PRICE&MYERS

97 Camden Mews, Camden

Energy Strategy Report

CIBSE LOW CARBON ENERGY ASSESSORS

Date: 21 June 2016

Project ref: 25220

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Reviewed by: Jessica James

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Contents

Executive Summary

This report details the proposed energy strategy for the 97 Camden Mews scheme, which entails the demolition of existing workshop space. The scheme comprises the construction of two 3 storey 3-bedroom houses. The scheme is located within the London Borough of Camden.

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

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

An energy assessment has been carried out based on design information to identify the most appropriate renewable strategy. The project is a minor development, as such, it is just required to follow the London Plan through the Energy Hierarchy. It has the potential to provide a 35% improvement over the Building Regulations 2013 minimum target; through passive design measures, energy efficient equipment and renewable technologies. The building fabric performance, of the development, has been specified to exceed the Building Regulations Part L 2013 requirements. High efficiency gas boilers will also be used for both houses with time and temperature controls.

As the project is a minor development, the LZCs technologies have been specified to achieve an overall 16.1% saving in carbon emissions. The reductions show an ambition towards meeting the targets set out in the London Plan and by the London Borough of Camden.

1 Introduction

1.1 Site Analysis

The 97 Camden Mews development is located within the London Borough of Camden.

The proposal entails the demolition of an existing commercial workshop space. The new scheme comprises two 3 storey, 3 bedroom houses. Both houses have flat roofs, these shall be used for the placement of PV panels with the remaining roof being used as a green roof. The houses occupy the whole site but outdoor space has been made available in the form of a terrace on the ground and second floors along with a balcony on the first floor. Storage for 3 bikes and waste and recycling bins has also been included in the proposed design. The roofs shall be a green roofs, while incorporating the use of PV panels.

Figure 1-1 Site location © Google Maps

1.2 Objective

This report summarises the work undertaken to support the development of an energy strategy for the 97 Camden Mews scheme. This work has resulted in a strategy that requires design, technical and commercial decisions in order to continue the design development and ultimately select the final solution for ensuring a low carbon development.

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

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

2 Policy

2.1 London Borough of Camden Policies on Energy

Policy DP22 – Promoting sustainable design and construction

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

- Expecting new build housing to meet Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016;
- Expecting developments (except new build) of 500 sq m of residential floor space or above or 5 or more dwellings to achieve "very good" in BREEAM for Domestic Refurbishment assessments prior to 2013 and encouraging "excellent" from 2013;

Policy CPG3 Sustainability

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

All residential new build should achieve a Code for Sustainable Homes Level 4 with 50% of the unweighted Energy, Water and Materials credits.

2.2 The London Plan Policies on Energy

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

Policy 5.2: Minimising Carbon Dioxide Emissions

Planning Decisions

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

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

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

2.3 Code for Sustainable Homes withdrawn

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

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

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

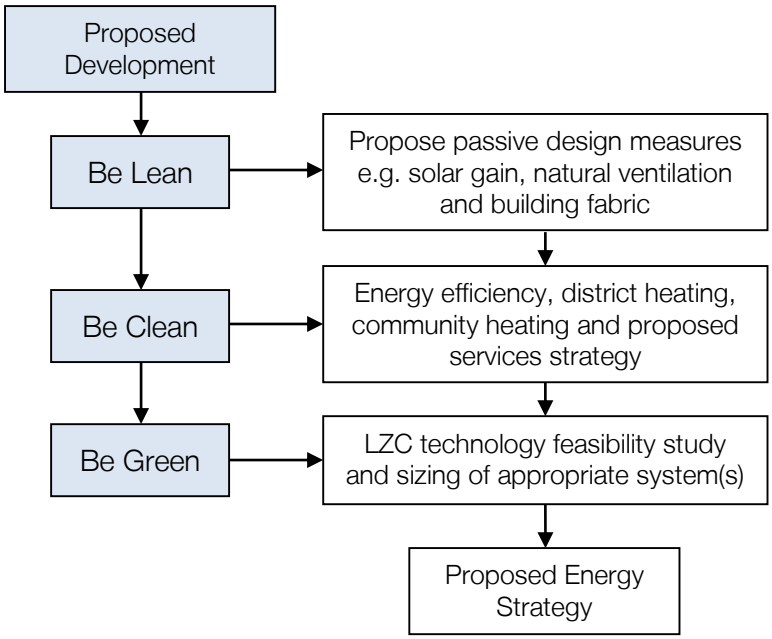
3 Approach

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

The development will adopt the following energy hierarchy:

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

This energy strategy examines the energy performance of the proposed 97 Camden Mews development based on the following methodology:



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

3.1 Accredited Energy Assessor

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

4 Energy Targets

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

Building Regulations Target Emission Rate Breakdown															
Regulated Energy & CO_2														Unregulated Energy & CO_2	
Type	Gas Demand				Electricity Demand							Total Energy (kWh/yr)	Total CO_2 (kg/yr)		
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Cooling (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Total (kWh/yr)	Electricity CO_2 ($kgCO_2$/yr)			Energy (kWh/yr)	CO_2 (kg/yr)
Residential	10,430	5,399	15,828	3,419	0	0	0	150	874	1,024	531	16,852	3,950	5,055	2623.47

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

The energy consumption calculations for this and all subsequent stages of the assessment include regulated energy (space and water heating, lighting, pumps and fans) and unregulated energy (appliances and equipment) derived from outputs of the Standard Assessment Procedure.

5 Be Lean: Passive Design

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

5.1 Solar Gain Control and Daylighting

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

5.2 Building Fabric Efficiency

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

Element	Proposed Measure
External Walls	0.17 W/m^{2}K
Party Walls*	0.00 W/m^{2}K*
Roof (All areas including main roof, 1st floor balcony)	0.13 W/m^{2}K
Ground Floor	0.10 W/m^{2}K
Exposed Floor (First Floor)	0.10 W/m^{2}K
Windows/ Rooflights/ French Doors	0.8 W/m^{2}K
External Doors	1.20 W/m^{2}K
Air Tightness	Pressure test will be carried out to determine air tightness. This will be an assumed: 3 m^3/m^2/h
Thermal Bridging	Independently assessed, designed to be equivalent to accredited detail figures Details to be calculated at the detailed design stage

Table 5-1 Proposed Be Lean passive design measures

*Where party walls have a cavity these are to meet the following requirements:

- Sealed to prevent air going in and out of any cavity
- Sealed at the top, bottom and vertically
- All cavities are to be fully filled

5.1 Improvement Over Part L

Based on the performance of the passive design measures proposed above, as calculated using SAP 2012, Table 5-2 and Figure 5-1 demonstrate the percentage improvement these have over the notional baseline levels for the development before the inclusion of any energy efficient measures or low or zero carbon technologies have been considered. Table 5-2 confirms that the development achieves a 4% improvement over Building Regulations Part L 2013.

Site Wide	CO_2 Emissions (tonnes /annum)	CO_2 Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	3.95		
Be Lean (after demand reduction)	3.77	0.18	4%

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

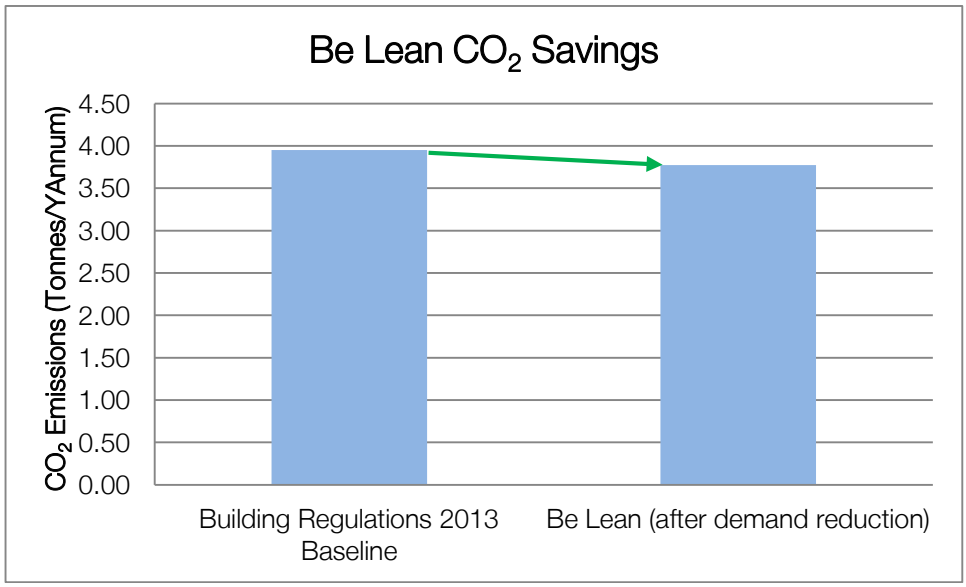


Figure 5-1 Improvement over Building Regulations Part L 2013 through the Energy Hierarchy at the Be Lean Stage

The Be Lean stage has the potential to provide 4% improvement over Building Regulations Part L 2013 Target Fabric Energy Efficiency; through passive design measures. Table 5-3 breaks down the energy use for the Be Lean case.

Be Lean															
	Regulated Energy & CO_2													Unregulated Energy & CO_2	
Type	Gas Demand				Electricity Demand							Total Energy (kWh/yr)	Total CO_2 (kg/yr)		
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Cooling (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Total (kWh/yr)	Electricity CO_2 ($kgCO_2$/yr)			Energy (kWh/yr)	CO_2 (kg/yr)
Residential	9,305	5,399	14,704	3,176	0	0	0	60	1,092	1,152	598	15,857	3,774	5,055	2623

Table 5-2 Estimated regulated and unregulated energy demand and carbon emissions per energy source

6 Be Clean: Energy Efficiency

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

6.1 District Energy Systems

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

According to the London Heat Map Study, the potential Camden heat network has been identified in the purple shading in Figure 6-1 below.

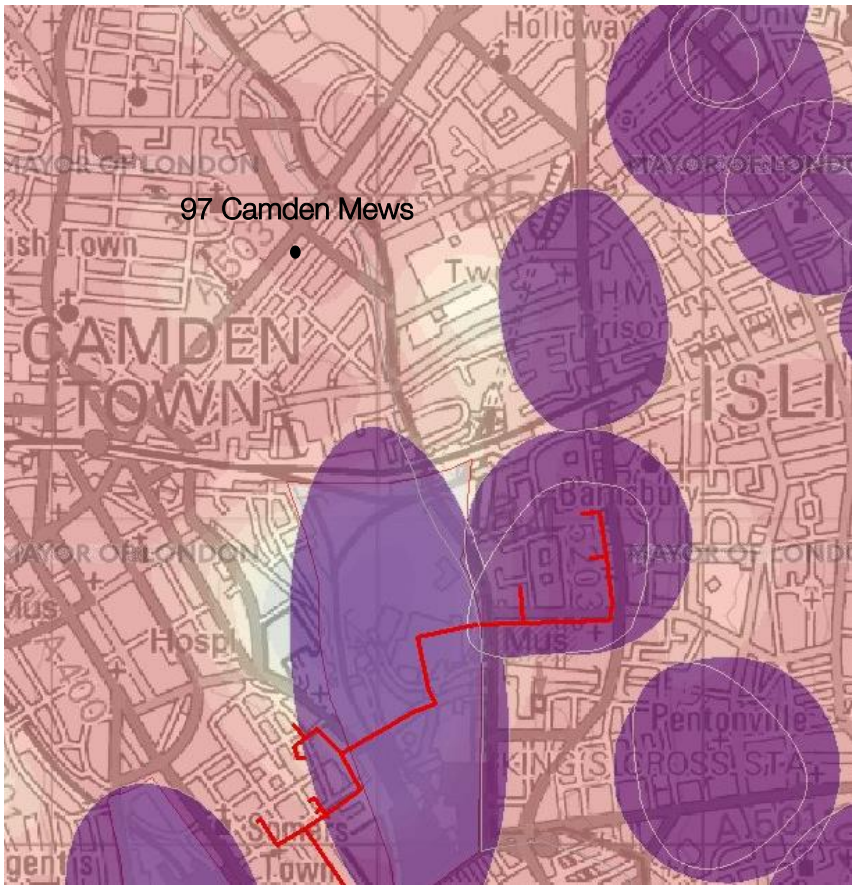


Figure 6-1 London Heat Map ©

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

6.2 Community Heating

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

As this development is relatively small, the installation of a community energy system would not be cost effective. A CHP system would not be viable for such small development due to low peak

demand. The potential savings associated with a communal gas heating system would not be significant enough to justify the additional cost. Fabric improvements would have a greater impact and are therefore more cost effective for this development.

6.3 Services Strategy

In addition to the passive design measures identified in Section 5, energy efficient equipment has been proposed where possible to support the services strategy. Table 6-1 shows the proposed services strategy and energy efficiency measures for the development.

Services	Proposed
Space Heating	Regular Gas Condensing Boiler 90% efficient Space heating from underfloor heating
Heating Controls	Time and temperature zone controls
Hot Water Heating	Regular Gas Condensing Boiler 90% efficient 300lt Cylinder Boiler Interlock Cylinder Stat 100mm foam insulation Fully insulated primary pipework
Ventilation	Natural ventilation, localised extract in wet rooms
Comfort Cooling	N/A
Lighting	100% Energy Efficient (LED) Lighting
Lighting Control	PIR/Daylight/Timer controls fitted to lighting in external areas

Table 6-1 Proposed energy efficient design measures

6.4 Improvement Over Part L

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

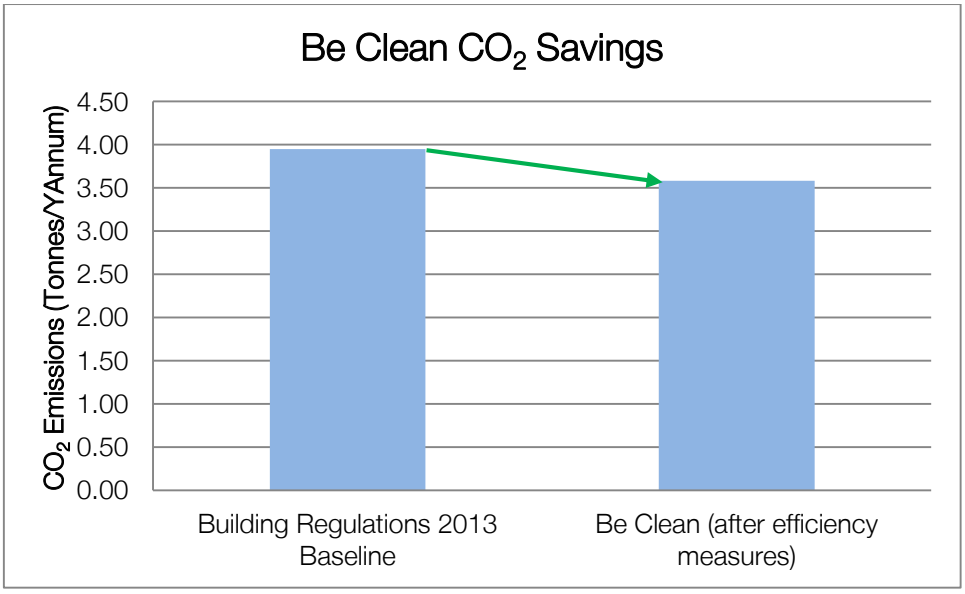


Figure 6-2 Improvement over Building Regulations Part L 2013 with a Communal Gas Boiler

Site Wide	CO_2 Emissions (tonnes /annum)	CO_2 Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	3.95		
Be Lean (after demand reduction)	3.77	0.18	4%
Be Clean (after efficiency measures)	3.58	0.19	5%
Total Cumulative Savings		0.37	9%

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

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

Be Clean															
Regulated Energy & CO_2														Unregulated Energy & CO_2	
Type	Gas Demand				Electricity Demand							Total Energy (kWh/yr)	Total CO_2 (kg/yr)		
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Cooling (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Total (kWh/yr)	Electricity CO_2 ($kgCO_2$/yr)			Energy (kWh/yr)	CO_2 (kg/yr)
Residential	9,180	5,157	14,337	3,097	0	0	0	60	874	934	485	15,271	3,581	5,055	2623

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

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

The final level of the energy hierarchy is to Be Green, therefore the following table discusses the options for on-site low and zero carbon technologies and their feasibility on this development to contribute to meeting the relevant London Plan and the London Borough of Camden'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 flat roof spaces where solar thermal panels can be installed. However, solar PV is favoured due to greater potential carbon savings.	✖
Solar Photovoltaic Panels (PV)	Solar PV panels provide noiseless, low-maintenance, carbon free electricity	Can have significant impact on carbon emissions by offsetting grid electricity (which has a high carbon footprint) Low maintenance, No noise issues No additional land use from the installation of PV panels Bolt on technology that does not need significant amounts of auxiliary equipment Favourable payback periods	Needs unobstructed space on roof Low efficiencies per unit area of PV Often used to supplement landlord's electricity so savings not always transferred to individual properties	There is flat roof space on which Solar PV panels could be installed to contribute to the electricity demand of the building.	✓

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

Wind Turbines	Vertical and horizontal axis wind turbines enable electricity to be generated using the power within the wind	Low noise Bolt on technology that does not need significant amounts of auxiliary equipment	Not suitable for urban environments due to low wind conditions and obstructions High visual impact Noise impact (45-65dB at 3m) High capital cost and only achieve good paybacks in locations with strong wind profiles Requires foundations or vibration supports for building installations (generally not recommended)	This development is in an urban environment and so a wind turbine will not generate much energy	✗
Ground Source Heat Pumps (GSHP)	Utilising horizontal loops or vertical boreholes, GSHP make use of the grounds almost constant temperature to provide heating and/or cooling using a heat exchanger connected to a space/water heating delivery system	Low maintenance and easy to manage High COP (ratio of energy output per energy input) Optimum efficiency with underfloor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through savings on a traditional boiler	The heat pump has a noise level around 35-60dB so some attenuation may be required and it should be sensibly located Relatively high capital cost Requires electricity to run the pump, therefore limited carbon savings in some cases For communal systems a plant room is required which may take additional land from the proposed development/surroundings	GSHP are not a feasible technology for the site since there is a limited external space available for installation of boreholes	✗

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

Table 7-1 Feasibility of LZC technologies for the development

Having reviewed potential LZC technologies for the development it has been identified that the most appropriate system would be Solar PV which would most suitably be installed within the systems. The chosen should be accurately sized during the detailed design stages and MCS (Microgeneration Certification Scheme) approved equipment and installers used.

7.1 Summary of CO_2 Emission Savings

The most appropriate LZC technology for the development has been identified as Solar PV in order to show ambition towards meeting the London Plan and the London Borough of Camden's target for on-site renewables. This provides 16.1% of total site energy and reduces carbon emissions by 9.46%. Table 7-2 shows the proposed system size and the estimate energy and carbon emissions savings for this development.

	Energy & CO_2				
Proposed LZC Technologies	Energy Generated (kWh/yr)	% site energy demand met	CO_2 saved by system ($kgCO_2$/yr)	% reduction in site CO_2 emissions	25 year CO_2 saving ($kgCO_2$)
Total Solar PV = 2.5 kWp 10 no.s Normal Efficiency Horizontal. SE/SW facing	1,922	9.46%	998	16.1%	24,938

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

7.2 Improvement Over Part L with LZCs

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

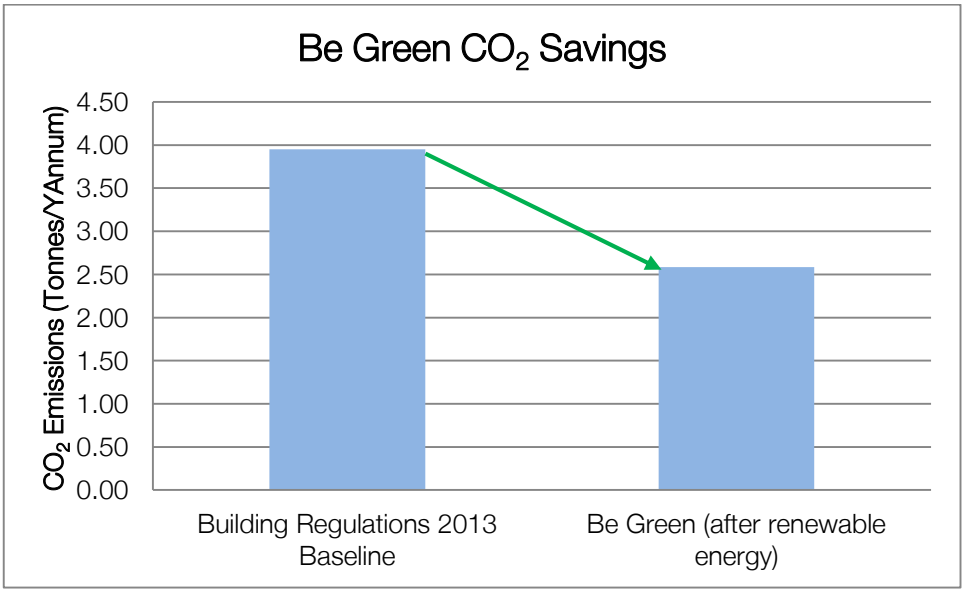


Figure 7-1 % Improvement over Building Regulations Part L 2013 after LZCs

Site Wide	CO_2 Emissions (tonnes /annum)	CO_2 Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	3.95		
Be Lean (after demand reduction)	3.77	0.18	4%
Be Clean (after efficiency measures)	3.58	0.19	5%

Be Green (after renewable energy)	2.58	1.00	25%
Total Cumulative Savings		1.37	35%

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

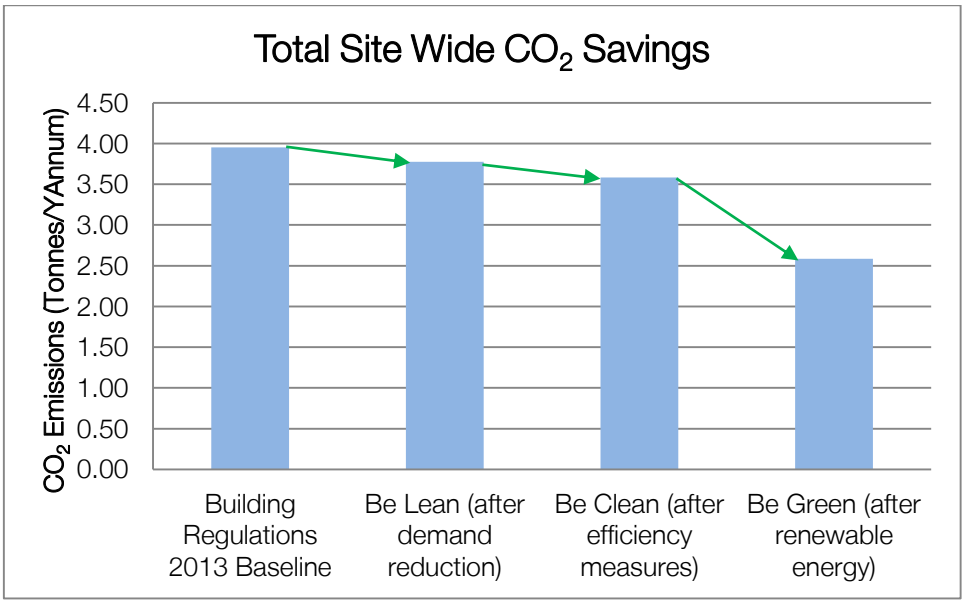


Figure 7-2 Summary of CO_2 savings (tonnes CO_2/annum) over Building Regulations 2013 baseline

The energy use for the Be Green case broken down in Table 7-2.

