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.4788	65.6840	65.8905	66.9428	67.1573	68.2507	68.2507	68.4737	67.8091	67.1573	66.7296	66.3074	
alpha	5.3653	5.3789	5.3927	5.4629	5.4772	5.5500	5.5500	5.5649	5.5206	5.4772	5.4486	5.4205	
util living area													
	0.9977	0.9957	0.9898	0.9666	0.8918	0.7246	0.5521	0.6089	0.8593	0.9777	0.9954	0.9982	(86)
MIT	20.1232	20.2137	20.3770	20.6063	20.8053	20.9190	20.9451	20.9413	20.8659	20.6174	20.3352	20.1106	(87)
Th 2	20.0332	20.0359	20.0386	20.0523	20.0550	20.0688	20.0688	20.0715	20.0633	20.0550	20.0496	20.0441	(88)
util rest of house													
	0.9969	0.9943	0.9861	0.9539	0.8513	0.6397	0.4407	0.4952	0.7939	0.9667	0.9935	0.9976	(89)
MIT 2	18.8560	18.9902	19.2296	19.5684	19.8365	19.9752	19.9948	19.9958	19.9209	19.5905	19.1789	18.8463	(90)
Living area fraction									fLA = Living area / (4) =			0.4932	(91)
MIT	19.4809	19.5936	19.7955	20.0803	20.3143	20.4406	20.4635	20.4621	20.3870	20.0970	19.7492	19.4698	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.4809	19.5936	19.7955	20.0803	20.3143	20.4406	20.4635	20.4621	20.3870	20.0970	19.7492	19.4698	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9934	0.9849	0.9543	0.8637	0.6753	0.4888	0.5444	0.8190	0.9673	0.9928	0.9971	(94)
Useful gains	348.2337	380.5742	410.0380	433.2828	415.7997	319.4662	219.8018	228.7657	317.0837	342.4459	332.9516	333.0615	(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													
	909.5088	877.5651	791.5725	655.1766	503.1951	335.7084	222.0644	232.7223	363.7155	554.7539	743.6223	903.4030	(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													
	417.5887	333.9779	283.8617	159.7635	65.0221	0.0000	0.0000	0.0000	0.0000	157.9572	295.6829	424.3340	(98)
Space heating												2138.1881	(98)
Space heating per m2											(98) / (4) =	37.8507	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2375.7645	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	417.5887	333.9779	283.8617	159.7635	65.0221	0.0000	0.0000	0.0000	0.0000	157.9572	295.6829	424.3340	(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)													
	463.9874	371.0865	315.4019	177.5151	72.2468	0.0000	0.0000	0.0000	0.0000	175.5080	328.5366	471.4823	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	192.0774	167.7846	174.5690	154.8339	149.9065	132.0293	126.4941	141.0113	142.5686	162.3428	173.2977	187.5667	(219)
Water heating fuel used												1904.4819	(219)
Annual totals kWh/year													
Space heating fuel - main system												2375.7645	(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)												135.6819	(230a)
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												165.6819	(231)
Electricity for lighting (calculated in Appendix L)												281.7027	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
Total delivered energy for all uses												4727.6310	(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	2375.7645	0.2160	513.1651	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1904.4819	0.2160	411.3681	(264)
Space and water heating			924.5332	(265)
Pumps and fans	165.6819	0.5190	85.9889	(267)
Energy for lighting	281.7027	0.5190	146.2037	(268)
Energy saving/generation technologies				
PV Unit	-488.0000	0.5190	-253.2720	(269)
Total CO2, kg/year			903.4538	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.9900	(273)

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

DER		15.9900	ZC1
Total Floor Area	TFA	56.4900	
Assumed number of occupants	N	1.8809	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.2053	ZC2
CO2 emissions from cooking, equation (L16)		2.9057	ZC3
Total CO2 emissions		36.1009	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		36.1009	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1124	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3624	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3080	(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	0.3927	0.3850	0.3773	0.3388	0.3311	0.2926	0.2926	0.2849	0.3080	0.3311	0.3465	0.3619	(22b)
Effective ac	0.5771	0.5741	0.5712	0.5574	0.5548	0.5428	0.5428	0.5406	0.5474	0.5548	0.5600	0.5655	(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			2.3000	1.0000	2.3000			(26)
TER Opening Type (Uw = 1.40)			7.3300	1.3258	9.7178			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1800	12.2994			(29a)
External Roof 1	56.4900		56.4900	0.1300	7.3437			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.6609			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.8683	(36)
Total fabric heat loss					(33) + (36) =		42.5292	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.8895	33.7137	33.5413	32.7316	32.5802	31.8750	31.8750	31.7444	32.1466	32.5802	32.8866	33.2070	(38)
Heat transfer coeff	76.4187	76.2429	76.0705	75.2608	75.1094	74.4042	74.4042	74.2736	74.6758	75.1094	75.4158	75.7362	(39)
Average = Sum(39)m / 12 =												75.2601	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3528	1.3497	1.3466	1.3323	1.3296	1.3171	1.3171	1.3148	1.3219	1.3296	1.3350	1.3407	(40)
HLP (average)												1.3323	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.8809 (42)
Average daily hot water use (litres/day)		78.8705 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(45)
Distribution loss (46)m = 0.15 x (45)m	19.2988	16.8789	17.4175	15.1850	14.5704	12.5731	11.6508	13.3695	13.5292	15.7670	17.2109	18.6899	(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	44.2107	38.4802	40.9954	38.1171	37.7801	35.0055	36.1724	37.7801	38.1171	40.9954	41.2288	44.2107	(61)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total heat required for water heating calculated for each month