Be Green Emission Breakdown																
Regulated Energy & CO_2															Unregulated Energy & CO_2	
Type	Gas Demand				Electricity Demand								Total Energy (kWh/yr)	Total CO_2 (kg/yr)		
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Cooling (kWh/yr)	PV (kWh/yr)	Total (kWh/yr)	Electricity CO_2 ($kgCO_2$/yr)			Energy (kWh/yr)	CO_2 (kg/yr)
Residential	9,180	5,157	14,337	3,097	0	0	0	60	874	-1,922	-988	-513	15,271	2,584	5,055	2,623

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

8 Sustainability

8.1 Water Consumption

Internal potable water use will be limited to a maximum of 110 l/person/day, as per the optional requirement of Part G: Sanitation, Hot Water Safety and Water Efficiency Standard. This will be set through the specification of low flow fittings, dual flush toilets and smaller baths. All white goods, where provided, will have maximum water efficiency ratings.

The proposed fittings will meet the following specification (or similar) will be considered in order to meet the water consumption target:

- Taps – 5 l/min
- Baths – 170 litre overflow
- Showers - 8 l/min
- Dishwasher – 1.25 l/place setting
- Washing machine – 8 l/kg load
- WC – 4/2.6 litre dual flush
- Kitchen Taps – 6 l/min

9 Conclusion

Following the Be Lean, Be Clean and Be Green energy hierarchy, passive design measures, energy efficient equipment and LZC technologies have been shown to provide a 35% improvement over the Building Regulations Part L 2013 Target Emissions Rate (TER) and overall 16.1% saving in carbon emissions from the LZCs technologies.

The design team have made all reasonable endeavours to achieve the minimum requirements of the London Plan and the London Borough of Camden. Although the saving from renewables does not meet the required 20% under Camden Planning policy, it does achieve the required improvement over Building Regulations Part L 2013, in line with the London Plan and Camden policy. In addition, fabric improvements have been prioritised for the development, which will have a longer lasting impact on energy use than renewable technologies with a finite lifetime. The fabric U-Values are low and exceed current Building Regulations. Energy efficiency has been maximised throughout the M&E strategy and in the reduction of unregulated energy uses. The strategy therefore represents the best possible savings that could be achieved for this development.

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

Appendix A

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

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

Table B-1 Energy intensity values

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

Table B-2 Natural Gas and Electricity fuel prices

Renewable Technology Outputs	
PV panel size	0.86 x 1.61
PV panel rated output (kWp)	0.25
Efficiency (kWp/m^2)	0.18

Table B-2 PV Specification Details

Appendix B

SAP Calculations

Sample Report Ltd
1 Sample Street
Sampletown

Full SAP Calculation Printout

Property Reference: 25220 - 97a Camden Mews
Survey Reference: Be Lean - JCA v1.1
Property: 97a, London, NW1 9BU

Issued on Date: 20.Jun.2016
Prop Type Ref:

SAP Rating:	85 B	**CO2 Emissions (t/year):**	1.50	**DER:** 16.37 Pass	**TER:** 17.16	**Percentage DER<TER:**	4.63 %
Environmental:	86 B	**General Requirements Compliance:**	Pass	**DFEE:** 43.82 Pass	**TFEE:** 57.09	**Percentage DFEE<TFEE:**	23.23 %

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

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

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

CALCULATION DETAILS for survey reference no 'Be Lean - JCA v1.1'
SAP2012 - 9.92 input data (DesignData) -


```
SAP2012 Input Data (House)     21/06/2016

FullRefNo:                     Be Lean - JCA v1.1

Regs Region:                   England
SAP Region:                    Thames Valley
Postcode:                      NW1 9BU
DwellingOrientation:           South East
Property Type:                 House, Mid-Terrace
Storeys:                       3
Date Built:                    2016
Sheltered Sides:               2
Sunlight Shade:                Average or unknown
Measurements                   Perimeter, Floor Area, Storey Height
    1st Storey:               20.16, 39.8, 2.4
    2nd Storey:               20.16, 45.62, 2.78
    3rd Storey:               18.11, 28.77, 2.78
Living Area:                   25.21 m2, fraction: 22.1%
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                72.67, 104.43, 0, Other, Cavity, 0, 0.17, Gross
Clad Wall                      39.75, 50.35, 0, Other, Cavity, 0, 0.17, Gross
Party Walls                    Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                   64.6, 0, Other, FilledWithEdge, 0, 0
External Roofs                 Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
    Flat Roof                 47.62, 52.82, 0, Other, 0.13
Heat Loss Floors               Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
    Heat Loss Floor 1         39.8, 110, Slab on ground, screed over insulation, Ground Floor - Solid, 0, 0.1
    Exposed Floor             5.82, 0, Other, Exposed Floor - Solid, 0, 0.1
Description                    Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
    Door                      Manufacturer, Solid Door, , , , , , ,
    Windows                   Manufacturer, Window, Triple Low-E Soft 0.1, , , 0.57, , 0.7,
    Rooflight                 Manufacturer, Roof Window, Triple Low-E Soft 0.1, , , 0.57, , 0.7,
    French Doors              Manufacturer, Window, Triple Low-E Soft 0.1, , , 0.57, , 0.7,
Openings                       Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    Rooflight                 Roof Window, Flat Roof, South East, 0, None, , , 0, 0, 0, 5.20,
    SE F Window               Window, External Wall 1, South East, , None, 0, , 0, 0, 0, 8.92,
    SE F Windows SF           Window, Clad Wall, South East, , None, 0, , 0, 0, 0, 6.29,
    NW F Window               Window, External Wall 1, North West, , None, 0, , 0, 0, 0, 6.89,
    NW F FDoors               Window, External Wall 1, North West, , None, 0, , 0, 0, 0, 4.05,
    SW F FDoor                Window, External Wall 1, South West, , None, 0, , 0, 0, 0, 4.73,
    NE F Windows              Window, External Wall 1, North East, , None, 0, , 0, 0, 0, 2.79,
    NE F FDoor                Window, External Wall 1, North East, , None, 0, , 0, 0, 0, 2.03,
    NE F Windows SF           Window, Clad Wall, North East, , None, 0, , 0, 0, 0, 4.31,
    Front Door                Solid Door, External Wall 1, South East, , , , , 0, 0, 0, 2.35,
Conservatory:                  None
Draught Proofing:              100
Draught Lobby:                 No
Thermal Bridges
    Bridging:                 Calculate Bridges
    Y                         0.08
    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, 18.92, 0.3, 0.3, 5.68,
    1.                        External wall, E3 Sill, Table K1 - Approved, Yes, 17.84, 0.04, 0.04, 0.71,
    2.                        External wall, E4 Jamb, Table K1 - Approved, Yes, 71.64, 0.05, 0.05, 3.58,
    3.                        External wall, E5 Ground floor (normal), Table K1 - Approved, Yes, 20.16, 0.16, 0.16, 3.23,
    4.                        External wall, E6 Intermediate floor within a dwelling, Table K1 - Approved, Yes, 38.27, 0.07, 0.07, 2.68,
    5.                        External wall, E8 Balcony within a dwelling, wall insulation continuous, Table K1 - Approved, No, 4.87, 0, 0, 0.00,
    6.                        External wall, E16 Corner (normal), Table K1 - Approved, No, 21.48, 0.09, 0.09, 1.93,
    7.                        External wall, E17 Corner (inverted - internal area greater than external area), Table K1 - Approved, No, 13.14, -0.09, -0.09, -1.18,
    8.                        External wall, E18 Party wall between dwellings, Table K1 - Approved, Yes, 31.84, 0.06, 0.06, 1.91,
    9.                        External roof, R1 Head of roof window, Table K1 - Default, Yes, 3.08, 0.08, 0.08, 0.25,
    10.                       External roof, R2 Sill of roof window, Table K1 - Default, Yes, 3.08, 0.06, 0.06, 0.18,
    11.                       External roof, R3 Jamb of roof window, Table K1 - Default, Yes, 17.08, 0.08, 0.08, 1.37,
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:            4
Passive Vents:                0
Flueless Gas Fires:           0
Cooling System                None
Light Fittings:               16
LEL Fittings:                 12
Percentage of LEL Fittings:   75
External Lights Fitted:       Yes
External LELs Fitted:         Yes
Electricity Tariff:           Standard
Main Heating 1
    Description
    Percentage               100
    MHS                      Mains gas BGB Post 98 Regular condens. with auto ign.
    SAP Code                 102
    Boiler Efficiency Type   SAP Table
    Efficiency               88
    Model Name               tbc
    Manufacturer             tbc
    Controls by PCDF         0
    MHS Controls             CBI Time and temperature zone control
    Boiler Interlock         Yes
    Compensator              0
    Delayed Start Stat       No
    Ctrl SAP Code            2110
    Burner Control           OnOff
    Flue Type                None or Unknown
    Fan Assisted Flue        No
    Pumped                   Pump in heated space
    Heat Pump Age            2013 or later
    Heat Emitter             Underfloor
    Flow Temperature         Normal (> 45°C)
    Under Floor Heating      Yes - Pipes in thin screed
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
    Cylinder Type            HotWaterCylinder
    Cylinder Insulation Type Foam
    Cylinder Volume          300.00
    Cylinder Stat            Yes
    Pipeworks Insulated      Fully insulated primary pipework
    Cylinder in Heated Space Yes
    Separate Time Control    Yes
Flue Gas Heat Recovery System None
Waste Water Heat Recovery     none
PV Unit                       None
Wind Turbine                  None
Terrain Type:                 Urban
Small Scale Hydro             None
Special Features              None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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-Terrace House, total floor area 114 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) 17.16 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.37 kg/m²OK
-------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)57.1 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)43.8 kWh/m²OK
-------------------------------------------------------------------------------------------------
2 Fabric U-values
Element         Average                Highest
External wall   0.17 (max. 0.30)       0.17 (max. 0.70)          OK
Party wall      0.00 (max. 0.20)        -                        OK
Floor           0.10 (max. 0.25)       0.10 (max. 0.70)          OK
Roof            0.13 (max. 0.20)       0.13 (max. 0.35)          OK
Openings        0.82 (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

Efficiency: 88%
Minimum: 88%                                  OK

Secondary heating system:              None
-------------------------------------------------------------------------------------------------
5 Cylinder insulation
Hot water storage                      Nominal cylinder loss: 2.55 kWh/day
Permitted by DBSCG 2.86                       OK
Primary pipework insulated:            Yes                                           OK
```

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6 Controls

Space heating controls:	Time and temperature zone control	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
Boiler interlock	Yes	OK

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7 Low energy lights

Percentage of fixed lights with low-energy fittings:75%

Minimum	75%	OK

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8 Mechanical ventilation

Not applicable

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9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing North East:	9.13 m^2, No overhang	
Windows facing South East:	15.21 m^2, No overhang	
Windows facing South West:	4.73 m^2, No overhang	
Windows facing North West:	10.94 m^2, No overhang	
Air change rate:	8.00 ach	
Blinds/curtains:	None	

---

10 Key features

Party wall U-value	0.00 W/m^2K
Floor U-value	0.10 W/m^2K
Exposed floor U-value	0.10 W/m^2K
Window U-value	0.80 W/m^2K
Window U-value	0.80 W/m^2K
Roof window U-value	0.80 W/m^2K
Air permeability	3.0 m^3/m^2h

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	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		302.3242	(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							4 * 10 =		40.0000	(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) =	40.0000 / (5) =	0.1323	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2823	(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) =	0.2400	(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	0.3060	0.3000	0.2940	0.2640	0.2580	0.2280	0.2280	0.2220	0.2400	0.2580	0.2700	0.2820	(22b)
Effective ac	0.5468	0.5450	0.5432	0.5348	0.5333	0.5260	0.5260	0.5246	0.5288	0.5333	0.5364	0.5397	(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	
Door			2.3500	1.2000	2.8200			(26)
Windows (Uw = 0.80)			29.2000	0.7752	22.6357			(27)
French Doors (Uw = 0.80)			10.8100	0.7752	8.3798			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1000	3.9800			(28a)
Exposed Floor			5.8200	0.1000	0.5820			(28b)
External Wall 1	104.4300	31.7600	72.6700	0.1700	12.3539			(29a)
Clad Wall	50.3500	10.6000	39.7500	0.1700	6.7575			(29a)
Flat Roof	52.8200	5.2000	47.6200	0.1300	6.1906			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.7305			(33)
Party Wall 1			64.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.3347	(36)
Total fabric heat loss (33) + (36) =	88.0652	(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	54.5529	54.3716	54.1939	53.3591	53.2029	52.4758	52.4758	52.3412	52.7559	53.2029	53.5188	53.8492	(38)
Heat transfer coeff	142.6181	142.4368	142.2591	141.4243	141.2681	140.5410	140.5410	140.4064	140.8211	141.2681	141.5841	141.9144	(39)
Average = Sum(39)m / 12 =												141.4235	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2490	1.2474	1.2458	1.2385	1.2371	1.2308	1.2308	1.2296	1.2332	1.2371	1.2399	1.2428	(40)
HLP (average)												1.2385	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8378 (42)
Average daily hot water use (litres/day)	101.5971 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8598	21.7426	22.4364	19.5606	18.7688	16.1961	15.0080	17.2220	17.4276	20.3102	22.1702	24.0754	(46)

Water storage loss:		
Store volume	300.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115	(51)
Volume factor from Table 2a	0.7368	(52)
Temperature factor from Table 2b	0.5400	(53)
Enter (49) or (54) in (55)	1.3784	(55)

Total storage loss
42.7290 38.5939 42.7290 41.3506 42.7290 41.3506 42.7290 42.7290 41.3506 42.7290 41.3506 42.7290 (56)
If cylinder contains dedicated solar storage
42.7290 38.5939 42.7290 41.3506 42.7290 41.3506 42.7290 42.7290 41.3506 42.7290 41.3506 42.7290 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
231.7235 204.5555 215.5672 194.2664 191.1169 171.8365 166.0450 180.8044 180.0469 201.3929 211.6640 226.4941 (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
231.7235 204.5555 215.5672 194.2664 191.1169 171.8365 166.0450 180.8044 180.0469 201.3929 211.6640 226.4941 (64)
Total per year (kWh/year) = Sum(64)m = 2375.5133 (64)
Heat gains from water heating, kWh/month
107.8990 95.8801 102.5271 94.4494 94.3973 86.9914 86.0609 90.9684 89.7214 97.8141 100.2341 106.1603 (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	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
30.9179 27.4610 22.3328 16.9074 12.6384 10.6699 11.5292 14.9861 20.1143 25.5398 29.8087 31.7772 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
277.4438 280.3228 273.0678 257.6228 238.1263 219.8023 207.5607 204.6817 211.9367 227.3817 246.8782 265.2022 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
37.1889 37.1889 37.1889 37.1889 37.1889 37.1889 37.1889 37.1889 37.1889 37.1889 37.1889 37.1889 (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)
-113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 (71)
Water heating gains (Table 5)
145.0256 142.6787 137.8052 131.1797 126.8782 120.8214 115.6733 122.2694 124.6130 131.4706 139.2140 142.6885 (72)
Total internal gains
521.9538 519.0291 501.7724 474.2764 446.2095 419.8601 403.3298 410.5038 425.2306 452.9586 484.4674 508.2345 (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	7.1000	11.2829	0.5700	0.7000	0.7700	22.1507	(75)
Southeast	15.2100	36.7938	0.5700	0.7000	0.7700	154.7428	(77)
Northwest	6.8900	11.2829	0.5700	0.7000	0.7700	21.4955	(81)
Southeast	5.2000	26.0000	0.5700	0.7000	1.0000	48.5503	(82)
Northeast	2.0300	11.2829	0.5700	0.7000	0.7700	6.3332	(75)
Southwest	4.7300	36.7938	0.5700	0.7000	0.7700	48.1218	(79)
Northwest	4.0500	11.2829	0.5700	0.7000	0.7700	12.6352	(81)

Solar gains	314.0296	573.8427	881.6955	1243.0425	1521.6211	1565.3253	1486.5338	1271.7742	1006.4951	660.9121	383.3920	263.9578	(83)
Total gains	835.9834	1092.8718	1383.4678	1717.3189	1967.8306	1985.1854	1889.8636	1682.2780	1431.7257	1113.8707	867.8595	772.1923	(84)

---
7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.6021	55.6728	55.7424	56.0714	56.1334	56.4238	56.4238	56.4779	56.3116	56.1334	56.0081	55.8778	
alpha	4.7068	4.7115	4.7162	4.7381	4.7422	4.7616	4.7616	4.7652	4.7541	4.7422	4.7339	4.7252	
util living area	0.9953	0.9838	0.9443	0.8243	0.6314	0.4473	0.3261	0.3814	0.6400	0.9183	0.9883	0.9967	(86)
MIT	20.0034	20.2042	20.4839	20.7632	20.8995	20.9361	20.9418	20.9405	20.9093	20.6718	20.2689	19.9633	(87)
Th 2	19.8810	19.8823	19.8835	19.8893	19.8904	19.8955	19.8955	19.8964	19.8935	19.8904	19.8882	19.8859	(88)
util rest of house	0.9937	0.9787	0.9277	0.7821	0.5675	0.3727	0.2448	0.2912	0.5522	0.8861	0.9837	0.9956	(89)
MIT 2	18.5618	18.8531	19.2484	19.6179	19.7708	19.8082	19.8117	19.8122	19.7875	19.5172	18.9538	18.5072	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	18.8801	19.1514	19.5211	19.8708	20.0200	20.0572	20.0612	20.0613	20.0352	19.7721	19.2441	18.8286	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8801	19.1514	19.5211	19.8708	20.0200	20.0572	20.0612	20.0613	20.0352	19.7721	19.2441	18.8286	(93)

---
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9918	0.9743	0.9212	0.7814	0.5753	0.3838	0.2571	0.3048	0.5641	0.8820	0.9801	0.9941	(94)
Useful gains	829.0871	1064.7715	1274.5139	1341.8289	1132.0088	761.8532	485.8715	512.8100	807.6027	982.3864	850.6269	767.6452	(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	2079.3864	2029.9194	1852.3767	1551.5314	1175.3481	766.9563	486.4357	514.0678	835.7998	1295.7279	1719.4108	2076.0148	(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	930.2226	648.5794	429.9299	150.9858	32.2444	0.0000	0.0000	0.0000	0.0000	233.1261	625.5244	973.4270	(98)
Space heating												4024.0396	(98)
Space heating per m2											(98) / (4) =	35.2399	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	88.0000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	4572.7723 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	930.2226	648.5794	429.9299	150.9858	32.2444	0.0000	0.0000	0.0000	0.0000	233.1261	625.5244	973.4270	(98)
Space heating efficiency (main heating system 1)													
	88.0000	88.0000	88.0000	88.0000	88.0000	0.0000	0.0000	0.0000	0.0000	88.0000	88.0000	88.0000	(210)
Space heating fuel (main heating system)													
	1057.0712	737.0221	488.5567	171.5747	36.6414	0.0000	0.0000	0.0000	0.0000	264.9160	710.8232	1106.1670	(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													
	231.7235	204.5555	215.5672	194.2664	191.1169	171.8365	166.0450	180.8044	180.0469	201.3929	211.6640	226.4941	(64)
Efficiency of water heater												88.0000	(216)
(217)m	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	(217)
Fuel for water heating, kWh/month													
	263.3222	232.4494	244.9627	220.7573	217.1783	195.2687	188.6875	205.4595	204.5987	228.8556	240.5273	257.3796	(219)
Water heating fuel used												2699.4469	(219)
Annual totals kWh/year													
Space heating fuel - main system												4572.7723	(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)	546.0197 (232)
Total delivered energy for all uses	7848.2389 (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	4572.7723	0.2160	987.7188	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2699.4469	0.2160	583.0805	(264)
Space and water heating			1570.7993	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	546.0197	0.5190	283.3842	(268)
Total CO2, kg/year			1869.7536	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.3700	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES			
DER		16.3700	ZC1
Total Floor Area	TFA	114.1900	
Assumed number of occupants	N	2.8378	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.3977	ZC2
CO2 emissions from cooking, equation (L16)		1.6386	ZC3
Total CO2 emissions		32.4063	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		32.4063	ZC8