	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(64)
								Total per year (kWh/year) = Sum(64)m =				1714.0337	(64)
Heat gains from water heating, kWh/month													
	53.8318	47.0349	48.8576	43.1894	41.7427	36.6218	34.8691	39.0808	39.5190	45.1990	48.4580	52.4820	(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	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.9512	14.1677	11.5219	8.7228	6.5204	5.5048	5.9482	7.7316	10.3774	13.1765	15.3789	16.3945	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.0163	165.7182	161.4293	152.2987	140.7729	129.9404	122.7035	121.0016	125.2905	134.4211	145.9468	156.7794	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	(71)
Water heating gains (Table 5)													
	72.3545	69.9924	65.6689	59.9852	56.1057	50.8636	46.8671	52.5279	54.8875	60.7513	67.3027	70.5403	(72)
Total internal gains													
	306.5349	304.0913	292.8331	275.2198	257.6121	240.5218	229.7318	235.4741	244.7683	262.5618	282.8414	297.9272	(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	
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)
Southwest	2.2700	36.7938	0.6300	0.7000	0.7700	25.5254	(79)

Solar gains	42.9734	78.9950	123.4784	178.7982	223.8203	232.5612	219.9027	184.7304	142.3859	91.4570	52.5276	36.0933	(83)
Total gains	349.5083	383.0864	416.3115	454.0180	481.4324	473.0830	449.6344	420.2045	387.1542	354.0188	335.3690	334.0205	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.3345	51.4529	51.5695	52.1243	52.2294	52.7244	52.7244	52.8171	52.5326	52.2294	52.0172	51.7971	
alpha	4.4223	4.4302	4.4380	4.4750	4.4820	4.5150	4.5150	4.5211	4.5022	4.4820	4.4678	4.4531	
util living area													
	0.9976	0.9960	0.9917	0.9772	0.9326	0.8213	0.6709	0.7255	0.9134	0.9840	0.9958	0.9981	(86)
MIT	19.5129	19.6430	19.8923	20.2486	20.5983	20.8586	20.9585	20.9406	20.7394	20.3033	19.8512	19.4913	(87)
Th 2	19.7997	19.8021	19.8045	19.8156	19.8177	19.8274	19.8274	19.8293	19.8237	19.8177	19.8135	19.8091	(88)
util rest of house													
	0.9968	0.9946	0.9885	0.9672	0.8995	0.7307	0.5189	0.5796	0.8563	0.9752	0.9940	0.9974	(89)
MIT 2	17.8364	18.0278	18.3927	18.9145	19.4011	19.7252	19.8114	19.8029	19.5972	18.9993	18.3402	17.8111	(90)
Living area fraction									fLA = Living area / (4) =			0.4932	(91)
MIT	18.6632	18.8244	19.1323	19.5724	19.9916	20.2842	20.3771	20.3640	20.1605	19.6424	19.0854	18.6398	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6632	18.8244	19.1323	19.5724	19.9916	20.2842	20.3771	20.3640	20.1605	19.6424	19.0854	18.6398	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9957	0.9930	0.9860	0.9646	0.9053	0.7700	0.5947	0.6518	0.8758	0.9734	0.9925	0.9965	(94)
Useful gains	347.9948	380.3981	410.4874	437.9432	435.8484	364.2887	267.3862	273.8956	339.0840	344.6143	332.8439	332.8391	(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													
	1097.6192	1061.6357	960.9418	803.2164	622.7741	422.9277	281.0337	294.4216	452.5761	679.1698	903.8874	1093.6132	(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													
	557.7206	457.7917	409.5380	262.9967	139.0727	0.0000	0.0000	0.0000	0.0000	248.9093	411.1513	566.0160	(98)
Space heating												3053.1963	(98)
Space heating per m2											(98) / (4) =	54.0484	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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												3268.9468	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	557.7206	457.7917	409.5380	262.9967	139.0727	0.0000	0.0000	0.0000	0.0000	248.9093	411.1513	566.0160	(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)	597.1312	490.1410	438.4776	281.5811	148.9001	0.0000	0.0000	0.0000	0.0000	266.4982	440.2048	606.0128	(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	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7873	87.6650	87.3536	86.6263	85.1276	80.3000	80.3000	80.3000	80.3000	86.3813	87.3775	87.8613	(217)
Fuel for water heating, kWh/month	196.9187	172.2536	179.8575	160.8639	158.4866	147.9780	141.7742	158.0450	159.7905	169.1437	178.4990	192.1325	(219)
Water heating fuel used												2015.7431	(219)
Annual totals kWh/year													
Space heating fuel - main system												3268.9468	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												281.7027	(232)
Total delivered energy for all uses												5641.3926	(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	3268.9468	0.2160	706.0925	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2015.7431	0.2160	435.4005	(264)
Space and water heating			1141.4930	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	281.7027	0.5190	146.2037	(268)
Total CO2, kg/m2/year			1326.6217	(272)
Emissions per m2 for space and water heating			20.2070	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.5881	(272b)
Emissions per m2 for pumps and fans			0.6891	(272c)
Target Carbon Dioxide Emission Rate (TER) = (20.2070 * 1.00) + 2.5881 + 0.6891, rounded to 2 d.p.			23.4800	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1124	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2624	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2230	(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	0.2844	0.2788	0.2732	0.2453	0.2398	0.2119	0.2119	0.2063	0.2230	0.2398	0.2509	0.2621	(22b)
Effective ac	0.5404	0.5389	0.5373	0.5301	0.5287	0.5224	0.5224	0.5213	0.5249	0.5287	0.5315	0.5343	(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	
Flat Door			2.3000	1.0000	2.3000			(26)
Windows (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
French Doors (Uw = 1.20)			5.0600	1.1450	5.7939			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1500	10.2495			(29a)
External Roof 1	56.4900		56.4900	0.1500	8.4735			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.4161			(33)
Party Wall 1			37.1400	0.0000	0.0000			(32)
Party Floor 1			56.4900					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.0495	(36)
Total fabric heat loss (33) + (36) =	43.4656	(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	31.7350	31.6428	31.5524	31.1279	31.0485	30.6788	30.6788	30.6104	30.8212	31.0485	31.2092	31.3771	(38)
Heat transfer coeff	75.2006	75.1084	75.0180	74.5936	74.5142	74.1445	74.1445	74.0760	74.2869	74.5142	74.6748	74.8428	(39)
Average = Sum(39)m / 12 =												74.5932	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3312	1.3296	1.3280	1.3205	1.3191	1.3125	1.3125	1.3113	1.3150	1.3191	1.3219	1.3249	(40)
HLP (average)												1.3205	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8809 (42)
Average daily hot water use (litres/day)	78.8705 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(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)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	(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	(59)

Heat gains from water heating, kWh/month

	27.3400	23.9118	24.6748	21.5121	20.6414	17.8119	16.5054	18.9401	19.1664	22.3365	24.3821	26.4774 (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	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	(66)

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

	15.9512	14.1677	11.5219	8.7228	6.5204	5.5048	5.9482	7.7316	10.3774	13.1765	15.3789	16.3945 (67)

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

	164.0163	165.7182	161.4293	152.2987	140.7729	129.9404	122.7035	121.0016	125.2905	134.4211	145.9468	156.7794 (68)

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

	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345 (71)

Water heating gains (Table 5)

	36.7474	35.5830	33.1651	29.8779	27.7438	24.7388	22.1846	25.4572	26.6199	30.0222	33.8640	35.5878 (72)

Total internal gains

	267.9277	266.6819	257.3293	242.1124	226.2501	211.3969	202.0493	205.4033	213.5008	228.8328	246.4027	259.9747 (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	
Southwest	2.2700	36.7938	0.6300	0.7000	0.7700	25.5254	(79)
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)

Solar gains	42.9734	78.9950	123.4784	178.7982	223.8203	232.5612	219.9027	184.7304	142.3859	91.4570	52.5276	36.0933 (83)
Total gains	310.9011	345.6769	380.8076	420.9106	450.0704	443.9581	421.9520	390.1338	355.8867	320.2897	298.9303	296.0681 (84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.1660	52.2301	52.2930	52.5905	52.6466	52.9091	52.9091	52.9580	52.8077	52.6466	52.5333	52.4154	
alpha	4.4777	4.4820	4.4862	4.5060	4.5098	4.5273	4.5273	4.5305	4.5205	4.5098	4.5022	4.4944	
util living area	0.9985	0.9974	0.9941	0.9826	0.9448	0.8452	0.7010	0.7598	0.9322	0.9890	0.9974	0.9988	(86)
MIT	19.4785	19.6083	19.8580	20.2115	20.5682	20.8397	20.9509	20.9284	20.7082	20.2610	19.8074	19.4506	(87)
Th 2	19.8165	19.8177	19.8190	19.8248	19.8259	19.8310	19.8310	19.8320	19.8291	19.8259	19.8237	19.8214	(88)
util rest of house	0.9980	0.9964	0.9918	0.9747	0.9163	0.7598	0.5480	0.6157	0.8837	0.9827	0.9962	0.9984	(89)
MIT 2	18.4379	18.5685	18.8182	19.1723	19.5145	19.7494	19.8176	19.8093	19.6498	19.2248	18.7721	18.4139	(90)
Living area fraction									fLA = Living area / (4) =			0.4932	(91)
MIT	18.9511	19.0813	19.3310	19.6848	20.0342	20.2871	20.3765	20.3612	20.1717	19.7358	19.2827	18.9252	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9511	19.0813	19.3310	19.6848	20.0342	20.2871	20.3765	20.3612	20.1717	19.7358	19.2827	18.9252	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9975	0.9956	0.9905	0.9735	0.9224	0.7974	0.6247	0.6875	0.9009	0.9821	0.9955	0.9980	(94)
Useful gains	310.1272	344.1680	377.1934	409.7599	415.1382	353.9979	263.5896	268.1989	320.6335	314.5408	297.5895	295.4787	(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	1101.7717	1065.1356	962.5561	804.4795	621.0125	421.6695	280.0055	293.4317	451.0510	680.7496	909.7391	1102.0759	(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	588.9835	484.4902	435.5099	284.1981	153.1705	0.0000	0.0000	0.0000	0.0000	272.4594	440.7478	600.1083	(98)
Space heating												3259.6675	(98)
Space heating per m2											(98) / (4) =	57.7034	(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	696.9578	548.6689	562.9775	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7450	0.8295	0.7912	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	519.2624	455.1105	445.4313	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	590.0498	563.0070	527.0876	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	50.9669	80.2750	60.7523	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												191.9943	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   12.7417   20.0688   15.1881    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                          47.9986 (107)
Space cooling per m2                                                                                                    0.8497 (108)
Energy for space heating                                                                                               57.7034 (99)
Energy for space cooling                                                                                                0.8497 (108)
Total                                                                                                                  58.5531 (109)
Dwelling Fabric Energy Efficiency (DFEE)                                                                                  58.6 (109)


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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1124	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3624	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3080	(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	0.3927	0.3850	0.3773	0.3388	0.3311	0.2926	0.2926	0.2849	0.3080	0.3311	0.3465	0.3619	(22b)
Effective ac	0.5771	0.5741	0.5712	0.5574	0.5548	0.5428	0.5428	0.5406	0.5474	0.5548	0.5600	0.5655	(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			2.3000	1.0000	2.3000			(26)
TER Opening Type (Uw = 1.40)			7.3300	1.3258	9.7178			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1800	12.2994			(29a)
External Roof 1	56.4900		56.4900	0.1300	7.3437			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.6609			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.8683	(36)
Total fabric heat loss					(33) + (36) =		42.5292	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	33.8895	33.7137	33.5413	32.7316	32.5802	31.8750	31.8750	31.7444	32.1466	32.5802	32.8866	33.2070	(38)
Heat transfer coeff	76.4187	76.2429	76.0705	75.2608	75.1094	74.4042	74.4042	74.2736	74.6758	75.1094	75.4158	75.7362	(39)
Average = Sum(39)m / 12 =												75.2601	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3528	1.3497	1.3466	1.3323	1.3296	1.3171	1.3171	1.3148	1.3219	1.3296	1.3350	1.3407	(40)
HLP (average)												1.3323	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.8809 (42)
Average daily hot water use (litres/day)		78.8705 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month