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	302.3242	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =	0.1323	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3823	(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) =	0.3250	(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	0.4143	0.4062	0.3981	0.3575	0.3493	0.3087	0.3087	0.3006	0.3250	0.3493	0.3656	0.3818	(22b)
Effective ac	0.5858	0.5825	0.5792	0.5639	0.5610	0.5477	0.5477	0.5452	0.5528	0.5610	0.5668	0.5729	(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			2.3500	1.0000	2.3500			(26)
TER Opening Type (Uw = 1.40)			23.1900	1.3258	30.7443			(27)
TER Room Window (Uw = 1.70)			3.0200	1.5918	4.8071			(27a)
Heat Loss Floor 1			39.8000	0.1300	5.1740			(28a)
Exposed Floor			5.8200	0.1300	0.7566			(28b)
External Wall 1	104.4300	19.4100	85.0200	0.1800	15.3036			(29a)
Clad Wall	50.3500	6.1300	44.2200	0.1800	7.9596			(29a)
Flat Roof	52.8200	3.0200	49.8000	0.1300	6.4740			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	73.5692			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1042 (36)
Total fabric heat loss	(33) + (36) =	86.6734 (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	58.4468	58.1143	57.7884	56.2574	55.9710	54.6376	54.6376	54.3907	55.1512	55.9710	56.5504	57.1562	(38)
Heat transfer coeff	145.1203	144.7877	144.4618	142.9309	142.6444	141.3110	141.3110	141.0641	141.8246	142.6444	143.2239	143.8297	(39)
Average = Sum(39)m / 12 =												142.9295	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2709	1.2680	1.2651	1.2517	1.2492	1.2375	1.2375	1.2353	1.2420	1.2492	1.2543	1.2596	(40)
HLP (average)												1.2517	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8378 (42)
Average daily hot water use (litres/day)	101.5971 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8598	21.7426	22.4364	19.5606	18.7688	16.1961	15.0080	17.2220	17.4276	20.3102	22.1702	24.0754	(46)

Water storage loss:	
Store volume	300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	2.1127 (48)
Temperature factor from Table 2b	0.5400 (49)
Enter (49) or (54) in (55)	1.1409 (55)

Total storage loss	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)
If cylinder contains dedicated solar storage	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(57)

Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	224.3609	197.9054	208.2046	187.1414	183.7544	164.7114	158.6825	173.4418	172.9218	194.0303	204.5389	219.1315	(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													
	224.3609	197.9054	208.2046	187.1414	183.7544	164.7114	158.6825	173.4418	172.9218	194.0303	204.5389	219.1315	(64)
Total per year (kWh/year) = Sum(64)m =												2288.8250	(64)
Heat gains from water heating, kWh/month													
	102.0090	90.5600	96.6370	88.7493	88.5073	81.2914	80.1709	85.0784	84.0213	91.9241	94.5340	100.2702	(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	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.7343	21.9688	17.8662	13.5259	10.1108	8.5359	9.2234	11.9889	16.0915	20.4318	23.8469	25.4218	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	277.4438	280.3228	273.0678	257.6228	238.1263	219.8023	207.5607	204.6817	211.9367	227.3817	246.8782	265.2022	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	(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)													
	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	(71)
Water heating gains (Table 5)													
	137.1088	134.7620	129.8884	123.2629	118.9614	112.9047	107.7566	114.3527	116.6963	123.5538	131.2972	134.7718	(72)
Total internal gains													
	507.8535	505.6201	489.3891	462.9782	435.7650	409.8094	393.1072	399.5898	413.2910	439.9339	470.5890	493.9623	(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	5.2800	11.2829	0.6300	0.7000	0.7700	18.2066	(75)
Southeast	8.8200	36.7938	0.6300	0.7000	0.7700	99.1780	(77)
Southwest	2.7400	36.7938	0.6300	0.7000	0.7700	30.8104	(79)
Northwest	6.3500	11.2829	0.6300	0.7000	0.7700	21.8962	(81)
Southeast	3.0200	26.0000	0.6300	0.7000	1.0000	31.1646	(82)

Solar gains	201.2557	367.7751	565.0953	796.7048	975.2590	1003.2702	952.7703	815.1223	645.0880	423.5832	245.7108	169.1643	(83)
Total gains	709.1093	873.3952	1054.4843	1259.6830	1411.0240	1413.0796	1345.8775	1214.7121	1058.3790	863.5172	716.2998	663.1267	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.6434	54.7689	54.8924	55.4804	55.5918	56.1164	56.1164	56.2146	55.9131	55.5918	55.3669	55.1337	
alpha	4.6429	4.6513	4.6595	4.6987	4.7061	4.7411	4.7411	4.7476	4.7275	4.7061	4.6911	4.6756	
util living area													
	0.9976	0.9935	0.9793	0.9267	0.7984	0.6099	0.4555	0.5212	0.7916	0.9657	0.9947	0.9983	(86)
MIT	19.6190	19.8217	20.1445	20.5461	20.8384	20.9656	20.9930	20.9872	20.8861	20.4752	19.9682	19.5854	(87)
Th 2	19.8637	19.8660	19.8683	19.8789	19.8809	19.8901	19.8901	19.8918	19.8865	19.8809	19.8768	19.8726	(88)
util rest of house													
	0.9968	0.9912	0.9720	0.9016	0.7386	0.5165	0.3440	0.4022	0.7072	0.9490	0.9925	0.9977	(89)
MIT 2	18.0347	18.3316	18.7990	19.3662	19.7332	19.8692	19.8878	19.8870	19.8010	19.2840	18.5540	17.9917	(90)
Living area fraction										fLA = Living area / (4) =		0.2208	(91)
MIT	18.3845	18.6606	19.0961	19.6267	19.9772	20.1112	20.1318	20.1299	20.0406	19.5470	18.8662	18.3436	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3845	18.6606	19.0961	19.6267	19.9772	20.1112	20.1318	20.1299	20.0406	19.5470	18.8662	18.3436	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9952	0.9878	0.9653	0.8948	0.7443	0.5360	0.3687	0.4285	0.7203	0.9424	0.9895	0.9964	(94)
Useful gains	705.7038	862.7070	1017.9231	1127.1698	1050.1675	757.3556	496.2211	520.4925	762.3630	813.7438	708.8000	660.7558	(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													
	2043.9474	1992.3640	1819.6506	1533.1757	1180.6931	778.7972	499.0771	526.1554	842.5190	1276.2431	1685.2015	2034.2631	(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													
	995.6532	759.1295	596.4853	292.3242	97.1111	0.0000	0.0000	0.0000	0.0000	344.0995	703.0091	1021.8894	(98)
Space heating												4809.7012	(98)
Space heating per m2											(98) / (4) =	42.1202	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5144.0654	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	995.6532	759.1295	596.4853	292.3242	97.1111	0.0000	0.0000	0.0000	0.0000	344.0995	703.0091	1021.8894	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1064.8697	811.9032	637.9521	312.6462	103.8621	0.0000	0.0000	0.0000	0.0000	368.0208	751.8814	1092.9298	(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													
	224.3609	197.9054	208.2046	187.1414	183.7544	164.7114	158.6825	173.4418	172.9218	194.0303	204.5389	219.1315	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.3221	88.0584	87.4656	85.9992	83.2012	79.8000	79.8000	79.8000	79.8000	86.3264	87.8454	88.4069	(217)
Fuel for water heating, kWh/month													
	254.0257	224.7435	238.0418	217.6082	220.8554	206.4053	198.8502	217.3456	216.6940	224.7635	232.8398	247.8670	(219)
Water heating fuel used												2700.0401	(219)
Annual totals kWh/year													
Space heating fuel - main system												5144.0654	(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)												436.8157	(232)
Total delivered energy for all uses												8355.9213	(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	5144.0654	0.2160	1111.1181	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2700.0401	0.2160	583.2087	(264)
Space and water heating			1694.3268	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	436.8157	0.5190	226.7074	(268)
Total CO2, kg/m2/year			1959.9592	(272)
Emissions per m2 for space and water heating			14.8378	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9854	(272b)
Emissions per m2 for pumps and fans			0.3409	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8378 * 1.00) + 1.9854 + 0.3409, rounded to 2 d.p.			17.1600	(273)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	302.3242	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =	0.1323	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2823	(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) =	0.2400	(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	0.3060	0.3000	0.2940	0.2640	0.2580	0.2280	0.2280	0.2220	0.2400	0.2580	0.2700	0.2820	(22b)
Effective ac	0.5468	0.5450	0.5432	0.5348	0.5333	0.5260	0.5260	0.5246	0.5288	0.5333	0.5364	0.5397	(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	
Door			2.3500	1.2000	2.8200			(26)
Windows (Uw = 0.80)			29.2000	0.7752	22.6357			(27)
French Doors (Uw = 0.80)			10.8100	0.7752	8.3798			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1000	3.9800			(28a)
Exposed Floor			5.8200	0.1000	0.5820			(28b)
External Wall 1	104.4300	31.7600	72.6700	0.1700	12.3539			(29a)
Clad Wall	50.3500	10.6000	39.7500	0.1700	6.7575			(29a)
Flat Roof	52.8200	5.2000	47.6200	0.1300	6.1906			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.7305			(33)
Party Wall 1			64.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		20.3347 (36)
Total fabric heat loss	(33) + (36) =	88.0652 (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	54.5529	54.3716	54.1939	53.3591	53.2029	52.4758	52.4758	52.3412	52.7559	53.2029	53.5188	53.8492	(38)
Heat transfer coeff	142.6181	142.4368	142.2591	141.4243	141.2681	140.5410	140.5410	140.4064	140.8211	141.2681	141.5841	141.9144	(39)
Average = Sum(39)m / 12 =												141.4235	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2490	1.2474	1.2458	1.2385	1.2371	1.2308	1.2308	1.2296	1.2332	1.2371	1.2399	1.2428	(40)
HLP (average)												1.2385	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8378 (42)
Average daily hot water use (litres/day)		101.5971 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													

	35.2181	30.8020	31.7849	27.7108	26.5892	22.9444	21.2614	24.3978	24.6892	28.7728	31.4078	34.1068 (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	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	(66)

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

	24.7343	21.9688	17.8662	13.5259	10.1108	8.5359	9.2234	11.9889	16.0915	20.4318	23.8469	25.4218	(67)

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

	277.4438	280.3228	273.0678	257.6228	238.1263	219.8023	207.5607	204.6817	211.9367	227.3817	246.8782	265.2022	(68)

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

	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	(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)

	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	(71)

Water heating gains (Table 5)													
	47.3361	45.8362	42.7216	38.4872	35.7381	31.8673	28.5771	32.7927	34.2905	38.6732	43.6219	45.8425	(72)
Total internal gains													
	415.0808	413.6944	399.2222	375.2025	349.5418	325.7721	310.9278	315.0299	327.8852	352.0532	379.9137	402.0331	(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	7.1000	11.2829	0.5700	0.7000	0.7700	22.1507	(75)
Southeast	15.2100	36.7938	0.5700	0.7000	0.7700	154.7428	(77)
Northwest	6.8900	11.2829	0.5700	0.7000	0.7700	21.4955	(81)
Southeast	5.2000	26.0000	0.5700	0.7000	1.0000	48.5503	(82)
Northeast	2.0300	11.2829	0.5700	0.7000	0.7700	6.3332	(75)
Southwest	4.7300	36.7938	0.5700	0.7000	0.7700	48.1218	(79)
Northwest	4.0500	11.2829	0.5700	0.7000	0.7700	12.6352	(81)

Solar gains	314.0296	573.8427	881.6955	1243.0425	1521.6211	1565.3253	1486.5338	1271.7742	1006.4951	660.9121	383.3920	263.9578	(83)
Total gains	729.1104	987.5371	1280.9177	1618.2450	1871.1629	1891.0973	1797.4616	1586.8040	1334.3803	1012.9653	763.3057	665.9909	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.6021	55.6728	55.7424	56.0714	56.1334	56.4238	56.4238	56.4779	56.3116	56.1334	56.0081	55.8778	
alpha	4.7068	4.7115	4.7162	4.7381	4.7422	4.7616	4.7616	4.7652	4.7541	4.7422	4.7339	4.7252	
util living area													
	0.9974	0.9892	0.9571	0.8480	0.6571	0.4683	0.3426	0.4037	0.6759	0.9396	0.9931	0.9983	(86)
MIT	19.6633	19.9362	20.3236	20.7256	20.9318	20.9887	20.9980	20.9957	20.9435	20.5811	20.0209	19.6094	(87)
Th 2	19.8810	19.8823	19.8835	19.8893	19.8904	19.8955	19.8955	19.8964	19.8935	19.8904	19.8882	19.8859	(88)
util rest of house													
	0.9965	0.9856	0.9437	0.8086	0.5926	0.3907	0.2574	0.3086	0.5871	0.9137	0.9902	0.9977	(89)
MIT 2	18.6727	18.9443	19.3216	19.6905	19.8514	19.8911	19.8950	19.8954	19.8672	19.5772	19.0347	18.6229	(90)
Living area fraction										fLA = Living area / (4) =		0.2208	(91)
MIT	18.8914	19.1633	19.5428	19.9191	20.0899	20.1335	20.1385	20.1383	20.1048	19.7988	19.2524	18.8407	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8914	19.1633	19.5428	19.9191	20.0899	20.1335	20.1385	20.1383	20.1048	19.7988	19.2524	18.8407	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9953	0.9825	0.9387	0.8098	0.6047	0.4077	0.2762	0.3296	0.6051	0.9111	0.9880	0.9969	(94)
Useful gains	725.7008	970.2988	1202.3831	1310.4575	1131.4845	770.9818	496.5152	523.0740	807.4277	922.8673	754.1596	663.8945	(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													
	2081.0023	2031.6142	1855.4594	1558.3617	1185.2243	777.6773	497.3079	524.8807	845.6059	1299.4982	1720.5887	2077.7257	(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													
	1008.3443	713.2040	485.8888	178.4910	39.9824	0.0000	0.0000	0.0000	0.0000	280.2134	695.8289	1051.8904	(98)
Space heating												4453.8433	(98)
Space heating per m2											(98) / (4) =	39.0038	(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	1321.0857	1040.0036	1067.0885	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9662	0.9835	0.9718	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1276.4483	1022.8642	1037.0434	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2259.4386	2150.9701	1916.8730	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	707.7530	839.3108	654.5932	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												2201.6570	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	176.9383	209.8277	163.6483	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												550.4143	(107)
Space cooling per m2												4.8202	(108)
Energy for space heating												39.0038	(99)

Energy for space cooling	4.8202 (108)
Total	43.8240 (109)
Dwelling Fabric Energy Efficiency (DFEE)	43.8 (109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	302.3242	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =	0.1323	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3823	(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) =	0.3250	(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	0.4143	0.4062	0.3981	0.3575	0.3493	0.3087	0.3087	0.3006	0.3250	0.3493	0.3656	0.3818	(22b)
Effective ac	0.5858	0.5825	0.5792	0.5639	0.5610	0.5477	0.5477	0.5452	0.5528	0.5610	0.5668	0.5729	(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			2.3500	1.0000	2.3500			(26)
TER Opening Type (Uw = 1.40)			23.1900	1.3258	30.7443			(27)
TER Room Window (Uw = 1.70)			3.0200	1.5918	4.8071			(27a)
Heat Loss Floor 1			39.8000	0.1300	5.1740			(28a)
Exposed Floor			5.8200	0.1300	0.7566			(28b)
External Wall 1	104.4300	19.4100	85.0200	0.1800	15.3036			(29a)
Clad Wall	50.3500	6.1300	44.2200	0.1800	7.9596			(29a)
Flat Roof	52.8200	3.0200	49.8000	0.1300	6.4740			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	73.5692			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1042 (36)
Total fabric heat loss	(33) + (36) =	86.6734 (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	58.4468	58.1143	57.7884	56.2574	55.9710	54.6376	54.6376	54.3907	55.1512	55.9710	56.5504	57.1562	(38)
Heat transfer coeff	145.1203	144.7877	144.4618	142.9309	142.6444	141.3110	141.3110	141.0641	141.8246	142.6444	143.2239	143.8297	(39)
Average = Sum(39)m / 12 =												142.9295	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2709	1.2680	1.2651	1.2517	1.2492	1.2375	1.2375	1.2353	1.2420	1.2492	1.2543	1.2596	(40)
HLP (average)												1.2517	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8378 (42)
Average daily hot water use (litres/day)		101.5971 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.2181	30.8020	31.7849	27.7108	26.5892	22.9444	21.2614	24.3978	24.6892	28.7728	31.4078	34.1068	(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	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	(66)

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

	24.7343	21.9688	17.8662	13.5259	10.1108	8.5359	9.2234	11.9889	16.0915	20.4318	23.8469	25.4218	(67)

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

	277.4438	280.3228	273.0678	257.6228	238.1263	219.8023	207.5607	204.6817	211.9367	227.3817	246.8782	265.2022	(68)

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

	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	(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)

	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	(71)

Water heating gains (Table 5)

	47.3361	45.8362	42.7216	38.4872	35.7381	31.8673	28.5771	32.7927	34.2905	38.6732	43.6219	45.8425	(72)

Total internal gains

	415.0808	413.6944	399.2222	375.2025	349.5418	325.7721	310.9278	315.0299	327.8852	352.0532	379.9137	402.0331	(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	5.2800	11.2829	0.6300	0.7000	0.7700	18.2066	(75)
Southeast	8.8200	36.7938	0.6300	0.7000	0.7700	99.1780	(77)
Southwest	2.7400	36.7938	0.6300	0.7000	0.7700	30.8104	(79)
Northwest	6.3500	11.2829	0.6300	0.7000	0.7700	21.8962	(81)
Southeast	3.0200	26.0000	0.6300	0.7000	1.0000	31.1646	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	201.2557	367.7751	565.0953	796.7048	975.2590	1003.2702	952.7703	815.1223	645.0880	423.5832	245.7108	169.1643	(83)
Total gains	616.3365	781.4695	964.3175	1171.9073	1324.8008	1329.0422	1263.6981	1130.1521	972.9732	775.6365	625.6245	571.1974	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.6434	54.7689	54.8924	55.4804	55.5918	56.1164	56.1164	56.2146	55.9131	55.5918	55.3669	55.1337	
alpha	4.6429	4.6513	4.6595	4.6987	4.7061	4.7411	4.7411	4.7476	4.7275	4.7061	4.6911	4.6756	
util living area	0.9987	0.9959	0.9853	0.9419	0.8253	0.6411	0.4832	0.5559	0.8278	0.9769	0.9970	0.9991	(86)
MIT	19.5451	19.7497	20.0780	20.4948	20.8116	20.9576	20.9910	20.9832	20.8599	20.4137	19.8966	19.5117	(87)
Th 2	19.8637	19.8660	19.8683	19.8789	19.8809	19.8901	19.8901	19.8918	19.8865	19.8809	19.8768	19.8726	(88)
util rest of house	0.9982	0.9944	0.9799	0.9208	0.7687	0.5458	0.3659	0.4310	0.7487	0.9649	0.9957	0.9988	(89)
MIT 2	18.5413	18.7470	19.0738	19.4831	19.7608	19.8721	19.8880	19.8874	19.8119	19.4160	18.9026	18.5150	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	18.7629	18.9684	19.2955	19.7064	19.9928	20.1118	20.1315	20.1294	20.0433	19.6362	19.1221	18.7350	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7629	18.9684	19.2955	19.7064	19.9928	20.1118	20.1315	20.1294	20.0433	19.6362	19.1221	18.7350	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9976	0.9928	0.9763	0.9168	0.7750	0.5658	0.3920	0.4588	0.7615	0.9614	0.9945	0.9983	(94)
Useful gains	614.8626	775.8531	941.4997	1074.4391	1026.7676	752.0334	495.3373	518.5310	740.8794	745.6900	622.1652	570.2338	(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	2098.8551	2036.9305	1848.4579	1544.5710	1182.9233	778.8776	499.0441	526.0778	842.9058	1288.9670	1721.8476	2090.5694	(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	1104.0904	847.4440	674.7769	338.4950	116.1798	0.0000	0.0000	0.0000	0.0000	404.1981	791.7713	1131.1296	(98)
Space heating												5408.0851	(98)
Space heating per m2											(98) / (4) =	47.3604	(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	1328.3238	1045.7017	1072.0873	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8976	0.9436	0.9160	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1192.3430	986.7148	982.0682	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1625.0700	1548.4277	1400.8485	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	311.5634	417.9144	311.5725	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1041.0503	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	77.8909	104.4786	77.8931	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												260.2626	(107)
Space cooling per m2												2.2792	(108)
Energy for space heating												47.3604	(99)
Energy for space cooling												2.2792	(108)
Total												49.6396	(109)
Target Fabric Energy Efficiency (TFEE)												57.1	(109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	302.3242	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =	0.1323	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2823	(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) =	0.2400	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.5000	3.4000	3.4000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8750	0.8500	0.8500	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.2580	0.2460	0.2460	0.2280	0.2340	0.2040	0.2100	0.2040	0.2040	0.2220	0.2160	0.2400	(22b)
Effective ac	0.5333	0.5302	0.5302	0.5260	0.5274	0.5208	0.5220	0.5208	0.5208	0.5246	0.5233	0.5288	(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	
Door			2.3500	1.2000	2.8200			(26)
Windows (Uw = 0.80)			29.2000	0.7752	22.6357			(27)
French Doors (Uw = 0.80)			10.8100	0.7752	8.3798			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1000	3.9800			(28a)
Exposed Floor			5.8200	0.1000	0.5820			(28b)
External Wall 1	104.4300	31.7600	72.6700	0.1700	12.3539			(29a)
Clad Wall	50.3500	10.6000	39.7500	0.1700	6.7575			(29a)
Flat Roof	52.8200	5.2000	47.6200	0.1300	6.1906			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.7305			(33)
Party Wall 1			64.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.3347	(36)
Total fabric heat loss (33) + (36) =	88.0652	(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	53.2029	52.9013	52.9013	52.4758	52.6140	51.9588	52.0827	51.9588	51.9588	52.3412	52.2101	52.7559	(38)
Heat transfer coeff	141.2681	140.9665	140.9665	140.5410	140.6793	140.0240	140.1479	140.0240	140.0240	140.4064	140.2753	140.8211	(39)

Average = Sum(39)m / 12 = 140.5120 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2371	1.2345	1.2345	1.2308	1.2320	1.2262	1.2273	1.2262	1.2262	1.2296	1.2284	1.2332	(40)
HLP (average)												1.2305	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8378	(42)
Average daily hot water use (litres/day)	101.5971	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8598	21.7426	22.4364	19.5606	18.7688	16.1961	15.0080	17.2220	17.4276	20.3102	22.1702	24.0754	(46)

Water storage loss:		
Store volume	300.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115	(51)
Volume factor from Table 2a	0.7368	(52)
Temperature factor from Table 2b	0.5400	(53)
Enter (49) or (54) in (55)	1.3784	(55)

Total storage loss
42.7290 38.5939 42.7290 41.3506 42.7290 41.3506 42.7290 42.7290 41.3506 42.7290 41.3506 42.7290 (56)
If cylinder contains dedicated solar storage
42.7290 38.5939 42.7290 41.3506 42.7290 41.3506 42.7290 42.7290 41.3506 42.7290 41.3506 42.7290 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
231.7235 204.5555 215.5672 194.2664 191.1169 171.8365 166.0450 180.8044 180.0469 201.3929 211.6640 226.4941 (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
231.7235 204.5555 215.5672 194.2664 191.1169 171.8365 166.0450 180.8044 180.0469 201.3929 211.6640 226.4941 (64)
Total per year (kWh/year) = Sum(64)m = 2375.5133 (64)
RHI water heating demand 2376 (64)
Heat gains from water heating, kWh/month
107.8990 95.8801 102.5271 94.4494 94.3973 86.9914 86.0609 90.9684 89.7214 97.8141 100.2341 106.1603 (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	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
77.2947 68.6525 55.8320 42.2684 31.5961 26.6748 28.8230 37.4653 50.2858 63.8494 74.5217 79.4430 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
414.0952 418.3922 407.5639 384.5116 355.4123 328.0631 309.7921 305.4951 316.3234 339.3757 368.4750 395.8242 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 (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)
-113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 (71)
Water heating gains (Table 5)
145.0256 142.6787 137.8052 131.1797 126.8782 120.8214 115.6733 122.2694 124.6130 131.4706 139.2140 142.6885 (72)
Total internal gains
751.0354 744.3433 715.8209 672.5796 628.5065 590.1791 568.9083 579.8496 605.8421 649.3155 696.8304 732.5756 (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	7.1000	12.4885	0.5700	0.7000	0.7700	24.5174	(75)
Southeast	15.2100	39.0225	0.5700	0.7000	0.7700	164.1157	(77)
Northwest	6.8900	12.4885	0.5700	0.7000	0.7700	23.7923	(81)
Southeast	5.2000	29.0000	0.5700	0.7000	1.0000	54.1523	(82)
Northeast	2.0300	12.4885	0.5700	0.7000	0.7700	7.0099	(75)
Southwest	4.7300	39.0225	0.5700	0.7000	0.7700	51.0366	(79)
Northwest	4.0500	12.4885	0.5700	0.7000	0.7700	13.9853	(81)

Solar gains	338.6095	557.0700	862.8518	1260.5061	1503.9990	1652.1925	1564.9580	1379.9906	1083.3225	701.8614	427.2371	279.2287	(83)
Total gains	1089.6449	1301.4132	1578.6727	1933.0857	2132.5054	2242.3716	2133.8663	1959.8402	1689.1646	1351.1769	1124.0675	1011.8043	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.1334	56.2535	56.2535	56.4238	56.3684	56.6322	56.5821	56.6322	56.6322	56.4779	56.5307	56.3116	
alpha	4.7422	4.7502	4.7502	4.7616	4.7579	4.7755	4.7721	4.7755	4.7755	4.7652	4.7687	4.7541	
util living area													
	0.9808	0.9582	0.8790	0.6952	0.4798	0.2743	0.1576	0.1857	0.4266	0.7824	0.9533	0.9856	(86)
MIT	20.2708	20.4245	20.6812	20.8715	20.9321	20.9426	20.9431	20.9431	20.9386	20.8431	20.5285	20.2312	(87)
Th 2	19.8904	19.8925	19.8925	19.8955	19.8945	19.8991	19.8982	19.8991	19.8991	19.8964	19.8973	19.8935	(88)
util rest of house													
	0.9745	0.9455	0.8467	0.6379	0.4115	0.2059	0.0853	0.1071	0.3385	0.7170	0.9363	0.9807	(89)
MIT 2	18.9557	19.1737	19.5191	19.7469	19.8039	19.8157	19.8150	19.8159	19.8139	19.7260	19.3274	18.9017	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	19.2460	19.4499	19.7757	19.9952	20.0530	20.0645	20.0640	20.0648	20.0622	19.9726	19.5926	19.1952	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2460	19.4499	19.7757	19.9952	20.0530	20.0645	20.0640	20.0648	20.0622	19.9726	19.5926	19.1952	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9698	0.9392	0.8429	0.6434	0.4215	0.2162	0.0962	0.1189	0.3517	0.7220	0.9305	0.9767	(94)
Useful gains	1056.7369	1222.3079	1330.5907	1243.7313	898.7762	484.8600	205.1788	233.0973	594.1247	975.5169	1045.9052	988.1937	(95)
Ext temp.	5.6000	6.1000	8.1000	10.6000	13.6000	16.6000	18.6000	18.4000	15.8000	12.3000	8.5000	5.6000	(96)
Heat loss rate W													
	1927.7459	1881.8843	1645.8789	1320.4051	907.8051	485.1141	205.1814	233.1052	596.8156	1077.2820	1556.0161	1914.4965	(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													
	648.0307	443.2354	234.5744	55.2051	6.7175	0.0000	0.0000	0.0000	0.0000	75.7133	367.2798	689.1693	(98)
Space heating												2519.9254	(98)
RHI space heating demand												2520	(98)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	302.3242	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =	0.1323	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2823	(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) =	0.2400	(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	0.3060	0.3000	0.2940	0.2640	0.2580	0.2280	0.2280	0.2220	0.2400	0.2580	0.2700	0.2820	(22b)
Effective ac	0.5468	0.5450	0.5432	0.5348	0.5333	0.5260	0.5260	0.5246	0.5288	0.5333	0.5364	0.5397	(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	
Door			2.3500	1.2000	2.8200			(26)
Windows (Uw = 0.80)			29.2000	0.7752	22.6357			(27)
French Doors (Uw = 0.80)			10.8100	0.7752	8.3798			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1000	3.9800			(28a)
Exposed Floor			5.8200	0.1000	0.5820			(28b)
External Wall 1	104.4300	31.7600	72.6700	0.1700	12.3539			(29a)
Clad Wall	50.3500	10.6000	39.7500	0.1700	6.7575			(29a)
Flat Roof	52.8200	5.2000	47.6200	0.1300	6.1906			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.7305			(33)
Party Wall 1			64.6000	0.0000	0.0000			(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							20.3347	(36)
Total fabric heat loss					(33) + (36) =		88.0652	(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	54.5529	54.3716	54.1939	53.3591	53.2029	52.4758	52.4758	52.3412	52.7559	53.2029	53.5188	53.8492	(38)
Heat transfer coeff	142.6181	142.4368	142.2591	141.4243	141.2681	140.5410	140.5410	140.4064	140.8211	141.2681	141.5841	141.9144	(39)
Average = Sum(39)m / 12 =												141.4235	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2490	1.2474	1.2458	1.2385	1.2371	1.2308	1.2308	1.2296	1.2332	1.2371	1.2399	1.2428	(40)
HLP (average)												1.2385	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8378 (42)
Average daily hot water use (litres/day)		101.5971 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8598	21.7426	22.4364	19.5606	18.7688	16.1961	15.0080	17.2220	17.4276	20.3102	22.1702	24.0754	(46)
Water storage loss:													
Store volume												300.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												1.3784	(55)

Total storage loss
42.7290 38.5939 42.7290 41.3506 42.7290 41.3506 42.7290 42.7290 41.3506 42.7290 41.3506 42.7290 (56)
If cylinder contains dedicated solar storage
42.7290 38.5939 42.7290 41.3506 42.7290 41.3506 42.7290 42.7290 41.3506 42.7290 41.3506 42.7290 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
231.7235 204.5555 215.5672 194.2664 191.1169 171.8365 166.0450 180.8044 180.0469 201.3929 211.6640 226.4941 (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
231.7235 204.5555 215.5672 194.2664 191.1169 171.8365 166.0450 180.8044 180.0469 201.3929 211.6640 226.4941 (64)
Total per year (kWh/year) = Sum(64)m = 2375.5133 (64)
Heat gains from water heating, kWh/month
107.8990 95.8801 102.5271 94.4494 94.3973 86.9914 86.0609 90.9684 89.7214 97.8141 100.2341 106.1603 (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	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
77.2947 68.6525 55.8320 42.2684 31.5961 26.6748 28.8230 37.4653 50.2858 63.8494 74.5217 79.4430 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
414.0952 418.3922 407.5639 384.5116 355.4123 328.0631 309.7921 305.4951 316.3234 339.3757 368.4750 395.8242 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 (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)
-113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 (71)
Water heating gains (Table 5)
145.0256 142.6787 137.8052 131.1797 126.8782 120.8214 115.6733 122.2694 124.6130 131.4706 139.2140 142.6885 (72)
Total internal gains
751.0354 744.3433 715.8209 672.5796 628.5065 590.1791 568.9083 579.8496 605.8421 649.3155 696.8304 732.5756 (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	7.1000	11.2829	0.5700	0.7000	0.7700	22.1507	(75)
Southeast	15.2100	36.7938	0.5700	0.7000	0.7700	154.7428	(77)
Northwest	6.8900	11.2829	0.5700	0.7000	0.7700	21.4955	(81)
Southeast	5.2000	26.0000	0.5700	0.7000	1.0000	48.5503	(82)
Northeast	2.0300	11.2829	0.5700	0.7000	0.7700	6.3332	(75)
Southwest	4.7300	36.7938	0.5700	0.7000	0.7700	48.1218	(79)
Northwest	4.0500	11.2829	0.5700	0.7000	0.7700	12.6352	(81)

Solar gains	314.0296	573.8427	881.6955	1243.0425	1521.6211	1565.3253	1486.5338	1271.7742	1006.4951	660.9121	383.3920	263.9578	(83)
Total gains	1065.0649	1318.1859	1597.5163	1915.6221	2150.1276	2155.5044	2055.4421	1851.6238	1612.3372	1310.2276	1080.2225	996.5334	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.6021	55.6728	55.7424	56.0714	56.1334	56.4238	56.4238	56.4779	56.3116	56.1334	56.0081	55.8778	
alpha	4.7068	4.7115	4.7162	4.7381	4.7422	4.7616	4.7616	4.7652	4.7541	4.7422	4.7339	4.7252	
util living area	0.9874	0.9673	0.9120	0.7761	0.5866	0.4135	0.3002	0.3473	0.5798	0.8696	0.9728	0.9905	(86)
MIT	20.1364	20.3254	20.5752	20.8065	20.9109	20.9380	20.9422	20.9414	20.9206	20.7425	20.3861	20.0951	(87)
Th 2	19.8810	19.8823	19.8835	19.8893	19.8904	19.8955	19.8955	19.8964	19.8935	19.8904	19.8882	19.8859	(88)
util rest of house	0.9834	0.9578	0.8889	0.7300	0.5246	0.3438	0.2252	0.2648	0.4960	0.8265	0.9631	0.9875	(89)
MIT 2	18.7541	19.0244	19.3696	19.6670	19.7808	19.8093	19.8118	19.8125	19.7956	19.6026	19.1196	18.6984	(90)
Living area fraction										fLA = Living area / (4) =		0.2208	(91)
MIT	19.0593	19.3116	19.6358	19.9185	20.0303	20.0585	20.0613	20.0617	20.0440	19.8542	19.3992	19.0068	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0593	19.3116	19.6358	19.9185	20.0303	20.0585	20.0613	20.0617	20.0440	19.8542	19.3992	19.0068	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9796	0.9518	0.8830	0.7313	0.5326	0.3542	0.2365	0.2772	0.5078	0.8249	0.9577	0.9843	(94)
Useful gains	1043.3112	1254.5900	1410.5417	1400.8419	1145.2489	763.5235	486.0717	513.2982	818.7861	1080.8535	1034.4858	980.8860	(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	2104.9437	2052.7432	1868.6871	1558.2883	1176.8004	767.1423	486.4606	514.1268	837.0385	1307.3288	1741.3757	2101.2963	(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	789.8546	536.3589	340.8602	113.3614	23.4743	0.0000	0.0000	0.0000	0.0000	168.4976	508.9607	833.5853	(98)
Space heating												3314.9530	(98)
Space heating per m2											(98) / (4) =	29.0302	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	88.0000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3766.9921 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	789.8546	536.3589	340.8602	113.3614	23.4743	0.0000	0.0000	0.0000	0.0000	168.4976	508.9607	833.5853	(98)
Space heating efficiency (main heating system 1)	88.0000	88.0000	88.0000	88.0000	88.0000	0.0000	0.0000	0.0000	0.0000	88.0000	88.0000	88.0000	(210)
Space heating fuel (main heating system)	897.5620	609.4988	387.3411	128.8197	26.6754	0.0000	0.0000	0.0000	0.0000	191.4745	578.3645	947.2560	(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	231.7235	204.5555	215.5672	194.2664	191.1169	171.8365	166.0450	180.8044	180.0469	201.3929	211.6640	226.4941	(64)
Efficiency of water heater												88.0000	(216)
(217)m	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	(217)
Fuel for water heating, kWh/month	263.3222	232.4494	244.9627	220.7573	217.1783	195.2687	188.6875	205.4595	204.5987	228.8556	240.5273	257.3796	(219)

Water heating fuel used	2699.4469 (219)
Annual totals kWh/year	
Space heating fuel - main system	3766.9921 (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)	546.0197 (232)
Total delivered energy for all uses	7042.4586 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3766.9921	3.4800	131.0913	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2699.4469	3.4800	93.9408	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	546.0197	13.1900	72.0200	(250)
Additional standing charges			120.0000	(251)
Total energy cost			421.0091	(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] =	1.1108 (257)
SAP value		84.5047
SAP rating (Section 12)		85 (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	3766.9921	0.2160	813.6703	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2699.4469	0.2160	583.0805	(264)
Space and water heating			1396.7508	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	546.0197	0.5190	283.3842	(268)
Total kg/year			1695.7050	(272)
CO2 emissions per m2			14.8500	(273)
EI value			85.7262	
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) / 0.8800 = 4.241, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.25) / 0.8800 = 0.2633, stars = 4
Water heating energy efficiency	3.48 / 0.8800 = 3.955, stars = 4
Water heating environmental impact	0.216 / 0.8800 = 0.2455, stars = 4

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	302.3242	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =	0.1323	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2823	(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) =	0.2400	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.5000	3.4000	3.4000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8750	0.8500	0.8500	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.2580	0.2460	0.2460	0.2280	0.2340	0.2040	0.2100	0.2040	0.2040	0.2220	0.2160	0.2400	(22b)
Effective ac	0.5333	0.5302	0.5302	0.5260	0.5274	0.5208	0.5220	0.5208	0.5208	0.5246	0.5233	0.5288	(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	
Door			2.3500	1.2000	2.8200			(26)
Windows (Uw = 0.80)			29.2000	0.7752	22.6357			(27)
French Doors (Uw = 0.80)			10.8100	0.7752	8.3798			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1000	3.9800			(28a)
Exposed Floor			5.8200	0.1000	0.5820			(28b)
External Wall 1	104.4300	31.7600	72.6700	0.1700	12.3539			(29a)
Clad Wall	50.3500	10.6000	39.7500	0.1700	6.7575			(29a)
Flat Roof	52.8200	5.2000	47.6200	0.1300	6.1906			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.7305			(33)
Party Wall 1			64.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		20.3347 (36)
Total fabric heat loss	(33) + (36) =	88.0652 (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	53.2029	52.9013	52.9013	52.4758	52.6140	51.9588	52.0827	51.9588	51.9588	52.3412	52.2101	52.7559	(38)
Heat transfer coeff	141.2681	140.9665	140.9665	140.5410	140.6793	140.0240	140.1479	140.0240	140.0240	140.4064	140.2753	140.8211	(39)
Average = Sum(39)m / 12 =												140.5120	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2371	1.2345	1.2345	1.2308	1.2320	1.2262	1.2273	1.2262	1.2262	1.2296	1.2284	1.2332	(40)
HLP (average)												1.2305	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8378 (42)
Average daily hot water use (litres/day)		101.5971 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8598	21.7426	22.4364	19.5606	18.7688	16.1961	15.0080	17.2220	17.4276	20.3102	22.1702	24.0754	(46)
Water storage loss:													
Store volume												300.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												1.3784	(55)

Total storage loss
42.7290 38.5939 42.7290 41.3506 42.7290 41.3506 42.7290 42.7290 41.3506 42.7290 41.3506 42.7290 (56)
If cylinder contains dedicated solar storage
42.7290 38.5939 42.7290 41.3506 42.7290 41.3506 42.7290 42.7290 41.3506 42.7290 41.3506 42.7290 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
231.7235 204.5555 215.5672 194.2664 191.1169 171.8365 166.0450 180.8044 180.0469 201.3929 211.6640 226.4941 (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
231.7235 204.5555 215.5672 194.2664 191.1169 171.8365 166.0450 180.8044 180.0469 201.3929 211.6640 226.4941 (64)
Total per year (kWh/year) = Sum(64)m = 2375.5133 (64)
Heat gains from water heating, kWh/month
107.8990 95.8801 102.5271 94.4494 94.3973 86.9914 86.0609 90.9684 89.7214 97.8141 100.2341 106.1603 (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	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
77.2947 68.6525 55.8320 42.2684 31.5961 26.6748 28.8230 37.4653 50.2858 63.8494 74.5217 79.4430 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
414.0952 418.3922 407.5639 384.5116 355.4123 328.0631 309.7921 305.4951 316.3234 339.3757 368.4750 395.8242 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 (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)
-113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 (71)
Water heating gains (Table 5)
145.0256 142.6787 137.8052 131.1797 126.8782 120.8214 115.6733 122.2694 124.6130 131.4706 139.2140 142.6885 (72)
Total internal gains
751.0354 744.3433 715.8209 672.5796 628.5065 590.1791 568.9083 579.8496 605.8421 649.3155 696.8304 732.5756 (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	7.1000	12.4885	0.5700	0.7000	0.7700	24.5174	(75)
Southeast	15.2100	39.0225	0.5700	0.7000	0.7700	164.1157	(77)
Northwest	6.8900	12.4885	0.5700	0.7000	0.7700	23.7923	(81)
Southeast	5.2000	29.0000	0.5700	0.7000	1.0000	54.1523	(82)
Northeast	2.0300	12.4885	0.5700	0.7000	0.7700	7.0099	(75)
Southwest	4.7300	39.0225	0.5700	0.7000	0.7700	51.0366	(79)
Northwest	4.0500	12.4885	0.5700	0.7000	0.7700	13.9853	(81)

Solar gains	338.6095	557.0700	862.8518	1260.5061	1503.9990	1652.1925	1564.9580	1379.9906	1083.3225	701.8614	427.2371	279.2287	(83)
Total gains	1089.6449	1301.4132	1578.6727	1933.0857	2132.5054	2242.3716	2133.8663	1959.8402	1689.1646	1351.1769	1124.0675	1011.8043	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.1334	56.2535	56.2535	56.4238	56.3684	56.6322	56.5821	56.6322	56.6322	56.4779	56.5307	56.3116	
alpha	4.7422	4.7502	4.7502	4.7616	4.7579	4.7755	4.7721	4.7755	4.7755	4.7652	4.7687	4.7541	
util living area	0.9808	0.9582	0.8790	0.6952	0.4798	0.2743	0.1576	0.1857	0.4266	0.7824	0.9533	0.9856	(86)
MIT	20.2708	20.4245	20.6812	20.8715	20.9321	20.9426	20.9431	20.9431	20.9386	20.8431	20.5285	20.2312	(87)
Th 2	19.8904	19.8925	19.8925	19.8955	19.8945	19.8991	19.8982	19.8991	19.8991	19.8964	19.8973	19.8935	(88)
util rest of house	0.9745	0.9455	0.8467	0.6379	0.4115	0.2059	0.0853	0.1071	0.3385	0.7170	0.9363	0.9807	(89)
MIT 2	18.9557	19.1737	19.5191	19.7469	19.8039	19.8157	19.8150	19.8159	19.8139	19.7260	19.3274	18.9017	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	19.2460	19.4499	19.7757	19.9952	20.0530	20.0645	20.0640	20.0648	20.0622	19.9726	19.5926	19.1952	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2460	19.4499	19.7757	19.9952	20.0530	20.0645	20.0640	20.0648	20.0622	19.9726	19.5926	19.1952	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9698	0.9392	0.8429	0.6434	0.4215	0.2162	0.0962	0.1189	0.3517	0.7220	0.9305	0.9767	(94)
Useful gains	1056.7369	1222.3079	1330.5907	1243.7313	898.7762	484.8600	205.1788	233.0973	594.1247	975.5169	1045.9052	988.1937	(95)
Ext temp.	5.6000	6.1000	8.1000	10.6000	13.6000	16.6000	18.6000	18.4000	15.8000	12.3000	8.5000	5.6000	(96)
Heat loss rate W	1927.7459	1881.8843	1645.8789	1320.4051	907.8051	485.1141	205.1814	233.1052	596.8156	1077.2820	1556.0161	1914.4965	(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	648.0307	443.2354	234.5744	55.2051	6.7175	0.0000	0.0000	0.0000	0.0000	75.7133	367.2798	689.1693	(98)
Space heating												2519.9254	(98)
Space heating per m2											(98) / (4) =	22.0678	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	88.0000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	2863.5515 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	648.0307	443.2354	234.5744	55.2051	6.7175	0.0000	0.0000	0.0000	0.0000	75.7133	367.2798	689.1693	(98)
Space heating efficiency (main heating system 1)													
	88.0000	88.0000	88.0000	88.0000	88.0000	0.0000	0.0000	0.0000	0.0000	88.0000	88.0000	88.0000	(210)
Space heating fuel (main heating system)													
	736.3985	503.6766	266.5618	62.7331	7.6335	0.0000	0.0000	0.0000	0.0000	86.0378	417.3635	783.1469	(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													
	231.7235	204.5555	215.5672	194.2664	191.1169	171.8365	166.0450	180.8044	180.0469	201.3929	211.6640	226.4941	(64)
Efficiency of water heater												88.0000	(216)
(217)m	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	(217)
Fuel for water heating, kWh/month													
	263.3222	232.4494	244.9627	220.7573	217.1783	195.2687	188.6875	205.4595	204.5987	228.8556	240.5273	257.3796	(219)
Water heating fuel used												2699.4469	(219)
Annual totals kWh/year													
Space heating fuel - main system												2863.5515	(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)	546.0197 (232)
Total delivered energy for all uses	6139.0181 (238)