	27.3400	23.9118	24.6748	21.5121	20.6414	17.8119	16.5054	18.9401	19.1664	22.3365	24.3821	26.4774 (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	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	94.0432	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	15.9512	14.1677	11.5219	8.7228	6.5204	5.5048	5.9482	7.7316	10.3774	13.1765	15.3789	16.3945	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.0163	165.7182	161.4293	152.2987	140.7729	129.9404	122.7035	121.0016	125.2905	134.4211	145.9468	156.7794	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	32.4043	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	(71)
Water heating gains (Table 5)													
	36.7474	35.5830	33.1651	29.8779	27.7438	24.7388	22.1846	25.4572	26.6199	30.0222	33.8640	35.5878	(72)
Total internal gains													
	267.9277	266.6819	257.3293	242.1124	226.2501	211.3969	202.0493	205.4033	213.5008	228.8328	246.4027	259.9747	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)
Southwest	2.2700	36.7938	0.6300	0.7000	0.7700	25.5254	(79)

Solar gains	42.9734	78.9950	123.4784	178.7982	223.8203	232.5612	219.9027	184.7304	142.3859	91.4570	52.5276	36.0933	(83)
Total gains	310.9011	345.6769	380.8076	420.9106	450.0704	443.9581	421.9520	390.1338	355.8867	320.2897	298.9303	296.0681	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.3345	51.4529	51.5695	52.1243	52.2294	52.7244	52.7244	52.8171	52.5326	52.2294	52.0172	51.7971	
alpha	4.4223	4.4302	4.4380	4.4750	4.4820	4.5150	4.5150	4.5211	4.5022	4.4820	4.4678	4.4531	
util living area													
	0.9985	0.9974	0.9941	0.9827	0.9455	0.8461	0.7025	0.7607	0.9328	0.9891	0.9974	0.9988	(86)
MIT	19.4516	19.5839	19.8372	20.2003	20.5606	20.8378	20.9500	20.9276	20.7045	20.2525	19.7935	19.4308	(87)
Th 2	19.7997	19.8021	19.8045	19.8156	19.8177	19.8274	19.8274	19.8293	19.8237	19.8177	19.8135	19.8091	(88)
util rest of house													
	0.9980	0.9964	0.9918	0.9749	0.9172	0.7607	0.5490	0.6164	0.8844	0.9828	0.9962	0.9984	(89)
MIT 2	18.3981	18.5320	18.7863	19.1540	19.5007	19.7448	19.8137	19.8063	19.6421	19.2099	18.7504	18.3846	(90)
Living area fraction										fLA = Living area / (4) =		0.4932	(91)
MIT	18.9177	19.0508	19.3046	19.6700	20.0234	20.2839	20.3741	20.3593	20.1661	19.7241	19.2649	18.9006	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9177	19.0508	19.3046	19.6700	20.0234	20.2839	20.3741	20.3593	20.1661	19.7241	19.2649	18.9006	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9975	0.9956	0.9905	0.9737	0.9231	0.7982	0.6259	0.6883	0.9015	0.9821	0.9955	0.9980	(94)
Useful gains	310.1159	344.1566	377.1948	409.8263	415.4553	354.3845	264.1033	268.5359	320.8483	314.5596	297.5830	295.4713	(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													
	1117.0655	1078.8984	974.0516	810.5594	625.1649	422.9027	280.8115	294.0716	452.9876	685.3031	917.4228	1113.3663	(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													
	600.3705	493.7465	444.0615	288.5279	156.0239	0.0000	0.0000	0.0000	0.0000	275.8332	446.2847	608.5139	(98)
Space heating												3313.3620	(98)
Space heating per m2											(98) / (4) =	58.6540	(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	699.3992	550.5909	564.4792	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7430	0.8277	0.7897	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	519.6792	455.7144	445.7925	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	590.0498	563.0070	527.0876	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	50.6668	79.8257	60.4836	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												190.9761	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

```
Space cooling kWh
                0.0000     0.0000     0.0000     0.0000     0.0000    12.6667    19.9564    15.1209     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                              47.7440 (107)
Space cooling per m2                                                                                                                        0.8452 (108)
Energy for space heating                                                                                                                   58.6540 (99)
Energy for space cooling                                                                                                                    0.8452 (108)
Total                                                                                                                                      59.4991 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                        68.4 (109)


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

CALCULATION OF HEAT DEMAND 09 Jan 2014

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	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	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	0.1211	0.1116	0.1116	0.1052	0.1084	0.0988	0.1052	0.0956	0.0956	0.0988	0.0988	0.1116	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2386	0.2291	0.2291	0.2227	0.2259	0.2163	0.2227	0.2131	0.2131	0.2163	0.2163	0.2291	(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	
Flat Door			2.3000	1.0000	2.3000			(26)
Windows (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
French Doors (Uw = 1.20)			5.0600	1.1450	5.7939			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1500	10.2495			(29a)
External Roof 1	56.4900		56.4900	0.1500	8.4735			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.4161			(33)
Party Wall 1			37.1400	0.0000	0.0000			(32)
Party Floor 1			56.4900					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.0495	(36)
Total fabric heat loss (33) + (36) =	43.4656	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	14.0124	13.4509	13.4509	13.0765	13.2637	12.7022	13.0765	12.5150	12.5150	12.7022	12.7022	13.4509	(38)
Heat transfer coeff	57.4780	56.9165	56.9165	56.5421	56.7293	56.1678	56.5421	55.9806	55.9806	56.1678	56.1678	56.9165	(39)
Average = Sum(39)m / 12 =												56.5421	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0175	1.0075	1.0075	1.0009	1.0042	0.9943	1.0009	0.9910	0.9910	0.9943	0.9943	1.0075	(40)
HLP (average)												1.0009	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8809 (42)
Average daily hot water use (litres/day)	78.8705 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(45)

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

CALCULATION OF HEAT DEMAND 09 Jan 2014