10a. Fuel costs - using BEDF prices (394)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2863.5515	4.3200	123.7054 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2699.4469	4.3200	116.6161 (247)
Pumps and fans for heating	30.0000	15.3200	4.5960 (249)
Energy for lighting	546.0197	15.3200	83.6502 (250)
Additional standing charges			95.0000 (251)
Total energy cost			423.5677 (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	2863.5515	0.2160	618.5271 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2699.4469	0.2160	583.0805 (264)
Space and water heating			1201.6077 (265)
Pumps and fans	30.0000	0.5190	15.5700 (267)
Energy for lighting	546.0197	0.5190	283.3842 (268)
Total kg/year			1500.5619 (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	2863.5515	1.2200	3493.5329 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2699.4469	1.2200	3293.3252 (264)
Space and water heating			6786.8581 (265)
Pumps and fans	30.0000	3.0700	92.1000 (267)
Energy for lighting	546.0197	3.0700	1676.2804 (268)
Primary energy kWh/year			8555.2384 (272)
Primary energy kWh/m2/year			74.9211 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 85
Current environmental impact rating:	B 86

(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	Recommended
O		Not considered
P		Not considered
R		Not considered

S	Not considered
T	Not considered
U Solar photovoltaic panels	Recommended
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
N Solar water heating	+ 1.3	-£ 47	-245 kg (16.4%)
U Solar photovoltaic panels	+ 8.4	-£ 274	-929 kg (74.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£47	2.15 kg/m²	B 86	B 88
Solar photovoltaic panels	£274	8.13 kg/m²	A 94	A 95
Total Savings	£321	10.28 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 394 TEST (20 May 2016)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£88	£96	-£8
Mains gas	£335	£281	£54
Space heating	£223	£225	-£2
Water heating	£117	£68	£48
Lighting	£84	£84	£0
Generated (PV)	-£0	-£274	£274
Total cost of fuels	£423	£103	£320
Total cost of uses	£424	£103	£320
Delivered energy	54 kWh/m²	28 kWh/m²	26 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.3 tonnes	1.2 tonnes
CO2 emissions per m²	13 kg/m²	3 kg/m²	10 kg/m²
Primary energy	75 kWh/m²	15 kWh/m²	60 kWh/m²

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	302.3242	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =	0.1323	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2823	(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) =	0.2400	(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	0.3060	0.3000	0.2940	0.2640	0.2580	0.2280	0.2280	0.2220	0.2400	0.2580	0.2700	0.2820	(22b)
Effective ac	0.5468	0.5450	0.5432	0.5348	0.5333	0.5260	0.5260	0.5246	0.5288	0.5333	0.5364	0.5397	(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	
Door			2.3500	1.2000	2.8200			(26)
Windows (Uw = 0.80)			29.2000	0.7752	22.6357			(27)
French Doors (Uw = 0.80)			10.8100	0.7752	8.3798			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1000	3.9800			(28a)
Exposed Floor			5.8200	0.1000	0.5820			(28b)
External Wall 1	104.4300	31.7600	72.6700	0.1700	12.3539			(29a)
Clad Wall	50.3500	10.6000	39.7500	0.1700	6.7575			(29a)
Flat Roof	52.8200	5.2000	47.6200	0.1300	6.1906			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.7305			(33)
Party Wall 1			64.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.3347	(36)
Total fabric heat loss (33) + (36) =	88.0652	(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	54.5529	54.3716	54.1939	53.3591	53.2029	52.4758	52.4758	52.3412	52.7559	53.2029	53.5188	53.8492	(38)
Heat transfer coeff	142.6181	142.4368	142.2591	141.4243	141.2681	140.5410	140.5410	140.4064	140.8211	141.2681	141.5841	141.9144	(39)
Average = Sum(39)m / 12 =												141.4235	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2490	1.2474	1.2458	1.2385	1.2371	1.2308	1.2308	1.2296	1.2332	1.2371	1.2399	1.2428	(40)
HLP (average)												1.2385	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8378 (42)
Average daily hot water use (litres/day)	101.5971 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8598	21.7426	22.4364	19.5606	18.7688	16.1961	15.0080	17.2220	17.4276	20.3102	22.1702	24.0754	(46)

Water storage loss:		
Store volume	300.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115	(51)
Volume factor from Table 2a	0.7368	(52)
Temperature factor from Table 2b	0.5400	(53)
Enter (49) or (54) in (55)	1.3784	(55)

Total storage loss
42.7290 38.5939 42.7290 41.3506 42.7290 41.3506 42.7290 42.7290 41.3506 42.7290 41.3506 42.7290 (56)
If cylinder contains dedicated solar storage
32.0467 28.9454 32.0467 31.0130 32.0467 31.0130 32.0467 32.0467 31.0130 32.0467 31.0130 32.0467 (57)
Primary loss 23.2624 21.0112 21.8667 15.7584 10.4681 9.9053 10.2355 11.1660 17.1091 21.8667 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
221.0413 194.9070 203.4892 177.1752 167.6404 148.8921 142.3358 158.0257 164.3063 189.3149 201.3263 215.8118 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1079.5246 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1813.6014 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.1346 (H8)
Utilisation factor	0.5858 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	142.5000 (H13)
Daily hot water demand	101.5971 (H14)
Volume ratio Veff/V	1.4026 (H15)
Solar storage volume factor	1.0000 (H16)
Solar input	-934.1675 (H17)

Solar input -27.0890 -45.2037 -76.9872 -103.1780 -127.4677 -125.3210 -123.6649 -108.0466 -84.6222 -57.7870 -32.1314 -22.6689 (63)
Solar input (sum of months) = Sum(63)m = -934.1675 (63)
Output from w/h
193.9523 149.7033 126.5020 73.9972 40.1727 23.5711 18.6710 49.9791 79.6842 131.5279 169.1949 193.1430 (64)
Total per year (kWh/year) = Sum(64)m = 1250.0986 (64)
Heat gains from water heating, kWh/month
99.3532 88.1613 92.8647 80.7764 75.6161 68.6359 67.0936 72.7455 77.1289 88.1517 91.9639 97.6145 (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	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
77.2947 68.6525 55.8320 42.2684 31.5961 26.6748 28.8230 37.4653 50.2858 63.8494 74.5217 79.4430 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
414.0952 418.3922 407.5639 384.5116 355.4123 328.0631 309.7921 305.4951 316.3234 339.3757 368.4750 395.8242 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 (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)
-113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 (71)
Water heating gains (Table 5)
133.5393 131.1924 124.8181 112.1894 101.6345 95.3276 90.1796 97.7762 107.1235 118.4835 127.7277 131.2022 (72)
Total internal gains
739.5491 732.8570 702.8338 653.5893 603.2628 564.6854 543.4145 555.3564 588.3526 636.3284 685.3442 721.0893 (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	7.1000	11.2829	0.5700	0.7000	0.7700	22.1507	(75)
Southeast	15.2100	36.7938	0.5700	0.7000	0.7700	154.7428	(77)
Northwest	6.8900	11.2829	0.5700	0.7000	0.7700	21.4955	(81)
Southeast	5.2000	26.0000	0.5700	0.7000	1.0000	48.5503	(82)
Northeast	2.0300	11.2829	0.5700	0.7000	0.7700	6.3332	(75)
Southwest	4.7300	36.7938	0.5700	0.7000	0.7700	48.1218	(79)
Northwest	4.0500	11.2829	0.5700	0.7000	0.7700	12.6352	(81)

Solar gains	314.0296	573.8427	881.6955	1243.0425	1521.6211	1565.3253	1486.5338	1271.7742	1006.4951	660.9121	383.3920	263.9578	(83)
Total gains	1053.5787	1306.6997	1584.5293	1896.6318	2124.8840	2130.0106	2029.9483	1827.1305	1594.8477	1297.2405	1068.7362	985.0471	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.6021	55.6728	55.7424	56.0714	56.1334	56.4238	56.4238	56.4779	56.3116	56.1334	56.0081	55.8778	
alpha	4.7068	4.7115	4.7162	4.7381	4.7422	4.7616	4.7616	4.7652	4.7541	4.7422	4.7339	4.7252	
util living area													
	0.9879	0.9683	0.9142	0.7807	0.5925	0.4182	0.3039	0.3519	0.5853	0.8730	0.9738	0.9909	(86)
MIT	20.1299	20.3194	20.5701	20.8029	20.9096	20.9378	20.9421	20.9413	20.9197	20.7384	20.3800	20.0885	(87)
Th 2	19.8810	19.8823	19.8835	19.8893	19.8904	19.8955	19.8955	19.8964	19.8935	19.8904	19.8882	19.8859	(88)
util rest of house													
	0.9841	0.9591	0.8914	0.7349	0.5302	0.3479	0.2280	0.2683	0.5010	0.8306	0.9645	0.9881	(89)
MIT 2	18.7447	19.0161	19.3630	19.6629	19.7796	19.8092	19.8118	19.8124	19.7950	19.5977	19.1111	18.6888	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	19.0505	19.3038	19.6295	19.9146	20.0291	20.0583	20.0613	20.0617	20.0433	19.8496	19.3913	18.9979	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0505	19.3038	19.6295	19.9146	20.0291	20.0583	20.0613	20.0617	20.0433	19.8496	19.3913	18.9979	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9804	0.9531	0.8854	0.7360	0.5382	0.3584	0.2394	0.2809	0.5129	0.8288	0.9591	0.9850	(94)
Useful gains	1032.8835	1245.4036	1402.9865	1395.9027	1143.6874	763.3145	486.0464	513.2416	817.9288	1075.1887	1025.0511	970.2307	(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													

	2103.6950	2051.6364	1867.7847	1557.7268	1176.6296	767.1190	486.4574	514.1199	836.9437	1306.6667	1740.2454	2100.0285 (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												
	796.6838	541.7885	345.8098	116.5133	24.5090	0.0000	0.0000	0.0000	0.0000	172.2196	514.9399	840.5695 (98)
Space heating												3353.0334 (98)
Space heating per m2											(98) / (4) =	29.3636 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													88.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3810.2652 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	796.6838	541.7885	345.8098	116.5133	24.5090	0.0000	0.0000	0.0000	0.0000	172.2196	514.9399	840.5695 (98)	
Space heating efficiency (main heating system 1)													
	88.0000	88.0000	88.0000	88.0000	88.0000	0.0000	0.0000	0.0000	0.0000	88.0000	88.0000	88.0000 (210)	
Space heating fuel (main heating system)													
	905.3225	615.6687	392.9657	132.4015	27.8511	0.0000	0.0000	0.0000	0.0000	195.7041	585.1590	955.1926 (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													
	193.9523	149.7033	126.5020	73.9972	40.1727	23.5711	18.6710	49.9791	79.6842	131.5279	169.1949	193.1430 (64)	
Efficiency of water heater													88.0000 (216)
(217)m	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000 (217)	
Fuel for water heating, kWh/month													
	220.4003	170.1173	143.7523	84.0877	45.6508	26.7853	21.2170	56.7944	90.5502	149.4636	192.2669	219.4807 (219)	
Water heating fuel used													1420.5666 (219)
Annual totals kWh/year													
Space heating fuel - main system													3810.2652 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													80.0000 (231)
Electricity for lighting (calculated in Appendix L)													546.0197 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394			-1727.2394 (233)
Total delivered energy for all uses													4129.6120 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3810.2652	3.4800	132.5972	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1420.5666	3.4800	49.4357	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	546.0197	13.1900	72.0200	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			156.7821	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4136 (257)
SAP value		94.2296
SAP rating (Section 12)		94 (258)
SAP band		A

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	3810.2652	0.2160	823.0173	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1420.5666	0.2160	306.8424	(264)
Space and water heating			1129.8597	(265)
Pumps and fans	80.0000	0.5190	41.5200	(267)
Energy for lighting	546.0197	0.5190	283.3842	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			558.3266	(272)
CO2 emissions per m2			4.8900	(273)
EI value			95.3002	
EI rating			95	(274)
EI band			A	

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	302.3242	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =	0.1323	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2823	(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) =	0.2400	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.5000	3.4000	3.4000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8750	0.8500	0.8500	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.2580	0.2460	0.2460	0.2280	0.2340	0.2040	0.2100	0.2040	0.2040	0.2220	0.2160	0.2400	(22b)
Effective ac	0.5333	0.5302	0.5302	0.5260	0.5274	0.5208	0.5220	0.5208	0.5208	0.5246	0.5233	0.5288	(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	
Door			2.3500	1.2000	2.8200			(26)
Windows (Uw = 0.80)			29.2000	0.7752	22.6357			(27)
French Doors (Uw = 0.80)			10.8100	0.7752	8.3798			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1000	3.9800			(28a)
Exposed Floor			5.8200	0.1000	0.5820			(28b)
External Wall 1	104.4300	31.7600	72.6700	0.1700	12.3539			(29a)
Clad Wall	50.3500	10.6000	39.7500	0.1700	6.7575			(29a)
Flat Roof	52.8200	5.2000	47.6200	0.1300	6.1906			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.7305			(33)
Party Wall 1			64.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.3347	(36)
Total fabric heat loss (33) + (36) =	88.0652	(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	53.2029	52.9013	52.9013	52.4758	52.6140	51.9588	52.0827	51.9588	51.9588	52.3412	52.2101	52.7559	(38)
Heat transfer coeff	141.2681	140.9665	140.9665	140.5410	140.6793	140.0240	140.1479	140.0240	140.0240	140.4064	140.2753	140.8211	(39)
Average = Sum(39)m / 12 =												140.5120	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2371	1.2345	1.2345	1.2308	1.2320	1.2262	1.2273	1.2262	1.2262	1.2296	1.2284	1.2332	(40)
HLP (average)												1.2305	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8378	(42)
Average daily hot water use (litres/day)	101.5971	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8598	21.7426	22.4364	19.5606	18.7688	16.1961	15.0080	17.2220	17.4276	20.3102	22.1702	24.0754	(46)
Water storage loss:													
Store volume												300.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												1.3784	(55)

Total storage loss
42.7290 38.5939 42.7290 41.3506 42.7290 41.3506 42.7290 42.7290 41.3506 42.7290 41.3506 42.7290 (56)
If cylinder contains dedicated solar storage
32.0467 28.9454 32.0467 31.0130 32.0467 31.0130 32.0467 32.0467 31.0130 32.0467 31.0130 32.0467 (57)
Primary loss 23.2624 21.0112 21.8667 15.7584 10.4681 9.9053 10.2355 11.1660 17.1091 21.8667 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
221.0413 194.9070 203.4892 177.1752 167.6404 148.8921 142.3358 158.0257 164.3063 189.3149 201.3263 215.8118 (62)
Aperture area of solar collector 3.0000 (H1)
Zero-loss collector efficiency 0.7000 (H2)
Collector heat loss coefficient 1.8000 (H3)
Collector 2nd order heat loss coefficient 0.0050 (H3a)
Collector effective heat loss coefficient 1.8063 (H3b)
Collector performance ratio 2.5804 (H4)
Annual solar radiation per m2 1118.1552 (H5)
Overshading factor 0.8000 (H6)
Solar energy available 1878.5008 (H7)
Adjustment factor for showers 1.0000 (H7a)
Solar-to-load ratio 1.1752 (H8)
Utilisation factor 0.5730 (H9)
Collector performance factor 0.8793 (H10)
Dedicated solar storage volume 75.0000 (H11)
Effective solar volume 142.5000 (H13)
Daily hot water demand 101.5971 (H14)
Volume ratio Veff/V 1.4026 (H15)
Solar storage volume factor 1.0000 (H16)
Solar input -946.4426 (H17)
Solar input -28.6694 -42.9890 -73.5662 -101.8581 -122.5253 -128.6332 -126.6006 -114.0655 -88.8145 -60.0469 -35.1267 -23.5474 (63)
Solar input (sum of months) = Sum(63)m = -946.4426 (63)
Output from w/h
192.3719 151.9180 129.9230 75.3171 45.1151 20.2589 15.7353 43.9602 75.4918 129.2681 166.1996 192.2644 (64)
Total per year (kWh/year) = Sum(64)m = 1237.8234 (64)
Heat gains from water heating, kWh/month
99.3532 88.1613 92.8647 80.7764 75.6161 68.6359 67.0936 72.7455 77.1289 88.1517 91.9639 97.6145 (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	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
77.2947 68.6525 55.8320 42.2684 31.5961 26.6748 28.8230 37.4653 50.2858 63.8494 74.5217 79.4430 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
414.0952 418.3922 407.5639 384.5116 355.4123 328.0631 309.7921 305.4951 316.3234 339.3757 368.4750 395.8242 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 (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)
-113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 (71)
Water heating gains (Table 5)
133.5393 131.1924 124.8181 112.1894 101.6345 95.3276 90.1796 97.7762 107.1235 118.4835 127.7277 131.2022 (72)
Total internal gains
739.5491 732.8570 702.8338 653.5893 603.2628 564.6854 543.4145 555.3564 588.3526 636.3284 685.3442 721.0893 (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	7.1000	12.4885	0.5700	0.7000	0.7700	24.5174	(75)
Southeast	15.2100	39.0225	0.5700	0.7000	0.7700	164.1157	(77)
Northwest	6.8900	12.4885	0.5700	0.7000	0.7700	23.7923	(81)
Southeast	5.2000	29.0000	0.5700	0.7000	1.0000	54.1523	(82)
Northeast	2.0300	12.4885	0.5700	0.7000	0.7700	7.0099	(75)
Southwest	4.7300	39.0225	0.5700	0.7000	0.7700	51.0366	(79)
Northwest	4.0500	12.4885	0.5700	0.7000	0.7700	13.9853	(81)

Solar gains	338.6095	557.0700	862.8518	1260.5061	1503.9990	1652.1925	1564.9580	1379.9906	1083.3225	701.8614	427.2371	279.2287	(83)
Total gains	1078.1586	1289.9269	1565.6856	1914.0954	2107.2618	2216.8778	2108.3726	1935.3469	1671.6751	1338.1898	1112.5812	1000.3180	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.1334	56.2535	56.2535	56.4238	56.3684	56.6322	56.5821	56.6322	56.6322	56.4779	56.5307	56.3116	
alpha	4.7422	4.7502	4.7502	4.7616	4.7579	4.7755	4.7721	4.7755	4.7755	4.7652	4.7687	4.7541	
util living area													
	0.9816	0.9595	0.8817	0.7002	0.4851	0.2775	0.1595	0.1881	0.4309	0.7868	0.9550	0.9862	(86)
MIT	20.2644	20.4188	20.6768	20.8693	20.9316	20.9426	20.9431	20.9431	20.9384	20.8406	20.5229	20.2247	(87)
Th 2	19.8904	19.8925	19.8925	19.8955	19.8945	19.8991	19.8982	19.8991	19.8991	19.8964	19.8973	19.8935	(88)
util rest of house													
	0.9755	0.9471	0.8499	0.6430	0.4163	0.2083	0.0863	0.1085	0.3420	0.7218	0.9384	0.9816	(89)
MIT 2	18.9467	19.1659	19.5138	19.7447	19.8036	19.8157	19.8150	19.8159	19.8138	19.7234	19.3199	18.8925	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	19.2376	19.4425	19.7705	19.9930	20.0526	20.0645	20.0640	20.0648	20.0621	19.9700	19.5855	19.1866	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2376	19.4425	19.7705	19.9930	20.0526	20.0645	20.0640	20.0648	20.0621	19.9700	19.5855	19.1866	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9709	0.9409	0.8459	0.6483	0.4263	0.2187	0.0973	0.1204	0.3553	0.7266	0.9326	0.9776	(94)
Useful gains	1046.7704	1213.6424	1324.4016	1240.9506	898.2781	484.8447	205.1786	233.0967	593.9880	972.3424	1037.5817	977.9103	(95)
Ext temp.	5.6000	6.1000	8.1000	10.6000	13.6000	16.6000	18.6000	18.4000	15.8000	12.3000	8.5000	5.6000	(96)
Heat loss rate W													

	1926.5570	1880.8485	1645.1530	1320.0971	907.7505	485.1122	205.1813	233.1050	596.7998	1076.9232	1555.0258	1913.2758 (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												
	654.5612	448.3625	238.6391	56.9855	7.0475	0.0000	0.0000	0.0000	0.0000	77.8081	372.5598	695.9119 (98)
Space heating												2551.8756 (98)
Space heating per m2											(98) / (4) =	22.3476 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													88.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2899.8586 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	654.5612	448.3625	238.6391	56.9855	7.0475	0.0000	0.0000	0.0000	0.0000	77.8081	372.5598	695.9119 (98)	
Space heating efficiency (main heating system 1)													
	88.0000	88.0000	88.0000	88.0000	88.0000	0.0000	0.0000	0.0000	0.0000	88.0000	88.0000	88.0000 (210)	
Space heating fuel (main heating system)													
	743.8196	509.5029	271.1808	64.7563	8.0085	0.0000	0.0000	0.0000	0.0000	88.4183	423.3634	790.8090 (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													
	192.3719	151.9180	129.9230	75.3171	45.1151	20.2589	15.7353	43.9602	75.4918	129.2681	166.1996	192.2644 (64)	
Efficiency of water heater													88.0000 (216)
(217)m	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000	88.0000 (217)	
Fuel for water heating, kWh/month													
	218.6044	172.6341	147.6397	85.5876	51.2671	23.0215	17.8810	49.9548	85.7861	146.8955	188.8632	218.4823 (219)	
Water heating fuel used													1406.6175 (219)
Annual totals kWh/year													
Space heating fuel - main system													2899.8586 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													80.0000 (231)
Electricity for lighting (calculated in Appendix L)													546.0197 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1118 * 0.80) =											-1789.0484		-1789.0484 (233)
Total delivered energy for all uses													3143.4475 (238)

10a. Fuel costs - using BEDF prices (394)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2899.8586	4.3200	125.2739 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1406.6175	4.3200	60.7659 (247)
Pumps and fans for heating	30.0000	15.3200	4.5960 (249)
Pump for solar water heating	50.0000	15.3200	7.6600 (249)
Energy for lighting	546.0197	15.3200	83.6502 (250)
Additional standing charges			95.0000 (251)
Energy saving/generation technologies			
PV Unit	-1789.0484	15.3200	-274.0822 (252)
Total energy cost			102.8638 (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	2899.8586	0.2160	626.3695 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1406.6175	0.2160	303.8294 (264)
Space and water heating			930.1989 (265)
Pumps and fans	80.0000	0.5190	41.5200 (267)
Energy for lighting	546.0197	0.5190	283.3842 (268)
Energy saving/generation technologies			
PV Unit	-1789.0484	0.5190	-928.5161 (269)
Total kg/year			326.5870 (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	2899.8586	1.2200	3537.8275 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1406.6175	1.2200	1716.0734 (264)
Space and water heating			5253.9009 (265)
Pumps and fans	80.0000	3.0700	245.6000 (267)
Energy for lighting	546.0197	3.0700	1676.2804 (268)
Energy saving/generation technologies			
PV Unit	-1789.0484	3.0700	-5492.3784 (269)
Primary energy kWh/year			1683.4028 (272)

Primary energy kWh/m2/year 14.7421 (273)

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

Overheating Calculation Input Data

Dwelling type	MidTerrace House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	250.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	798.14 (P1)
Transmission heat loss coefficient	88.07 (37)
Summer heat loss coefficient	886.20 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
North 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 East	1.000	1.00	1.000	1.000 (P8)
South East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)
North West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	7.1000	98.8453	0.5700	0.7000	0.9000	226.8152
South East	15.2100	119.9223	0.5700	0.7000	0.9000	589.5047
North West	6.8900	98.8453	0.5700	0.7000	0.9000	220.1066
South East	5.2000	203.0000	0.5700	0.7000	1.0000	379.0660
North East	2.0300	98.8453	0.5700	0.7000	0.9000	64.8500
South West	4.7300	119.9223	0.5700	0.7000	0.9000	183.3239
North West	4.0500	98.8453	0.5700	0.7000	0.9000	129.3805
total:						1793.0468

	Jun	Jul	Aug	
Solar gains	1909	1793	1569	(P3)
Internal gains	587	566	577	
Total summer gains	2496	2359	2145	(P5)
Summer gain/loss ratio	2.82	2.66	2.42	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	19.07	20.81	20.47	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight

---

Sample Report Ltd
1 Sample Street
Sampletown

Full SAP Calculation Printout

Property Reference: 25220 - 97a Camden Mews
Survey Reference: Be Green - JCA v1.1
Property: 97a, London, NW1 9BU

Issued on Date: 21.Jun.2016
Prop Type Ref:

SAP Rating:	90 B	**CO2 Emissions (t/year):**	0.92	**DER:** 11.16 Pass	**TER:** 17.16	**Percentage DER<TER:**	34.98 %
Environmental:	91 B	**General Requirements Compliance:**	Pass	**DFEE:** 43.82 Pass	**TFEE:** 57.09	**Percentage DFEE<TFEE:**	23.23 %