```
                19.2988    16.8789    17.4175    15.1850    14.5704    12.5731    11.6508    13.3695    13.5292    15.7670    17.2109    18.6899 (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      44.2107    38.4802    40.9954    38.1171    37.7801    35.0055    36.1724    37.7801    38.1171    40.9954    41.2288    44.2107 (61)
Total heat required for water heating calculated for each month
               172.8697   151.0061   157.1121   139.3505   134.9159   118.8264   113.8447   126.9102   128.3118   146.1085   155.9679   168.8100 (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
               172.8697   151.0061   157.1121   139.3505   134.9159   118.8264   113.8447   126.9102   128.3118   146.1085   155.9679   168.8100 (64)
                                                                                            Total per year (kWh/year) = Sum(64)m =   1714.0337 (64)
RHI water heating demand                                                                                                                1714 (64)
Heat gains from water heating, kWh/month
                53.8318    47.0349    48.8576    43.1894    41.7427    36.6218    34.8691    39.0808    39.5190    45.1990    48.4580    52.4820 (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	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	(66)

```
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                39.8779    35.4192    28.8048    21.8071    16.3011    13.7621    14.8704    19.3291    25.9435    32.9412    38.4472    40.9863 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               244.8004   247.3407   240.9393   227.3115   210.1089   193.9408   183.1396   180.5993   187.0007   200.6285   217.8311   233.9992 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                48.1660    48.1660    48.1660    48.1660    48.1660    48.1660    48.1660    48.1660    48.1660    48.1660    48.1660    48.1660 (69)
Pumps, fans      3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000     3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
               -75.2345   -75.2345   -75.2345   -75.2345   -75.2345   -75.2345   -75.2345   -75.2345   -75.2345   -75.2345   -75.2345   -75.2345 (71)
Water heating gains (Table 5)
                72.3545    69.9924    65.6689    59.9852    56.1057    50.8636    46.8671    52.5279    54.8875    60.7513    67.3027    70.5403 (72)
Total internal gains
               445.8162   441.5356   424.1963   397.8872   371.2990   347.3498   333.6604   341.2397   356.6150   383.1043   412.3644   434.3090 (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	
Southwest	2.2700	40.3681	0.6300	0.7000	0.7700	28.0050	(79)
Northeast	5.0600	12.9191	0.6300	0.7000	0.7700	19.9782	(75)

Solar gains	47.9832	78.2908	123.8676	184.5883	225.7708	250.0283	234.8840	201.4529	153.9691	100.1288	58.6159	39.8674	(83)
Total gains	493.7994	519.8265	548.0639	582.4755	597.0698	597.3782	568.5445	542.6926	510.5841	483.2331	470.9803	474.1764	(84)

---

7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                             21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	68.2507	68.9241	68.9241	69.3804	69.1515	69.8428	69.3804	70.0763	70.0763	69.8428	69.8428	68.9241	
alpha	5.5500	5.5949	5.5949	5.6254	5.6101	5.6562	5.6254	5.6718	5.6718	5.6562	5.6562	5.5949	

```
util living area
                 0.9828     0.9739     0.9471     0.8609     0.6783     0.4212     0.2486     0.2887     0.5890     0.8682     0.9642     0.9854 (86)
```

MIT	20.4328	20.5139	20.6541	20.8262	20.9254	20.9505	20.9516	20.9520	20.9429	20.8416	20.6265	20.4203	(87)
Th 2	20.0688	20.0770	20.0770	20.0826	20.0798	20.0881	20.0826	20.0909	20.0909	20.0881	20.0881	20.0770	(88)

```
util rest of house
                 0.9774     0.9659     0.9306     0.8215     0.6076     0.3369     0.1574     0.1950     0.4982     0.8223     0.9515     0.9808 (89)
```

MIT 2	19.3332	19.4557	19.6521	19.8824	19.9891	20.0172	20.0118	20.0206	20.0157	19.9107	19.6261	19.3223	(90)

```
Living area fraction                                                                                  fLA = Living area / (4) =      0.4932 (91)
```

MIT	19.8755	19.9776	20.1463	20.3479	20.4509	20.4775	20.4753	20.4800	20.4730	20.3698	20.1195	19.8638	(92)

```
Temperature adjustment                                                                                                                  0.0000
```

adjusted MIT	19.8755	19.9776	20.1463	20.3479	20.4509	20.4775	20.4753	20.4800	20.4730	20.3698	20.1195	19.8638	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9761	0.9649	0.9320	0.8338	0.6370	0.3731	0.1964	0.2351	0.5371	0.8378	0.9520	0.9795	(94)
Useful gains	481.9824	501.5630	510.8079	485.6915	380.3583	222.8686	111.6788	127.6067	274.2587	404.8649	448.3748	464.4551	(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
               826.2749   789.8654   702.7061   562.4741   394.3184   223.4059   111.6883   127.6332   278.3899   470.1154   658.2572   817.5368 (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
               256.1536   193.7392   142.7723    55.2835    10.3863     0.0000     0.0000     0.0000     0.0000    48.5464   151.1153   262.6928 (98)
Space heating                                                                                                                  1120.6894 (98)
RHI space heating demand                                                                                                          1121 (98)
```

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1626	0.1594	0.1562	0.1403	0.1371	0.1211	0.1211	0.1179	0.1275	0.1371	0.1434	0.1498	(22b)

Balanced mechanical ventilation with heat recovery

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2801	0.2769	0.2737	0.2578	0.2546	0.2386	0.2386	0.2354	0.2450	0.2546	0.2609	0.2673	(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	
Flat Door			2.3000	1.0000	2.3000			(26)
Windows (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
French Doors (Uw = 1.20)			5.0600	1.1450	5.7939			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1500	10.2495			(29a)
External Roof 1	56.4900		56.4900	0.1500	8.4735			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	29.4161			(33)
Party Wall 1			37.1400	0.0000	0.0000			(32)
Party Floor 1			56.4900					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.0495	(36)
Total fabric heat loss (33) + (36) =	43.4656	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	16.4456	16.2585	16.0713	15.1354	14.9483	14.0124	14.0124	13.8252	14.3867	14.9483	15.3226	15.6970	(38)
Heat transfer coeff	59.9113	59.7241	59.5369	58.6011	58.4139	57.4780	57.4780	57.2908	57.8524	58.4139	58.7882	59.1626	(39)
Average = Sum(39)m / 12 =												58.5543	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0606	1.0573	1.0539	1.0374	1.0341	1.0175	1.0175	1.0142	1.0241	1.0341	1.0407	1.0473	(40)
HLP (average)												1.0365	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8809	(42)
Average daily hot water use (litres/day)	78.8705	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(45)