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

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

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

CALCULATION DETAILS for survey reference no 'Be Green - JCA v1.1'
SAP2012 - 9.92 input data (DesignData) -


```
SAP2012 Input Data (House)     21/06/2016

FullRefNo:                     Be Green - JCA v1.1

Regs Region:                   England
SAP Region:                    Thames Valley
Postcode:                      NW1 9BU
DwellingOrientation:           South East
Property Type:                 House, Mid-Terrace
Storeys:                       3
Date Built:                    2016
Sheltered Sides:               2
Sunlight Shade:                Average or unknown
Measurements                   Perimeter, Floor Area, Storey Height
    1st Storey:               20.16, 39.8, 2.4
    2nd Storey:               20.16, 45.62, 2.78
    3rd Storey:               18.11, 28.77, 2.78
Living Area:                   25.21 m2, fraction: 22.1%
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                72.67, 104.43, 0, Other, Cavity, 0, 0.17, Gross
Clad Wall                      39.75, 50.35, 0, Other, Cavity, 0, 0.17, Gross
Party Walls                    Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall 1                   64.6, 0, Other, FilledWithEdge, 0, 0
External Roofs                 Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
    Flat Roof                 47.62, 52.82, 0, Other, 0.13
Heat Loss Floors               Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
    Heat Loss Floor 1         39.8, 110, Slab on ground, screed over insulation, Ground Floor - Solid, 0, 0.1
    Exposed Floor             5.82, 0, Other, Exposed Floor - Solid, 0, 0.1
Description                    Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
    Door                      Manufacturer, Solid Door, , , , , , ,
    Windows                   Manufacturer, Window, Triple Low-E Soft 0.1, , , 0.57, , 0.7,
    Rooflight                 Manufacturer, Roof Window, Triple Low-E Soft 0.1, , , 0.57, , 0.7,
    French Doors              Manufacturer, Window, Triple Low-E Soft 0.1, , , 0.57, , 0.7,
Openings                       Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    Rooflight                 Roof Window, Flat Roof, South East, 0, None, , , 0, 0, 0, 5.20,
    SE F Window               Window, External Wall 1, South East, , None, 0, , 0, 0, 0, 8.92,
    SE F Windows SF           Window, Clad Wall, South East, , None, 0, , 0, 0, 0, 6.29,
    NW F Window               Window, External Wall 1, North West, , None, 0, , 0, 0, 0, 6.89,
    NW F FDoors               Window, External Wall 1, North West, , None, 0, , 0, 0, 0, 4.05,
    SW F FDoor                Window, External Wall 1, South West, , None, 0, , 0, 0, 0, 4.73,
    NE F Windows              Window, External Wall 1, North East, , None, 0, , 0, 0, 0, 2.79,
    NE F FDoor                Window, External Wall 1, North East, , None, 0, , 0, 0, 0, 2.03,
    NE F Windows SF           Window, Clad Wall, North East, , None, 0, , 0, 0, 0, 4.31,
    Front Door                Solid Door, External Wall 1, South East, , , , , 0, 0, 0, 2.35,
Conservatory:                  None
Draught Proofing:              100
Draught Lobby:                 No
Thermal Bridges
    Bridging:                 Calculate Bridges
    Y                         0.08
    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, 18.92, 0.3, 0.3, 5.68,
    1.                        External wall, E3 Sill, Table K1 - Approved, Yes, 17.84, 0.04, 0.04, 0.71,
    2.                        External wall, E4 Jamb, Table K1 - Approved, Yes, 71.64, 0.05, 0.05, 3.58,
    3.                        External wall, E5 Ground floor (normal), Table K1 - Approved, Yes, 20.16, 0.16, 0.16, 3.23,
    4.                        External wall, E6 Intermediate floor within a dwelling, Table K1 - Approved, Yes, 38.27, 0.07, 0.07, 2.68,
    5.                        External wall, E8 Balcony within a dwelling, wall insulation continuous, Table K1 - Approved, No, 4.87, 0, 0, 0.00,
    6.                        External wall, E16 Corner (normal), Table K1 - Approved, No, 21.48, 0.09, 0.09, 1.93,
    7.                        External wall, E17 Corner (inverted - internal area greater than external area), Table K1 - Approved, No, 13.14, -0.09, -0.09, -1.18,
    8.                        External wall, E18 Party wall between dwellings, Table K1 - Approved, Yes, 31.84, 0.06, 0.06, 1.91,
    9.                        External roof, R1 Head of roof window, Table K1 - Default, Yes, 3.08, 0.08, 0.08, 0.25,
    10.                       External roof, R2 Sill of roof window, Table K1 - Default, Yes, 3.08, 0.06, 0.06, 0.18,
    11.                       External roof, R3 Jamb of roof window, Table K1 - Default, Yes, 17.08, 0.08, 0.08, 1.37,
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:            4
Passive Vents:                0
Flueless Gas Fires:           0
Cooling System                None
Light Fittings:               16
LEL Fittings:                 16
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 BGB Post 98 Regular condens. with auto ign.
    SAP Code                  102
    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
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
    Cylinder Type             HotWaterCylinder
    Cylinder Insulation Type  Foam
    Cylinder Volume           300.00
    Cylinder Stat             Yes
    Pipeworks Insulated       Fully insulated primary pipework
    Cylinder in Heated Space  Yes
    Separate Time Control     Yes
Flue Gas Heat Recovery System None
Waste Water Heat Recovery     none
PV Unit
Type                          More Dwellings, One Block
Apportioned Energy            962
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-Terrace House, total floor area 114 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) 17.16 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.16 kg/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)57.1 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)43.8 kWh/m²OK

---

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.10 (max. 0.25)	0.10 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	0.82 (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

Efficiency: 90%
Minimum: 88% OK

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage: Nominal cylinder loss: 2.27 kWh/day

Permitted by DBSCG 2.86	OK	
Primary pipework insulated:	Yes	OK

---

6 Controls

Space heating controls:	Time and temperature zone control	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
Boiler interlock	Yes	OK

---

7 Low energy lights

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

Minimum	75%	OK

---

8 Mechanical ventilation

Not applicable

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9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing North East:	9.13 m^2, No overhang	
Windows facing South East:	15.21 m^2, No overhang	
Windows facing South West:	4.73 m^2, No overhang	
Windows facing North West:	10.94 m^2, No overhang	
Air change rate:	8.00 ach	
Blinds/curtains:	None	

---

10 Key features

Party wall U-value	0.00 W/m^2K
Floor U-value	0.10 W/m^2K
Exposed floor U-value	0.10 W/m^2K
Window U-value	0.80 W/m^2K
Window U-value	0.80 W/m^2K
Roof window U-value	0.80 W/m^2K
Air permeability	3.0 m^3/m^2h

Photovoltaic array

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	302.3242	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =	0.1323	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2823	(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) =	0.2400	(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	0.3060	0.3000	0.2940	0.2640	0.2580	0.2280	0.2280	0.2220	0.2400	0.2580	0.2700	0.2820	(22b)
Effective ac	0.5468	0.5450	0.5432	0.5348	0.5333	0.5260	0.5260	0.5246	0.5288	0.5333	0.5364	0.5397	(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	
Door			2.3500	1.2000	2.8200			(26)
Windows (Uw = 0.80)			29.2000	0.7752	22.6357			(27)
French Doors (Uw = 0.80)			10.8100	0.7752	8.3798			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1000	3.9800			(28a)
Exposed Floor			5.8200	0.1000	0.5820			(28b)
External Wall 1	104.4300	31.7600	72.6700	0.1700	12.3539			(29a)
Clad Wall	50.3500	10.6000	39.7500	0.1700	6.7575			(29a)
Flat Roof	52.8200	5.2000	47.6200	0.1300	6.1906			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.7305			(33)
Party Wall 1			64.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.3347	(36)
Total fabric heat loss (33) + (36) =	88.0652	(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	54.5529	54.3716	54.1939	53.3591	53.2029	52.4758	52.4758	52.3412	52.7559	53.2029	53.5188	53.8492	(38)
Heat transfer coeff	142.6181	142.4368	142.2591	141.4243	141.2681	140.5410	140.5410	140.4064	140.8211	141.2681	141.5841	141.9144	(39)
Average = Sum(39)m / 12 =												141.4235	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2490	1.2474	1.2458	1.2385	1.2371	1.2308	1.2308	1.2296	1.2332	1.2371	1.2399	1.2428	(40)
HLP (average)												1.2385	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8378	(42)
Average daily hot water use (litres/day)	101.5971	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8598	21.7426	22.4364	19.5606	18.7688	16.1961	15.0080	17.2220	17.4276	20.3102	22.1702	24.0754	(46)
Water storage loss:													
Store volume												300.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												1.2281	(55)

Total storage loss
38.0698 34.3856 38.0698 36.8417 38.0698 36.8417 38.0698 38.0698 36.8417 38.0698 36.8417 38.0698 (56)
If cylinder contains dedicated solar storage
38.0698 34.3856 38.0698 36.8417 38.0698 36.8417 38.0698 38.0698 36.8417 38.0698 36.8417 38.0698 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
227.0643 200.3472 210.9080 189.7575 186.4577 167.3276 161.3858 176.1452 175.5380 196.7337 207.1551 221.8349 (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
227.0643 200.3472 210.9080 189.7575 186.4577 167.3276 161.3858 176.1452 175.5380 196.7337 207.1551 221.8349 (64)
Total per year (kWh/year) = Sum(64)m = 2320.6551 (64)
Heat gains from water heating, kWh/month
104.1717 92.5135 98.7997 90.8423 90.6700 83.3843 82.3336 87.2411 86.1142 94.0868 96.6269 102.4329 (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	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	(66)

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

	24.7343	21.9688	17.8662	13.5259	10.1108	8.5359	9.2234	11.9889	16.0915	20.4318	23.8469	25.4218	(67)

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

	277.4438	280.3228	273.0678	257.6228	238.1263	219.8023	207.5607	204.6817	211.9367	227.3817	246.8782	265.2022	(68)

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

	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	(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)

	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	(71)

Water heating gains (Table 5)

	140.0157	137.6688	132.7953	126.1698	121.8683	115.8115	110.6634	117.2595	119.6031	126.4607	134.2041	137.6786	(72)

Total internal gains

	510.7604	508.5270	492.2959	465.8851	438.6719	412.7163	396.0141	402.4967	416.1979	442.8408	473.4958	496.8692	(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	7.1000	11.2829	0.5700	0.7000	0.7700	22.1507	(75)
Southeast	15.2100	36.7938	0.5700	0.7000	0.7700	154.7428	(77)
Northwest	6.8900	11.2829	0.5700	0.7000	0.7700	21.4955	(81)
Southeast	5.2000	26.0000	0.5700	0.7000	1.0000	48.5503	(82)
Northeast	2.0300	11.2829	0.5700	0.7000	0.7700	6.3332	(75)
Southwest	4.7300	36.7938	0.5700	0.7000	0.7700	48.1218	(79)
Northwest	4.0500	11.2829	0.5700	0.7000	0.7700	12.6352	(81)

Solar gains	314.0296	573.8427	881.6955	1243.0425	1521.6211	1565.3253	1486.5338	1271.7742	1006.4951	660.9121	383.3920	263.9578	(83)
Total gains	824.7900	1082.3697	1373.9914	1708.9276	1960.2930	1978.0416	1882.5479	1674.2709	1422.6930	1103.7529	856.8879	760.8270	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.6021	55.6728	55.7424	56.0714	56.1334	56.4238	56.4238	56.4779	56.3116	56.1334	56.0081	55.8778	
alpha	4.7068	4.7115	4.7162	4.7381	4.7422	4.7616	4.7616	4.7652	4.7541	4.7422	4.7339	4.7252	
util living area	0.9955	0.9844	0.9455	0.8263	0.6334	0.4488	0.3274	0.3832	0.6432	0.9205	0.9889	0.9969	(86)
MIT	19.9968	20.1983	20.4796	20.7611	20.8990	20.9360	20.9418	20.9405	20.9086	20.6677	20.2626	19.9565	(87)
Th 2	19.8810	19.8823	19.8835	19.8893	19.8904	19.8955	19.8955	19.8964	19.8935	19.8904	19.8882	19.8859	(88)
util rest of house	0.9941	0.9795	0.9293	0.7844	0.5694	0.3740	0.2458	0.2926	0.5553	0.8890	0.9845	0.9959	(89)
MIT 2	18.5522	18.8447	19.2425	19.6155	19.7703	19.8081	19.8117	19.8122	19.7870	19.5121	18.9448	18.4973	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	18.8711	19.1435	19.5156	19.8684	20.0195	20.0571	20.0612	20.0613	20.0346	19.7672	19.2357	18.8195	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8711	19.1435	19.5156	19.8684	20.0195	20.0571	20.0612	20.0613	20.0346	19.7672	19.2357	18.8195	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9922	0.9751	0.9228	0.7835	0.5771	0.3851	0.2581	0.3063	0.5672	0.8847	0.9810	0.9944	(94)
Useful gains	818.3333	1055.4672	1267.9253	1338.9408	1131.3510	761.7669	485.8604	512.7802	806.8823	976.5370	840.6411	756.6037	(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	2078.1086	2028.8039	1851.5843	1551.1981	1175.2757	766.9467	486.4344	514.0642	835.7198	1295.0337	1718.2223	2074.7107	(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	937.2728	654.0822	434.2423	152.8253	32.6800	0.0000	0.0000	0.0000	0.0000	236.9615	631.8585	980.6716	(98)
Space heating												4060.5941	(98)
Space heating per m2											(98) / (4) =	35.5600	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.0000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	4511.7713 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	937.2728	654.0822	434.2423	152.8253	32.6800	0.0000	0.0000	0.0000	0.0000	236.9615	631.8585	980.6716	(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)													
	1041.4142	726.7580	482.4914	169.8058	36.3111	0.0000	0.0000	0.0000	0.0000	263.2906	702.0649	1089.6351	(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													
	227.0643	200.3472	210.9080	189.7575	186.4577	167.3276	161.3858	176.1452	175.5380	196.7337	207.1551	221.8349	(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													
	252.2937	222.6080	234.3422	210.8417	207.1753	185.9195	179.3176	195.7169	195.0422	218.5930	230.1723	246.4832	(219)
Water heating fuel used												2578.5057	(219)
Annual totals kWh/year													
Space heating fuel - main system												4511.7713	(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)												436.8157	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
Total delivered energy for all uses												7557.0927	(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	4511.7713	0.2160	974.5426	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2578.5057	0.2160	556.9572	(264)
Space and water heating			1531.4998	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	436.8157	0.5190	226.7074	(268)
Energy saving/generation technologies				
PV Unit	-962.0000	0.5190	-499.2780	(269)
Total CO2, kg/year			1274.4992	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.1600	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES			
DER		11.1600	ZC1
Total Floor Area	TFA	114.1900	
Assumed number of occupants	N	2.8378	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.3977	ZC2
CO2 emissions from cooking, equation (L16)		1.6386	ZC3
Total CO2 emissions		27.1963	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		27.1963	ZC8

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		302.3242	(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							4 * 10 =		40.0000	(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) =	40.0000 / (5) =	0.1323	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3823	(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) =	0.3250	(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	0.4143	0.4062	0.3981	0.3575	0.3493	0.3087	0.3087	0.3006	0.3250	0.3493	0.3656	0.3818	(22b)
Effective ac	0.5858	0.5825	0.5792	0.5639	0.5610	0.5477	0.5477	0.5452	0.5528	0.5610	0.5668	0.5729	(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			2.3500	1.0000	2.3500			(26)
TER Opening Type (Uw = 1.40)			23.1900	1.3258	30.7443			(27)
TER Room Window (Uw = 1.70)			3.0200	1.5918	4.8071			(27a)
Heat Loss Floor 1			39.8000	0.1300	5.1740			(28a)
Exposed Floor			5.8200	0.1300	0.7566			(28b)
External Wall 1	104.4300	19.4100	85.0200	0.1800	15.3036			(29a)
Clad Wall	50.3500	6.1300	44.2200	0.1800	7.9596			(29a)
Flat Roof	52.8200	3.0200	49.8000	0.1300	6.4740			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		73.5692			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1042 (36)
Total fabric heat loss	(33) + (36) =	86.6734 (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	58.4468	58.1143	57.7884	56.2574	55.9710	54.6376	54.6376	54.3907	55.1512	55.9710	56.5504	57.1562	(38)
Heat transfer coeff	145.1203	144.7877	144.4618	142.9309	142.6444	141.3110	141.3110	141.0641	141.8246	142.6444	143.2239	143.8297	(39)
Average = Sum(39)m / 12 =												142.9295	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2709	1.2680	1.2651	1.2517	1.2492	1.2375	1.2375	1.2353	1.2420	1.2492	1.2543	1.2596	(40)
HLP (average)												1.2517	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8378 (42)
Average daily hot water use (litres/day)		101.5971 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8598	21.7426	22.4364	19.5606	18.7688	16.1961	15.0080	17.2220	17.4276	20.3102	22.1702	24.0754	(46)

Water storage loss:		
Store volume		300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):		2.1127 (48)
Temperature factor from Table 2b		0.5400 (49)
Enter (49) or (54) in (55)		1.1409 (55)

Total storage loss	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(56)
If cylinder contains dedicated solar storage	35.3664	31.9439	35.3664	34.2256	35.3664	34.2256	35.3664	35.3664	34.2256	35.3664	34.2256	35.3664	(57)

Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	224.3609	197.9054	208.2046	187.1414	183.7544	164.7114	158.6825	173.4418	172.9218	194.0303	204.5389	219.1315	(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													
	224.3609	197.9054	208.2046	187.1414	183.7544	164.7114	158.6825	173.4418	172.9218	194.0303	204.5389	219.1315	(64)
Total per year (kWh/year) = Sum(64)m =												2288.8250	(64)
Heat gains from water heating, kWh/month													
	102.0090	90.5600	96.6370	88.7493	88.5073	81.2914	80.1709	85.0784	84.0213	91.9241	94.5340	100.2702	(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	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.7343	21.9688	17.8662	13.5259	10.1108	8.5359	9.2234	11.9889	16.0915	20.4318	23.8469	25.4218	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	277.4438	280.3228	273.0678	257.6228	238.1263	219.8023	207.5607	204.6817	211.9367	227.3817	246.8782	265.2022	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	(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)													
	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	(71)
Water heating gains (Table 5)													
	137.1088	134.7620	129.8884	123.2629	118.9614	112.9047	107.7566	114.3527	116.6963	123.5538	131.2972	134.7718	(72)
Total internal gains													
	507.8535	505.6201	489.3891	462.9782	435.7650	409.8094	393.1072	399.5898	413.2910	439.9339	470.5890	493.9623	(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	5.2800	11.2829	0.6300	0.7000	0.7700	18.2066	(75)
Southeast	8.8200	36.7938	0.6300	0.7000	0.7700	99.1780	(77)
Southwest	2.7400	36.7938	0.6300	0.7000	0.7700	30.8104	(79)
Northwest	6.3500	11.2829	0.6300	0.7000	0.7700	21.8962	(81)
Southeast	3.0200	26.0000	0.6300	0.7000	1.0000	31.1646	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	201.2557	367.7751	565.0953	796.7048	975.2590	1003.2702	952.7703	815.1223	645.0880	423.5832	245.7108	169.1643	(83)
Total gains	709.1093	873.3952	1054.4843	1259.6830	1411.0240	1413.0796	1345.8775	1214.7121	1058.3790	863.5172	716.2998	663.1267	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.6434	54.7689	54.8924	55.4804	55.5918	56.1164	56.1164	56.2146	55.9131	55.5918	55.3669	55.1337	
alpha	4.6429	4.6513	4.6595	4.6987	4.7061	4.7411	4.7411	4.7476	4.7275	4.7061	4.6911	4.6756	
util living area													
	0.9976	0.9935	0.9793	0.9267	0.7984	0.6099	0.4555	0.5212	0.7916	0.9657	0.9947	0.9983	(86)
MIT	19.6190	19.8217	20.1445	20.5461	20.8384	20.9656	20.9930	20.9872	20.8861	20.4752	19.9682	19.5854	(87)
Th 2	19.8637	19.8660	19.8683	19.8789	19.8809	19.8901	19.8901	19.8918	19.8865	19.8809	19.8768	19.8726	(88)
util rest of house													
	0.9968	0.9912	0.9720	0.9016	0.7386	0.5165	0.3440	0.4022	0.7072	0.9490	0.9925	0.9977	(89)
MIT 2	18.0347	18.3316	18.7990	19.3662	19.7332	19.8692	19.8878	19.8870	19.8010	19.2840	18.5540	17.9917	(90)
Living area fraction										fLA = Living area / (4) =		0.2208	(91)
MIT	18.3845	18.6606	19.0961	19.6267	19.9772	20.1112	20.1318	20.1299	20.0406	19.5470	18.8662	18.3436	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3845	18.6606	19.0961	19.6267	19.9772	20.1112	20.1318	20.1299	20.0406	19.5470	18.8662	18.3436	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9952	0.9878	0.9653	0.8948	0.7443	0.5360	0.3687	0.4285	0.7203	0.9424	0.9895	0.9964	(94)
Useful gains	705.7038	862.7070	1017.9231	1127.1698	1050.1675	757.3556	496.2211	520.4925	762.3630	813.7438	708.8000	660.7558	(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													
	2043.9474	1992.3640	1819.6506	1533.1757	1180.6931	778.7972	499.0771	526.1554	842.5190	1276.2431	1685.2015	2034.2631	(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													
	995.6532	759.1295	596.4853	292.3242	97.1111	0.0000	0.0000	0.0000	0.0000	344.0995	703.0091	1021.8894	(98)
Space heating												4809.7012	(98)
Space heating per m2											(98) / (4) =	42.1202	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	93.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	5144.0654 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	995.6532	759.1295	596.4853	292.3242	97.1111	0.0000	0.0000	0.0000	0.0000	344.0995	703.0091	1021.8894	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1064.8697	811.9032	637.9521	312.6462	103.8621	0.0000	0.0000	0.0000	0.0000	368.0208	751.8814	1092.9298	(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													
	224.3609	197.9054	208.2046	187.1414	183.7544	164.7114	158.6825	173.4418	172.9218	194.0303	204.5389	219.1315	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.3221	88.0584	87.4656	85.9992	83.2012	79.8000	79.8000	79.8000	79.8000	86.3264	87.8454	88.4069	(217)
Fuel for water heating, kWh/month													
	254.0257	224.7435	238.0418	217.6082	220.8554	206.4053	198.8502	217.3456	216.6940	224.7635	232.8398	247.8670	(219)
Water heating fuel used												2700.0401	(219)
Annual totals kWh/year													
Space heating fuel - main system												5144.0654	(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)												436.8157	(232)
Total delivered energy for all uses												8355.9213	(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	5144.0654	0.2160	1111.1181	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2700.0401	0.2160	583.2087	(264)
Space and water heating			1694.3268	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	436.8157	0.5190	226.7074	(268)
Total CO2, kg/m2/year			1959.9592	(272)
Emissions per m2 for space and water heating			14.8378	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9854	(272b)
Emissions per m2 for pumps and fans			0.3409	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8378 * 1.00) + 1.9854 + 0.3409, rounded to 2 d.p.			17.1600	(273)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	302.3242	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =	0.1323	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2823	(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) =	0.2400	(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	0.3060	0.3000	0.2940	0.2640	0.2580	0.2280	0.2280	0.2220	0.2400	0.2580	0.2700	0.2820	(22b)
Effective ac	0.5468	0.5450	0.5432	0.5348	0.5333	0.5260	0.5260	0.5246	0.5288	0.5333	0.5364	0.5397	(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	
Door			2.3500	1.2000	2.8200			(26)
Windows (Uw = 0.80)			29.2000	0.7752	22.6357			(27)
French Doors (Uw = 0.80)			10.8100	0.7752	8.3798			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1000	3.9800			(28a)
Exposed Floor			5.8200	0.1000	0.5820			(28b)
External Wall 1	104.4300	31.7600	72.6700	0.1700	12.3539			(29a)
Clad Wall	50.3500	10.6000	39.7500	0.1700	6.7575			(29a)
Flat Roof	52.8200	5.2000	47.6200	0.1300	6.1906			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.7305			(33)
Party Wall 1			64.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.3347	(36)
Total fabric heat loss	(33) + (36) = 88.0652	(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	54.5529	54.3716	54.1939	53.3591	53.2029	52.4758	52.4758	52.3412	52.7559	53.2029	53.5188	53.8492	(38)
Heat transfer coeff	142.6181	142.4368	142.2591	141.4243	141.2681	140.5410	140.5410	140.4064	140.8211	141.2681	141.5841	141.9144	(39)
Average = Sum(39)m / 12 =												141.4235	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2490	1.2474	1.2458	1.2385	1.2371	1.2308	1.2308	1.2296	1.2332	1.2371	1.2399	1.2428	(40)
HLP (average)												1.2385	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8378	(42)
Average daily hot water use (litres/day)	101.5971	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													

	35.2181	30.8020	31.7849	27.7108	26.5892	22.9444	21.2614	24.3978	24.6892	28.7728	31.4078	34.1068 (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	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.7343	21.9688	17.8662	13.5259	10.1108	8.5359	9.2234	11.9889	16.0915	20.4318	23.8469	25.4218	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	277.4438	280.3228	273.0678	257.6228	238.1263	219.8023	207.5607	204.6817	211.9367	227.3817	246.8782	265.2022	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	(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)													
	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	(71)
Water heating gains (Table 5)													
	47.3361	45.8362	42.7216	38.4872	35.7381	31.8673	28.5771	32.7927	34.2905	38.6732	43.6219	45.8425	(72)
Total internal gains													
	415.0808	413.6944	399.2222	375.2025	349.5418	325.7721	310.9278	315.0299	327.8852	352.0532	379.9137	402.0331	(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	7.1000	11.2829	0.5700	0.7000	0.7700	22.1507	(75)
Southeast	15.2100	36.7938	0.5700	0.7000	0.7700	154.7428	(77)
Northwest	6.8900	11.2829	0.5700	0.7000	0.7700	21.4955	(81)
Southeast	5.2000	26.0000	0.5700	0.7000	1.0000	48.5503	(82)
Northeast	2.0300	11.2829	0.5700	0.7000	0.7700	6.3332	(75)
Southwest	4.7300	36.7938	0.5700	0.7000	0.7700	48.1218	(79)
Northwest	4.0500	11.2829	0.5700	0.7000	0.7700	12.6352	(81)

Solar gains	314.0296	573.8427	881.6955	1243.0425	1521.6211	1565.3253	1486.5338	1271.7742	1006.4951	660.9121	383.3920	263.9578	(83)
Total gains	729.1104	987.5371	1280.9177	1618.2450	1871.1629	1891.0973	1797.4616	1586.8040	1334.3803	1012.9653	763.3057	665.9909	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.6021	55.6728	55.7424	56.0714	56.1334	56.4238	56.4238	56.4779	56.3116	56.1334	56.0081	55.8778	
alpha	4.7068	4.7115	4.7162	4.7381	4.7422	4.7616	4.7616	4.7652	4.7541	4.7422	4.7339	4.7252	
util living area													
	0.9974	0.9892	0.9571	0.8480	0.6571	0.4683	0.3426	0.4037	0.6759	0.9396	0.9931	0.9983	(86)
MIT	19.6633	19.9362	20.3236	20.7256	20.9318	20.9887	20.9980	20.9957	20.9435	20.5811	20.0209	19.6094	(87)
Th 2	19.8810	19.8823	19.8835	19.8893	19.8904	19.8955	19.8955	19.8964	19.8935	19.8904	19.8882	19.8859	(88)
util rest of house													
	0.9965	0.9856	0.9437	0.8086	0.5926	0.3907	0.2574	0.3086	0.5871	0.9137	0.9902	0.9977	(89)
MIT 2	18.6727	18.9443	19.3216	19.6905	19.8514	19.8911	19.8950	19.8954	19.8672	19.5772	19.0347	18.6229	(90)
Living area fraction										fLA = Living area / (4) =		0.2208	(91)
MIT	18.8914	19.1633	19.5428	19.9191	20.0899	20.1335	20.1385	20.1383	20.1048	19.7988	19.2524	18.8407	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8914	19.1633	19.5428	19.9191	20.0899	20.1335	20.1385	20.1383	20.1048	19.7988	19.2524	18.8407	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9953	0.9825	0.9387	0.8098	0.6047	0.4077	0.2762	0.3296	0.6051	0.9111	0.9880	0.9969	(94)
Useful gains	725.7008	970.2988	1202.3831	1310.4575	1131.4845	770.9818	496.5152	523.0740	807.4277	922.8673	754.1596	663.8945	(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													
	2081.0023	2031.6142	1855.4594	1558.3617	1185.2243	777.6773	497.3079	524.8807	845.6059	1299.4982	1720.5887	2077.7257	(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													
	1008.3443	713.2040	485.8888	178.4910	39.9824	0.0000	0.0000	0.0000	0.0000	280.2134	695.8289	1051.8904	(98)
Space heating												4453.8433	(98)
Space heating per m2											(98) / (4) =	39.0038	(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	1321.0857	1040.0036	1067.0885	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9662	0.9835	0.9718	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1276.4483	1022.8642	1037.0434	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2259.4386	2150.9701	1916.8730	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	707.7530	839.3108	654.5932	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												2201.6570	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	176.9383	209.8277	163.6483	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												550.4143	(107)
Space cooling per m2												4.8202	(108)
Energy for space heating												39.0038	(99)

Energy for space cooling	4.8202 (108)
Total	43.8240 (109)
Dwelling Fabric Energy Efficiency (DFEE)	43.8 (109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	302.3242	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =	0.1323	(8)
Pressure test		Yes	
Measured/design q50		5.0000	
Infiltration rate		0.3823	(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) =	0.3250	(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	0.4143	0.4062	0.3981	0.3575	0.3493	0.3087	0.3087	0.3006	0.3250	0.3493	0.3656	0.3818	(22b)
Effective ac	0.5858	0.5825	0.5792	0.5639	0.5610	0.5477	0.5477	0.5452	0.5528	0.5610	0.5668	0.5729	(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			2.3500	1.0000	2.3500			(26)
TER Opening Type (Uw = 1.40)			23.1900	1.3258	30.7443			(27)
TER Room Window (Uw = 1.70)			3.0200	1.5918	4.8071			(27a)
Heat Loss Floor 1			39.8000	0.1300	5.1740			(28a)
Exposed Floor			5.8200	0.1300	0.7566			(28b)
External Wall 1	104.4300	19.4100	85.0200	0.1800	15.3036			(29a)
Clad Wall	50.3500	6.1300	44.2200	0.1800	7.9596			(29a)
Flat Roof	52.8200	3.0200	49.8000	0.1300	6.4740			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	73.5692			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		13.1042 (36)
Total fabric heat loss	(33) + (36) =	86.6734 (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	58.4468	58.1143	57.7884	56.2574	55.9710	54.6376	54.6376	54.3907	55.1512	55.9710	56.5504	57.1562	(38)
Heat transfer coeff	145.1203	144.7877	144.4618	142.9309	142.6444	141.3110	141.3110	141.0641	141.8246	142.6444	143.2239	143.8297	(39)
Average = Sum(39)m / 12 =												142.9295	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2709	1.2680	1.2651	1.2517	1.2492	1.2375	1.2375	1.2353	1.2420	1.2492	1.2543	1.2596	(40)
HLP (average)												1.2517	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8378 (42)