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

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	19.2988	16.8789	17.4175	15.1850	14.5704	12.5731	11.6508	13.3695	13.5292	15.7670	17.2109	18.6899	(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	44.2107	38.4802	40.9954	38.1171	37.7801	35.0055	36.1724	37.7801	38.1171	40.9954	41.2288	44.2107	(61)
Total heat required for water heating calculated for each month													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(64)
								Total per year (kWh/year) = Sum(64)m =				1714.0337	(64)
Heat gains from water heating, kWh/month													
	53.8318	47.0349	48.8576	43.1894	41.7427	36.6218	34.8691	39.0808	39.5190	45.1990	48.4580	52.4820	(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	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	39.8779	35.4192	28.8048	21.8071	16.3011	13.7621	14.8704	19.3291	25.9435	32.9412	38.4472	40.9863	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	244.8004	247.3407	240.9393	227.3115	210.1089	193.9408	183.1396	180.5993	187.0007	200.6285	217.8311	233.9992	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	(71)
Water heating gains (Table 5)													
	72.3545	69.9924	65.6689	59.9852	56.1057	50.8636	46.8671	52.5279	54.8875	60.7513	67.3027	70.5403	(72)
Total internal gains													
	445.8162	441.5356	424.1963	397.8872	371.2990	347.3498	333.6604	341.2397	356.6150	383.1043	412.3644	434.3090	(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	
Southwest	2.2700	36.7938	0.6300	0.7000	0.7700	25.5254	(79)
Northeast	5.0600	11.2829	0.6300	0.7000	0.7700	17.4480	(75)

Solar gains	42.9734	78.9950	123.4784	178.7982	223.8203	232.5612	219.9027	184.7304	142.3859	91.4570	52.5276	36.0933	(83)
Total gains	488.7896	520.5307	547.6747	576.6854	595.1193	579.9110	553.5631	525.9701	499.0009	474.5612	464.8920	470.4023	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.4788	65.6840	65.8905	66.9428	67.1573	68.2507	68.2507	68.4737	67.8091	67.1573	66.7296	66.3074	
alpha	5.3653	5.3789	5.3927	5.4629	5.4772	5.5500	5.5500	5.5649	5.5206	5.4772	5.4486	5.4205	
util living area													
	0.9889	0.9828	0.9668	0.9181	0.8046	0.6148	0.4536	0.4956	0.7391	0.9291	0.9795	0.9908	(86)
MIT	20.2939	20.3788	20.5260	20.7216	20.8683	20.9366	20.9488	20.9475	20.9120	20.7382	20.4899	20.2792	(87)
Th 2	20.0332	20.0359	20.0386	20.0523	20.0550	20.0688	20.0688	20.0715	20.0633	20.0550	20.0496	20.0441	(88)
util rest of house													
	0.9856	0.9776	0.9564	0.8929	0.7513	0.5336	0.3594	0.3985	0.6608	0.9020	0.9724	0.9880	(89)
MIT 2	19.1034	19.2279	19.4402	19.7210	19.9060	19.9879	19.9962	19.9986	19.9627	19.7506	19.4003	19.0911	(90)
Living area fraction									fLA = Living area / (4) =			0.4932	(91)
MIT	19.6905	19.7955	19.9757	20.2145	20.3806	20.4558	20.4660	20.4666	20.4309	20.2377	19.9377	19.6770	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6905	19.7955	19.9757	20.2145	20.3806	20.4558	20.4660	20.4666	20.4309	20.2377	19.9377	19.6770	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9841	0.9760	0.9556	0.8977	0.7708	0.5682	0.3999	0.4403	0.6931	0.9080	0.9713	0.9867	(94)
Useful gains	481.0279	508.0325	523.3822	517.7035	458.7149	329.4811	221.3693	231.5744	345.8754	430.8784	451.5663	464.1295	(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													
	922.0673	889.6200	802.3027	663.0418	507.0672	336.5780	222.2105	232.9781	366.2564	562.9729	754.7032	915.6612	(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													
	328.1333	256.4268	207.5168	104.6436	35.9741	0.0000	0.0000	0.0000	0.0000	98.2783	218.2586	335.9396	(98)
Space heating												1585.1710	(98)
Space heating per m2											(98) / (4) =	28.0611	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1761.3011	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	328.1333	256.4268	207.5168	104.6436	35.9741	0.0000	0.0000	0.0000	0.0000	98.2783	218.2586	335.9396	(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)													
	364.5926	284.9186	230.5742	116.2706	39.9712	0.0000	0.0000	0.0000	0.0000	109.1981	242.5095	373.2662	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	192.0774	167.7846	174.5690	154.8339	149.9065	132.0293	126.4941	141.0113	142.5686	162.3428	173.2977	187.5667	(219)
Water heating fuel used												1904.4819	(219)
Annual totals kWh/year													
Space heating fuel - main system												1761.3011	(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)												135.6819	(230a)
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												165.6819	(231)
Electricity for lighting (calculated in Appendix L)												281.7027	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
Total delivered energy for all uses												4113.1676	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1761.3011	3.4800	61.2933	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1904.4819	3.4800	66.2760	(247)
Mechanical ventilation fans	135.6819	13.1900	17.8964	(249)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	281.7027	13.1900	37.1566	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-488.0000	13.1900	-64.3672	(252)
Total energy cost			242.2121	(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] =	1.0024	(257)
SAP value		86.0171	
SAP rating (Section 12)		86	(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	1761.3011	0.2160	380.4410	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1904.4819	0.2160	411.3681	(264)
Space and water heating			791.8091	(265)
Pumps and fans	165.6819	0.5190	85.9889	(267)
Energy for lighting	281.7027	0.5190	146.2037	(268)
Energy saving/generation technologies				
PV Unit	-488.0000	0.5190	-253.2720	(269)
Total kg/year			770.7297	(272)
CO2 emissions per m2			13.6400	(273)
EI value			89.8238	
EI rating			90	(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

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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	56.4900 (1b)	x	3.1500 (2b)	=	177.9435	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	56.4900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	177.9435	(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		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	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	0.1211	0.1116	0.1116	0.1052	0.1084	0.0988	0.1052	0.0956	0.0956	0.0988	0.0988	0.1116	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2386	0.2291	0.2291	0.2227	0.2259	0.2163	0.2227	0.2131	0.2131	0.2163	0.2163	0.2291	(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	
Flat Door			2.3000	1.0000	2.3000			(26)
Windows (Uw = 1.20)			2.2700	1.1450	2.5992			(27)
French Doors (Uw = 1.20)			5.0600	1.1450	5.7939			(27)
External Wall 1	77.9600	9.6300	68.3300	0.1500	10.2495			(29a)
External Roof 1	56.4900		56.4900	0.1500	8.4735			(30)
Total net area of external elements Aum(A, m2)			134.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.4161			(33)
Party Wall 1			37.1400	0.0000	0.0000			(32)
Party Floor 1			56.4900					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.0495	(36)
Total fabric heat loss (33) + (36) =	43.4656	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	14.0124	13.4509	13.4509	13.0765	13.2637	12.7022	13.0765	12.5150	12.5150	12.7022	12.7022	13.4509	(38)
Heat transfer coeff	57.4780	56.9165	56.9165	56.5421	56.7293	56.1678	56.5421	55.9806	55.9806	56.1678	56.1678	56.9165	(39)
Average = Sum(39)m / 12 =												56.5421	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0175	1.0075	1.0075	1.0009	1.0042	0.9943	1.0009	0.9910	0.9910	0.9943	0.9943	1.0075	(40)
HLP (average)												1.0009	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.8809	(42)
Average daily hot water use (litres/day)	78.8705	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	86.7576	83.6027	80.4479	77.2931	74.1383	70.9835	70.9835	74.1383	77.2931	80.4479	83.6027	86.7576	(44)
Energy conte	128.6590	112.5259	116.1167	101.2334	97.1358	83.8208	77.6723	89.1301	90.1946	105.1131	114.7392	124.5993	(45)
Energy content (annual)										Total = Sum(45)m =		1240.9403	(45)

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

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	19.2988	16.8789	17.4175	15.1850	14.5704	12.5731	11.6508	13.3695	13.5292	15.7670	17.2109	18.6899	(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	44.2107	38.4802	40.9954	38.1171	37.7801	35.0055	36.1724	37.7801	38.1171	40.9954	41.2288	44.2107	(61)
Total heat required for water heating calculated for each month													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(64)
								Total per year (kWh/year) = Sum(64)m =				1714.0337	(64)
Heat gains from water heating, kWh/month													
	53.8318	47.0349	48.8576	43.1894	41.7427	36.6218	34.8691	39.0808	39.5190	45.1990	48.4580	52.4820	(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	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	112.8518	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	39.8779	35.4192	28.8048	21.8071	16.3011	13.7621	14.8704	19.3291	25.9435	32.9412	38.4472	40.9863	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	244.8004	247.3407	240.9393	227.3115	210.1089	193.9408	183.1396	180.5993	187.0007	200.6285	217.8311	233.9992	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	48.1660	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	-75.2345	(71)
Water heating gains (Table 5)													
	72.3545	69.9924	65.6689	59.9852	56.1057	50.8636	46.8671	52.5279	54.8875	60.7513	67.3027	70.5403	(72)
Total internal gains													
	445.8162	441.5356	424.1963	397.8872	371.2990	347.3498	333.6604	341.2397	356.6150	383.1043	412.3644	434.3090	(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	
Southwest	2.2700	40.3681	0.6300	0.7000	0.7700	28.0050	(79)
Northeast	5.0600	12.9191	0.6300	0.7000	0.7700	19.9782	(75)

Solar gains	47.9832	78.2908	123.8676	184.5883	225.7708	250.0283	234.8840	201.4529	153.9691	100.1288	58.6159	39.8674	(83)
Total gains	493.7994	519.8265	548.0639	582.4755	597.0698	597.3782	568.5445	542.6926	510.5841	483.2331	470.9803	474.1764	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	68.2507	68.9241	68.9241	69.3804	69.1515	69.8428	69.3804	70.0763	70.0763	69.8428	69.8428	68.9241	
alpha	5.5500	5.5949	5.5949	5.6254	5.6101	5.6562	5.6254	5.6718	5.6718	5.6562	5.6562	5.5949	
util living area													
	0.9828	0.9739	0.9471	0.8609	0.6783	0.4212	0.2486	0.2887	0.5890	0.8682	0.9642	0.9854	(86)
MIT	20.4328	20.5139	20.6541	20.8262	20.9254	20.9505	20.9516	20.9520	20.9429	20.8416	20.6265	20.4203	(87)
Th 2	20.0688	20.0770	20.0770	20.0826	20.0798	20.0881	20.0826	20.0909	20.0909	20.0881	20.0881	20.0770	(88)
util rest of house													
	0.9774	0.9659	0.9306	0.8215	0.6076	0.3369	0.1574	0.1950	0.4982	0.8223	0.9515	0.9808	(89)
MIT 2	19.3332	19.4557	19.6521	19.8824	19.9891	20.0172	20.0118	20.0206	20.0157	19.9107	19.6261	19.3223	(90)
Living area fraction									fLA = Living area / (4) =			0.4932	(91)
MIT	19.8755	19.9776	20.1463	20.3479	20.4509	20.4775	20.4753	20.4800	20.4730	20.3698	20.1195	19.8638	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8755	19.9776	20.1463	20.3479	20.4509	20.4775	20.4753	20.4800	20.4730	20.3698	20.1195	19.8638	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9761	0.9649	0.9320	0.8338	0.6370	0.3731	0.1964	0.2351	0.5371	0.8378	0.9520	0.9795	(94)
Useful gains	481.9824	501.5630	510.8079	485.6915	380.3583	222.8686	111.6788	127.6067	274.2587	404.8649	448.3748	464.4551	(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													
	826.2749	789.8654	702.7061	562.4741	394.3184	223.4059	111.6883	127.6332	278.3899	470.1154	658.2572	817.5368	(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													
	256.1536	193.7392	142.7723	55.2835	10.3863	0.0000	0.0000	0.0000	0.0000	48.5464	151.1153	262.6928	(98)
Space heating												1120.6894	(98)
Space heating per m2											(98) / (4) =	19.8387	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1245.2104	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	256.1536	193.7392	142.7723	55.2835	10.3863	0.0000	0.0000	0.0000	0.0000	48.5464	151.1153	262.6928	(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)													
	284.6152	215.2658	158.6359	61.4261	11.5403	0.0000	0.0000	0.0000	0.0000	53.9404	167.9059	291.8809	(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													
	172.8697	151.0061	157.1121	139.3505	134.9159	118.8264	113.8447	126.9102	128.3118	146.1085	155.9679	168.8100	(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													
	192.0774	167.7846	174.5690	154.8339	149.9065	132.0293	126.4941	141.0113	142.5686	162.3428	173.2977	187.5667	(219)
Water heating fuel used												1904.4819	(219)
Annual totals kWh/year													
Space heating fuel - main system												1245.2104	(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)												135.6819	(230a)
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												165.6819	(231)
Electricity for lighting (calculated in Appendix L)												281.7027	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
Total delivered energy for all uses												3597.0769	(238)

10a. Fuel costs - using BEDF prices (419)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1245.2104	4.1000	51.0536	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1904.4819	4.1000	78.0838	(247)
Mechanical ventilation fans	135.6819	15.7000	21.3021	(249)
Pumps and fans for heating	30.0000	15.7000	4.7100	(249)
Energy for lighting	281.7027	15.7000	44.2273	(250)
Additional standing charges			89.0000	(251)
Energy saving/generation technologies				
PV Unit	-488.0000	15.7000	-76.6160	(252)
Total energy cost			211.7608	(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	1245.2104	0.2160	268.9655	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1904.4819	0.2160	411.3681	(264)
Space and water heating			680.3335	(265)
Pumps and fans	165.6819	0.5190	85.9889	(267)
Energy for lighting	281.7027	0.5190	146.2037	(268)
Energy saving/generation technologies				
PV Unit	-488.0000	0.5190	-253.2720	(269)
Total kg/year			659.2542	(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	1245.2104	1.2200	1519.1567	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1904.4819	1.2200	2323.4679	(264)
Space and water heating			3842.6246	(265)
Pumps and fans	165.6819	3.0700	508.6435	(267)
Energy for lighting	281.7027	3.0700	864.8272	(268)
Energy saving/generation technologies				
PV Unit	-488.0000	3.0700	-1498.1600	(269)
Primary energy kWh/year			3717.9354	(272)
Primary energy kWh/m2/year			65.8158	(273)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 86
Current environmental impact rating: B 90

(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 86
Potential environmental impact rating: B 90

Fuel prices for cost data on this page from database revision number 419 TEST (30 Oct 2017)
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	£70	£70	£0
Mains gas	£218	£218	£0
Space heating	£166	£166	£0
Water heating	£78	£78	£0
Lighting	£44	£44	£0
Generated (PV)	-£77	-£77	£0
Total cost of fuels	£211	£211	£0
Total cost of uses	£211	£211	£0
Delivered energy	64 kWh/m²	64 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.7 tonnes	0.0 tonnes
CO2 emissions per m²	12 kg/m²	12 kg/m²	0 kg/m²
Primary energy	66 kWh/m²	66 kWh/m²	0 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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

Overheating Calculation

Summer ventilation heat loss coefficient	352.33 (P1)
Transmission heat loss coefficient	43.47 (37)
Summer heat loss coefficient	395.79 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
South West	2.2700	119.9223	0.6300	0.7000	0.9000	97.2410
North East	5.0600	98.8453	0.6300	0.7000	0.9000	178.6611
total:						275.9021

	Jun	Jul	Aug	
Solar gains	295	276	237	(P3)
Internal gains	344	331	338	
Total summer gains	639	607	575	(P5)
Summer gain/loss ratio	1.62	1.53	1.45	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	17.87	19.68	19.50	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature: Not significant

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Twickenham Be Clean

As designed

Date: Fri Nov 03 16:37:51 2017

Administrative information

Building Details

Address: ,

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.4.1"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.4.1

BRUKL compliance check version: v5.2.g.3

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name:

Telephone number:

Address: , ,

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2.annum$	19.4
Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	19.4
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	15.9
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.15	0.15	External Wall
Floor	0.25	0.13	0.14	Exposed Floor
Roof	0.25	0.14	0.14	Roof
Windows***, roof windows, and rooflights	2.2	1.23	1.23	W6
Personnel doors	2.2	1.85	1.85	W5
Vehicle access & similar large doors	1.5	-	-	No vehicle doors in project
High usage entrance doors	3.5	-	-	No high usage entrance doors in project

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [$W/(m^2K)$]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [$W/(m^2K)$]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [$W/(m^2K)$]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	5

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs. Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- commercial space (5 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	3.71	3.6	-	1.1	0.8
Standard value	0.91*	2.6	N/A	1.6^	0.5
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.

^ Allowed SFP may be increased by the amounts specified in the Non-Domestic Building Services Compliance Guide if the system includes additional components as listed in the Guide.

1- New HWS Circuit

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	0.95	0
Standard value	0.9*	N/A

* Standard shown is for gas boilers >30 kW output. For boilers <=30 kW output, limiting efficiency is 0.73.

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
Unit 1	-	-	-	1.1	-	-	-	-	-	-	N/A
Unit 2	-	-	-	1.1	-	-	-	-	-	-	N/A
Unit 3	-	-	-	1.1	-	-	-	-	-	-	N/A
Unit 4	-	-	-	1.1	-	-	-	-	-	-	N/A
Unit 5	-	-	-	1.1	-	-	-	-	-	-	N/A

General lighting and display lighting

Zone name	Luminous efficacy [lm/W]			
	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
Unit 1	95	-	-	1941
Unit 2	95	-	-	1707
Unit 3	95	-	-	1731