Average daily hot water use (litres/day)	101.5971 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	35.2181	30.8020	31.7849	27.7108	26.5892	22.9444	21.2614	24.3978	24.6892	28.7728	31.4078	34.1068	(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	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	141.8886	(66)

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

	24.7343	21.9688	17.8662	13.5259	10.1108	8.5359	9.2234	11.9889	16.0915	20.4318	23.8469	25.4218	(67)

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

	277.4438	280.3228	273.0678	257.6228	238.1263	219.8023	207.5607	204.6817	211.9367	227.3817	246.8782	265.2022	(68)

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

	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	37.1889	(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)

	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	(71)

Water heating gains (Table 5)

	47.3361	45.8362	42.7216	38.4872	35.7381	31.8673	28.5771	32.7927	34.2905	38.6732	43.6219	45.8425	(72)

Total internal gains

	415.0808	413.6944	399.2222	375.2025	349.5418	325.7721	310.9278	315.0299	327.8852	352.0532	379.9137	402.0331	(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	5.2800	11.2829	0.6300	0.7000	0.7700	18.2066	(75)
Southeast	8.8200	36.7938	0.6300	0.7000	0.7700	99.1780	(77)
Southwest	2.7400	36.7938	0.6300	0.7000	0.7700	30.8104	(79)
Northwest	6.3500	11.2829	0.6300	0.7000	0.7700	21.8962	(81)
Southeast	3.0200	26.0000	0.6300	0.7000	1.0000	31.1646	(82)

Solar gains	201.2557	367.7751	565.0953	796.7048	975.2590	1003.2702	952.7703	815.1223	645.0880	423.5832	245.7108	169.1643	(83)
Total gains	616.3365	781.4695	964.3175	1171.9073	1324.8008	1329.0422	1263.6981	1130.1521	972.9732	775.6365	625.6245	571.1974	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.6434	54.7689	54.8924	55.4804	55.5918	56.1164	56.1164	56.2146	55.9131	55.5918	55.3669	55.1337	
alpha	4.6429	4.6513	4.6595	4.6987	4.7061	4.7411	4.7411	4.7476	4.7275	4.7061	4.6911	4.6756	
util living area													
	0.9987	0.9959	0.9853	0.9419	0.8253	0.6411	0.4832	0.5559	0.8278	0.9769	0.9970	0.9991	(86)
MIT	19.5451	19.7497	20.0780	20.4948	20.8116	20.9576	20.9910	20.9832	20.8599	20.4137	19.8966	19.5117	(87)
Th 2	19.8637	19.8660	19.8683	19.8789	19.8809	19.8901	19.8901	19.8918	19.8865	19.8809	19.8768	19.8726	(88)
util rest of house													
	0.9982	0.9944	0.9799	0.9208	0.7687	0.5458	0.3659	0.4310	0.7487	0.9649	0.9957	0.9988	(89)
MIT 2	18.5413	18.7470	19.0738	19.4831	19.7608	19.8721	19.8880	19.8874	19.8119	19.4160	18.9026	18.5150	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	18.7629	18.9684	19.2955	19.7064	19.9928	20.1118	20.1315	20.1294	20.0433	19.6362	19.1221	18.7350	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7629	18.9684	19.2955	19.7064	19.9928	20.1118	20.1315	20.1294	20.0433	19.6362	19.1221	18.7350	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9976	0.9928	0.9763	0.9168	0.7750	0.5658	0.3920	0.4588	0.7615	0.9614	0.9945	0.9983	(94)
Useful gains	614.8626	775.8531	941.4997	1074.4391	1026.7676	752.0334	495.3373	518.5310	740.8794	745.6900	622.1652	570.2338	(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													
	2098.8551	2036.9305	1848.4579	1544.5710	1182.9233	778.8776	499.0441	526.0778	842.9058	1288.9670	1721.8476	2090.5694	(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													
	1104.0904	847.4440	674.7769	338.4950	116.1798	0.0000	0.0000	0.0000	0.0000	404.1981	791.7713	1131.1296	(98)
Space heating												5408.0851	(98)
Space heating per m2										(98) / (4) =		47.3604	(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	1328.3238	1045.7017	1072.0873	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8976	0.9436	0.9160	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1192.3430	986.7148	982.0682	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1625.0700	1548.4277	1400.8485	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	311.5634	417.9144	311.5725	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1041.0503	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	77.8909	104.4786	77.8931	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												260.2626	(107)
Space cooling per m2												2.2792	(108)
Energy for space heating												47.3604	(99)
Energy for space cooling												2.2792	(108)
Total												49.6396	(109)
Target Fabric Energy Efficiency (TFEE)												57.1	(109)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	302.3242	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =	0.1323	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2823	(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) =	0.2400	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.5000	3.4000	3.4000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8750	0.8500	0.8500	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.2580	0.2460	0.2460	0.2280	0.2340	0.2040	0.2100	0.2040	0.2040	0.2220	0.2160	0.2400	(22b)
Effective ac	0.5333	0.5302	0.5302	0.5260	0.5274	0.5208	0.5220	0.5208	0.5208	0.5246	0.5233	0.5288	(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	
Door			2.3500	1.2000	2.8200			(26)
Windows (Uw = 0.80)			29.2000	0.7752	22.6357			(27)
French Doors (Uw = 0.80)			10.8100	0.7752	8.3798			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1000	3.9800			(28a)
Exposed Floor			5.8200	0.1000	0.5820			(28b)
External Wall 1	104.4300	31.7600	72.6700	0.1700	12.3539			(29a)
Clad Wall	50.3500	10.6000	39.7500	0.1700	6.7575			(29a)
Flat Roof	52.8200	5.2000	47.6200	0.1300	6.1906			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.7305			(33)
Party Wall 1			64.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.3347	(36)
Total fabric heat loss	(33) + (36) = 88.0652	(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	53.2029	52.9013	52.9013	52.4758	52.6140	51.9588	52.0827	51.9588	51.9588	52.3412	52.2101	52.7559	(38)
Heat transfer coeff	141.2681	140.9665	140.9665	140.5410	140.6793	140.0240	140.1479	140.0240	140.0240	140.4064	140.2753	140.8211	(39)

Average = Sum(39)m / 12 = 140.5120 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2371	1.2345	1.2345	1.2308	1.2320	1.2262	1.2273	1.2262	1.2262	1.2296	1.2284	1.2332	(40)
HLP (average)												1.2305	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8378	(42)
Average daily hot water use (litres/day)	101.5971	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8598	21.7426	22.4364	19.5606	18.7688	16.1961	15.0080	17.2220	17.4276	20.3102	22.1702	24.0754	(46)

Water storage loss:		
Store volume	300.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0103	(51)
Volume factor from Table 2a	0.7368	(52)
Temperature factor from Table 2b	0.5400	(53)
Enter (49) or (54) in (55)	1.2281	(55)

Total storage loss
38.0698 34.3856 38.0698 36.8417 38.0698 36.8417 38.0698 38.0698 36.8417 38.0698 36.8417 38.0698 (56)
If cylinder contains dedicated solar storage
38.0698 34.3856 38.0698 36.8417 38.0698 36.8417 38.0698 38.0698 36.8417 38.0698 36.8417 38.0698 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
227.0643 200.3472 210.9080 189.7575 186.4577 167.3276 161.3858 176.1452 175.5380 196.7337 207.1551 221.8349 (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
227.0643 200.3472 210.9080 189.7575 186.4577 167.3276 161.3858 176.1452 175.5380 196.7337 207.1551 221.8349 (64)
Total per year (kWh/year) = Sum(64)m = 2320.6551 (64)
RHI water heating demand 2321 (64)
Heat gains from water heating, kWh/month
104.1717 92.5135 98.7997 90.8423 90.6700 83.3843 82.3336 87.2411 86.1142 94.0868 96.6269 102.4329 (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	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	61.8358	54.9220	44.6656	33.8147	25.2769	21.3398	23.0584	29.9722	40.2286	51.0795	59.6173	63.5544	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	414.0952	418.3922	407.5639	384.5116	355.4123	328.0631	309.7921	305.4951	316.3234	339.3757	368.4750	395.8242	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.8644	54.8644	54.8644	54.8644	54.8644	54.8644	54.8644	54.8644	54.8644	54.8644	54.8644	54.8644	(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)													
	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	-113.5109	(71)
Water heating gains (Table 5)													
	140.0157	137.6688	132.7953	126.1698	121.8683	115.8115	110.6634	117.2595	119.6031	126.4607	134.2041	137.6786	(72)
Total internal gains													
	730.5665	725.6029	699.6446	659.1160	617.1774	579.8343	558.1338	567.3467	590.7750	631.5357	676.9162	711.6771	(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	7.1000	12.4885	0.5700	0.7000	0.7700	24.5174	(75)
Southeast	15.2100	39.0225	0.5700	0.7000	0.7700	164.1157	(77)
Northwest	6.8900	12.4885	0.5700	0.7000	0.7700	23.7923	(81)
Southeast	5.2000	29.0000	0.5700	0.7000	1.0000	54.1523	(82)
Northeast	2.0300	12.4885	0.5700	0.7000	0.7700	7.0099	(75)
Southwest	4.7300	39.0225	0.5700	0.7000	0.7700	51.0366	(79)
Northwest	4.0500	12.4885	0.5700	0.7000	0.7700	13.9853	(81)

Solar gains	338.6095	557.0700	862.8518	1260.5061	1503.9990	1652.1925	1564.9580	1379.9906	1083.3225	701.8614	427.2371	279.2287	(83)
Total gains	1069.1760	1282.6729	1562.4965	1919.6221	2121.1763	2232.0267	2123.0918	1947.3372	1674.0976	1333.3971	1104.1533	990.9058	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.1334	56.2535	56.2535	56.4238	56.3684	56.6322	56.5821	56.6322	56.6322	56.4779	56.5307	56.3116	
alpha	4.7422	4.7502	4.7502	4.7616	4.7579	4.7755	4.7721	4.7755	4.7755	4.7652	4.7687	4.7541	
util living area													
	0.9822	0.9603	0.8824	0.6988	0.4822	0.2756	0.1584	0.1869	0.4303	0.7885	0.9562	0.9867	(86)
MIT	20.2595	20.4152	20.6757	20.8699	20.9319	20.9426	20.9431	20.9431	20.9385	20.8396	20.5188	20.2193	(87)
Th 2	19.8904	19.8925	19.8925	19.8955	19.8945	19.8991	19.8982	19.8991	19.8991	19.8964	19.8973	19.8935	(88)
util rest of house													
	0.9763	0.9481	0.8507	0.6415	0.4136	0.2069	0.0857	0.1078	0.3415	0.7236	0.9399	0.9822	(89)
MIT 2	18.9396	19.1610	19.5124	19.7453	19.8038	19.8157	19.8150	19.8159	19.8139	19.7224	19.3144	18.8848	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	19.2310	19.4379	19.7692	19.9936	20.0528	20.0645	20.0640	20.0648	20.0621	19.9691	19.5803	19.1794	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2310	19.4379	19.7692	19.9936	20.0528	20.0645	20.0640	20.0648	20.0621	19.9691	19.5803	19.1794	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9717	0.9419	0.8466	0.6469	0.4236	0.2172	0.0966	0.1197	0.3548	0.7283	0.9341	0.9783	(94)
Useful gains	1038.9416	1208.1359	1322.8672	1241.7698	898.5561	484.8539	205.1787	233.0970	594.0073	971.1481	1031.4222	969.4506	(95)
Ext temp.	5.6000	6.1000	8.1000	10.6000	13.6000	16.6000	18.6000	18.4000	15.8000	12.3000	8.5000	5.6000	(96)
Heat loss rate W													
	1925.6234	1880.1904	1644.9730	1320.1879	907.7810	485.1134	205.1814	233.1051	596.8020	1076.7881	1554.2928	1912.2719	(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													
	659.6912	451.6206	239.6467	56.4610	6.8633	0.0000	0.0000	0.0000	0.0000	78.5962	376.4669	701.4591	(98)
Space heating												2570.8048	(98)
RHI space heating demand												2571	(98)

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	302.3242	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =	0.1323	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2823	(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) =	0.2400	(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	0.3060	0.3000	0.2940	0.2640	0.2580	0.2280	0.2280	0.2220	0.2400	0.2580	0.2700	0.2820	(22b)
Effective ac	0.5468	0.5450	0.5432	0.5348	0.5333	0.5260	0.5260	0.5246	0.5288	0.5333	0.5364	0.5397	(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	
Door			2.3500	1.2000	2.8200			(26)
Windows (Uw = 0.80)			29.2000	0.7752	22.6357			(27)
French Doors (Uw = 0.80)			10.8100	0.7752	8.3798			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1000	3.9800			(28a)
Exposed Floor			5.8200	0.1000	0.5820			(28b)
External Wall 1	104.4300	31.7600	72.6700	0.1700	12.3539			(29a)
Clad Wall	50.3500	10.6000	39.7500	0.1700	6.7575			(29a)
Flat Roof	52.8200	5.2000	47.6200	0.1300	6.1906			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.7305			(33)
Party Wall 1			64.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.3347	(36)
Total fabric heat loss (33) + (36) =	88.0652	(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	54.5529	54.3716	54.1939	53.3591	53.2029	52.4758	52.4758	52.3412	52.7559	53.2029	53.5188	53.8492	(38)
Heat transfer coeff	142.6181	142.4368	142.2591	141.4243	141.2681	140.5410	140.5410	140.4064	140.8211	141.2681	141.5841	141.9144	(39)
Average = Sum(39)m / 12 =												141.4235	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2490	1.2474	1.2458	1.2385	1.2371	1.2308	1.2308	1.2296	1.2332	1.2371	1.2399	1.2428	(40)
HLP (average)												1.2385	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8378	(42)
Average daily hot water use (litres/day)	101.5971	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8598	21.7426	22.4364	19.5606	18.7688	16.1961	15.0080	17.2220	17.4276	20.3102	22.1702	24.0754	(46)

Water storage loss:		
Store volume	300.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0103	(51)
Volume factor from Table 2a	0.7368	(52)
Temperature factor from Table 2b	0.5400	(53)
Enter (49) or (54) in (55)	1.2281	(55)

Total storage loss
38.0698 34.3856 38.0698 36.8417 38.0698 36.8417 38.0698 38.0698 36.8417 38.0698 36.8417 38.0698 (56)
If cylinder contains dedicated solar storage
38.0698 34.3856 38.0698 36.8417 38.0698 36.8417 38.0698 38.0698 36.8417 38.0698 36.8417 38.0698 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
227.0643 200.3472 210.9080 189.7575 186.4577 167.3276 161.3858 176.1452 175.5380 196.7337 207.1551 221.8349 (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
227.0643 200.3472 210.9080 189.7575 186.4577 167.3276 161.3858 176.1452 175.5380 196.7337 207.1551 221.8349 (64)
Total per year (kWh/year) = Sum(64)m = 2320.6551 (64)
Heat gains from water heating, kWh/month
104.1717 92.5135 98.7997 90.8423 90.6700 83.3843 82.3336 87.2411 86.1142 94.0868 96.6269 102.4329 (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	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
61.8358 54.9220 44.6656 33.8147 25.2769 21.3398 23.0584 29.9722 40.2286 51.0795 59.6173 63.5544 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
414.0952 418.3922 407.5639 384.5116 355.4123 328.0631 309.7921 305.4951 316.3234 339.3757 368.4750 395.8242 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 (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)
-113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 (71)
Water heating gains (Table 5)
140.0157 137.6688 132.7953 126.1698 121.8683 115.8115 110.6634 117.2595 119.6031 126.4607 134.2041 137.6786 (72)
Total internal gains
730.5665 725.6029 699.6446 659.1160 617.1774 579.8343 558.1338 567.3467 590.7750 631.5357 676.9162 711.6771 (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	7.1000	11.2829	0.5700	0.7000	0.7700	22.1507	(75)
Southeast	15.2100	36.7938	0.5700	0.7000	0.7700	154.7428	(77)
Northwest	6.8900	11.2829	0.5700	0.7000	0.7700	21.4955	(81)
Southeast	5.2000	26.0000	0.5700	0.7000	1.0000	48.5503	(82)
Northeast	2.0300	11.2829	0.5700	0.7000	0.7700	6.3332	(75)
Southwest	4.7300	36.7938	0.5700	0.7000	0.7700	48.1218	(79)
Northwest	4.0500	11.2829	0.5700	0.7000	0.7700	12.6352	(81)

Solar gains	314.0296	573.8427	881.6955	1243.0425	1521.6211	1565.3253	1486.5338	1271.7742	1006.4951	660.9121	383.3920	263.9578	(83)
Total gains	1044.5961	1299.4456	1581.3401	1902.1585	2138.7985	2145.1595	2044.6676	1839.1208	1597.2702	1292.4478	1060.3083	975.6349	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.6021	55.6728	55.7424	56.0714	56.1334	56.4238	56.4238	56.4779	56.3116	56.1334	56.0081	55.8778	
alpha	4.7068	4.7115	4.7162	4.7381	4.7422	4.7616	4.7616	4.7652	4.7541	4.7422	4.7339	4.7252	
util living area	0.9883	0.9690	0.9147	0.7794	0.5892	0.4154	0.3017	0.3496	0.5845	0.8743	0.9746	0.9913	(86)
MIT	20.1248	20.3157	20.5689	20.8039	20.9103	20.9379	20.9422	20.9413	20.9199	20.7368	20.3755	20.0831	(87)
Th 2	19.8810	19.8823	19.8835	19.8893	19.8904	19.8955	19.8955	19.8964	19.8935	19.8904	19.8882	19.8859	(88)
util rest of house	0.9846	0.9599	0.8921	0.7334	0.5271	0.3455	0.2264	0.2666	0.5003	0.8321	0.9655	0.9885	(89)
MIT 2	18.7374	19.0108	19.3613	19.6641	19.7802	19.8092	19.8118	19.8125	19.7951	19.5959	19.1048	18.6810	(90)
Living area fraction										fLA = Living area / (4) =		0.2208	(91)
MIT	19.0437	19.2989	19.6279	19.9157	20.0297	20.0584	20.0613	20.0617	20.0434	19.8478	19.3854	18.9905	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0437	19.2989	19.6279	19.9157	20.0297	20.0584	20.0613	20.0617	20.0434	19.8478	19.3854	18.9905	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9810	0.9539	0.8860	0.7346	0.5351	0.3559	0.2377	0.2791	0.5122	0.8303	0.9602	0.9855	(94)
Useful gains	1024.7025	1239.5732	1401.1175	1397.3546	1144.5577	763.4402	486.0612	513.2698	818.0500	1073.0693	1018.0883	961.4751	(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	2102.7157	2050.9341	1867.5613	1557.8919	1176.7248	767.1330	486.4593	514.1233	836.9571	1306.4188	1739.4115	2098.9870	(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	802.0418	545.2345	347.0342	115.5869	23.9324	0.0000	0.0000	0.0000	0.0000	173.6120	519.3526	846.3089	(98)
Space heating												3373.1033	(98)
Space heating per m2											(98) / (4) =	29.5394	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.0000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	3747.8926 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	802.0418	545.2345	347.0342	115.5869	23.9324	0.0000	0.0000	0.0000	0.0000	173.6120	519.3526	846.3089	(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)													
	891.1576	605.8161	385.5935	128.4299	26.5915	0.0000	0.0000	0.0000	0.0000	192.9022	577.0585	940.3432	(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													
	227.0643	200.3472	210.9080	189.7575	186.4577	167.3276	161.3858	176.1452	175.5380	196.7337	207.1551	221.8349	(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													
	252.2937	222.6080	234.3422	210.8417	207.1753	185.9195	179.3176	195.7169	195.0422	218.5930	230.1723	246.4832	(219)
Water heating fuel used												2578.5057	(219)
Annual totals kWh/year													
Space heating fuel - main system												3747.8926	(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)												436.8157	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
Total delivered energy for all uses												6793.2139	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3747.8926	3.4800	130.4267	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2578.5057	3.4800	89.7320	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	436.8157	13.1900	57.6160	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-962.0000	13.1900	-126.8878	(252)
Total energy cost			274.8439	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7251 (257)
SAP value		89.8844
SAP rating (Section 12)		90 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3747.8926	0.2160	809.5448	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2578.5057	0.2160	556.9572	(264)
Space and water heating			1366.5020	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	436.8157	0.5190	226.7074	(268)
Energy saving/generation technologies				
PV Unit	-962.0000	0.5190	-499.2780	(269)
Total kg/year			1109.5014	(272)
CO2 emissions per m2			9.7200	(273)
EI value			90.6606	
EI rating			91	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.25) / 0.9000 = 4.147, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.25) / 0.9000 = 0.2574, stars = 4
Water heating energy efficiency	3.48 / 0.9000 = 3.867, stars = 4
Water heating environmental impact	0.216 / 0.9000 = 0.2400, stars = 4

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	302.3242	(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							4 * 10	=	40.0000	(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) =	40.0000	/ (5) =	0.1323	(8)
Pressure test			Yes	
Measured/design q50			3.0000	
Infiltration rate			0.2823	(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)	=	0.2400	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.5000	3.4000	3.4000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8750	0.8500	0.8500	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.2580	0.2460	0.2460	0.2280	0.2340	0.2040	0.2100	0.2040	0.2040	0.2220	0.2160	0.2400	(22b)
Effective ac	0.5333	0.5302	0.5302	0.5260	0.5274	0.5208	0.5220	0.5208	0.5208	0.5246	0.5233	0.5288	(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	
Door			2.3500	1.2000	2.8200			(26)
Windows (Uw = 0.80)			29.2000	0.7752	22.6357			(27)
French Doors (Uw = 0.80)			10.8100	0.7752	8.3798			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1000	3.9800			(28a)
Exposed Floor			5.8200	0.1000	0.5820			(28b)
External Wall 1	104.4300	31.7600	72.6700	0.1700	12.3539			(29a)
Clad Wall	50.3500	10.6000	39.7500	0.1700	6.7575			(29a)
Flat Roof	52.8200	5.2000	47.6200	0.1300	6.1906			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.7305			(33)
Party Wall 1			64.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		20.3347 (36)
Total fabric heat loss	(33) + (36) =	88.0652 (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	53.2029	52.9013	52.9013	52.4758	52.6140	51.9588	52.0827	51.9588	51.9588	52.3412	52.2101	52.7559	(38)
Heat transfer coeff	141.2681	140.9665	140.9665	140.5410	140.6793	140.0240	140.1479	140.0240	140.0240	140.4064	140.2753	140.8211	(39)
Average = Sum(39)m / 12 =												140.5120	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2371	1.2345	1.2345	1.2308	1.2320	1.2262	1.2273	1.2262	1.2262	1.2296	1.2284	1.2332	(40)
HLP (average)												1.2305	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.8378 (42)
Average daily hot water use (litres/day)		101.5971 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8598	21.7426	22.4364	19.5606	18.7688	16.1961	15.0080	17.2220	17.4276	20.3102	22.1702	24.0754	(46)

Water storage loss:		
Store volume		300.0000 (47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.0103 (51)
Volume factor from Table 2a		0.7368 (52)
Temperature factor from Table 2b		0.5400 (53)
Enter (49) or (54) in (55)		1.2281 (55)

Total storage loss
38.0698 34.3856 38.0698 36.8417 38.0698 36.8417 38.0698 38.0698 36.8417 38.0698 36.8417 38.0698 (56)
If cylinder contains dedicated solar storage
38.0698 34.3856 38.0698 36.8417 38.0698 36.8417 38.0698 38.0698 36.8417 38.0698 36.8417 38.0698 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
227.0643 200.3472 210.9080 189.7575 186.4577 167.3276 161.3858 176.1452 175.5380 196.7337 207.1551 221.8349 (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
227.0643 200.3472 210.9080 189.7575 186.4577 167.3276 161.3858 176.1452 175.5380 196.7337 207.1551 221.8349 (64)
Total per year (kWh/year) = Sum(64)m = 2320.6551 (64)
Heat gains from water heating, kWh/month
104.1717 92.5135 98.7997 90.8423 90.6700 83.3843 82.3336 87.2411 86.1142 94.0868 96.6269 102.4329 (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	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
61.8358 54.9220 44.6656 33.8147 25.2769 21.3398 23.0584 29.9722 40.2286 51.0795 59.6173 63.5544 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
414.0952 418.3922 407.5639 384.5116 355.4123 328.0631 309.7921 305.4951 316.3234 339.3757 368.4750 395.8242 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 (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)
-113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 (71)
Water heating gains (Table 5)
140.0157 137.6688 132.7953 126.1698 121.8683 115.8115 110.6634 117.2595 119.6031 126.4607 134.2041 137.6786 (72)
Total internal gains
730.5665 725.6029 699.6446 659.1160 617.1774 579.8343 558.1338 567.3467 590.7750 631.5357 676.9162 711.6771 (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	7.1000	12.4885	0.5700	0.7000	0.7700	24.5174	(75)
Southeast	15.2100	39.0225	0.5700	0.7000	0.7700	164.1157	(77)
Northwest	6.8900	12.4885	0.5700	0.7000	0.7700	23.7923	(81)
Southeast	5.2000	29.0000	0.5700	0.7000	1.0000	54.1523	(82)
Northeast	2.0300	12.4885	0.5700	0.7000	0.7700	7.0099	(75)
Southwest	4.7300	39.0225	0.5700	0.7000	0.7700	51.0366	(79)
Northwest	4.0500	12.4885	0.5700	0.7000	0.7700	13.9853	(81)

Solar gains	338.6095	557.0700	862.8518	1260.5061	1503.9990	1652.1925	1564.9580	1379.9906	1083.3225	701.8614	427.2371	279.2287	(83)
Total gains	1069.1760	1282.6729	1562.4965	1919.6221	2121.1763	2232.0267	2123.0918	1947.3372	1674.0976	1333.3971	1104.1533	990.9058	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.1334	56.2535	56.2535	56.4238	56.3684	56.6322	56.5821	56.6322	56.6322	56.4779	56.5307	56.3116	
alpha	4.7422	4.7502	4.7502	4.7616	4.7579	4.7755	4.7721	4.7755	4.7755	4.7652	4.7687	4.7541	
util living area	0.9822	0.9603	0.8824	0.6988	0.4822	0.2756	0.1584	0.1869	0.4303	0.7885	0.9562	0.9867	(86)
MIT	20.2595	20.4152	20.6757	20.8699	20.9319	20.9426	20.9431	20.9431	20.9385	20.8396	20.5188	20.2193	(87)
Th 2	19.8904	19.8925	19.8925	19.8955	19.8945	19.8991	19.8982	19.8991	19.8991	19.8964	19.8973	19.8935	(88)
util rest of house	0.9763	0.9481	0.8507	0.6415	0.4136	0.2069	0.0857	0.1078	0.3415	0.7236	0.9399	0.9822	(89)
MIT 2	18.9396	19.1610	19.5124	19.7453	19.8038	19.8157	19.8150	19.8159	19.8139	19.7224	19.3144	18.8848	(90)

Living area fraction fLA = Living area / (4) = 0.2208 (91)

MIT	19.2310	19.4379	19.7692	19.9936	20.0528	20.0645	20.0640	20.0648	20.0621	19.9691	19.5803	19.1794	(92)

Temperature adjustment 0.0000

adjusted MIT	19.2310	19.4379	19.7692	19.9936	20.0528	20.0645	20.0640	20.0648	20.0621	19.9691	19.5803	19.1794	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9717	0.9419	0.8466	0.6469	0.4236	0.2172	0.0966	0.1197	0.3548	0.7283	0.9341	0.9783	(94)
Useful gains	1038.9416	1208.1359	1322.8672	1241.7698	898.5561	484.8539	205.1787	233.0970	594.0073	971.1481	1031.4222	969.4506	(95)
Ext temp.	5.6000	6.1000	8.1000	10.6000	13.6000	16.6000	18.6000	18.4000	15.8000	12.3000	8.5000	5.6000	(96)
Heat loss rate W	1925.6234	1880.1904	1644.9730	1320.1879	907.7810	485.1134	205.1814	233.1051	596.8020	1076.7881	1554.2928	1912.2719	(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	659.6912	451.6206	239.6467	56.4610	6.8633	0.0000	0.0000	0.0000	0.0000	78.5962	376.4669	701.4591	(98)

Space heating 2570.8048 (98)
Space heating per m2 (98) / (4) = 22.5134 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.0000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	2856.4498 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	659.6912	451.6206	239.6467	56.4610	6.8633	0.0000	0.0000	0.0000	0.0000	78.5962	376.4669	701.4591	(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)													
	732.9902	501.8006	266.2741	62.7344	7.6258	0.0000	0.0000	0.0000	0.0000	87.3291	418.2965	779.3990	(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													
	227.0643	200.3472	210.9080	189.7575	186.4577	167.3276	161.3858	176.1452	175.5380	196.7337	207.1551	221.8349	(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													
	252.2937	222.6080	234.3422	210.8417	207.1753	185.9195	179.3176	195.7169	195.0422	218.5930	230.1723	246.4832	(219)
Water heating fuel used												2578.5057	(219)
Annual totals kWh/year													
Space heating fuel - main system												2856.4498	(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)												436.8157	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
Total delivered energy for all uses												5901.7712	(238)

10a. Fuel costs - using BEDF prices (394)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2856.4498	4.3200	123.3986	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2578.5057	4.3200	111.3914	(247)
Pumps and fans for heating	30.0000	15.3200	4.5960	(249)
Energy for lighting	436.8157	15.3200	66.9202	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-962.0000	15.3200	-147.3784	(252)
Total energy cost			253.9278	(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	2856.4498	0.2160	616.9932	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2578.5057	0.2160	556.9572	(264)
Space and water heating			1173.9504	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	436.8157	0.5190	226.7074	(268)
Energy saving/generation technologies				
PV Unit	-962.0000	0.5190	-499.2780	(269)
Total kg/year			916.9497	(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	2856.4498	1.2200	3484.8688	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2578.5057	1.2200	3145.7769	(264)
Space and water heating			6630.6457	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	436.8157	3.0700	1341.0243	(268)
Energy saving/generation technologies				
PV Unit	-962.0000	3.0700	-2953.3400	(269)
Primary energy kWh/year			5110.4300	(272)
Primary energy kWh/m2/year			44.7537	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 90
Current environmental impact rating:	B 91

(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	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
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
N Solar water heating	+ 1.3	-£ 45	-237 kg (25.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£45	2.07 kg/m²	B 91	A 93
Total Savings	£45	2.07 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 394 TEST (20 May 2016)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£72	£79	-£8
Mains gas	£330	£277	£53
Space heating	£223	£224	-£1
Water heating	£111	£65	£46
Lighting	£67	£67	£0
Generated (PV)	-£147	-£147	£0
Total cost of fuels	£255	£209	£45
Total cost of uses	£254	£209	£45
Delivered energy	52 kWh/m²	41 kWh/m²	10 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.7 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	45 kWh/m²	33 kWh/m²	12 kWh/m²

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	302.3242	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =	0.1323	(8)
Pressure test		Yes	
Measured/design q50		3.0000	
Infiltration rate		0.2823	(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) =	0.2400	(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	0.3060	0.3000	0.2940	0.2640	0.2580	0.2280	0.2280	0.2220	0.2400	0.2580	0.2700	0.2820	(22b)
Effective ac	0.5468	0.5450	0.5432	0.5348	0.5333	0.5260	0.5260	0.5246	0.5288	0.5333	0.5364	0.5397	(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	
Door			2.3500	1.2000	2.8200			(26)
Windows (Uw = 0.80)			29.2000	0.7752	22.6357			(27)
French Doors (Uw = 0.80)			10.8100	0.7752	8.3798			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1000	3.9800			(28a)
Exposed Floor			5.8200	0.1000	0.5820			(28b)
External Wall 1	104.4300	31.7600	72.6700	0.1700	12.3539			(29a)
Clad Wall	50.3500	10.6000	39.7500	0.1700	6.7575			(29a)
Flat Roof	52.8200	5.2000	47.6200	0.1300	6.1906			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.7305			(33)
Party Wall 1			64.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.3347	(36)
Total fabric heat loss (33) + (36) =	88.0652	(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	54.5529	54.3716	54.1939	53.3591	53.2029	52.4758	52.4758	52.3412	52.7559	53.2029	53.5188	53.8492	(38)
Heat transfer coeff	142.6181	142.4368	142.2591	141.4243	141.2681	140.5410	140.5410	140.4064	140.8211	141.2681	141.5841	141.9144	(39)
Average = Sum(39)m / 12 =												141.4235	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2490	1.2474	1.2458	1.2385	1.2371	1.2308	1.2308	1.2296	1.2332	1.2371	1.2399	1.2428	(40)
HLP (average)												1.2385	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8378 (42)
Average daily hot water use (litres/day)	101.5971 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8598	21.7426	22.4364	19.5606	18.7688	16.1961	15.0080	17.2220	17.4276	20.3102	22.1702	24.0754	(46)

Water storage loss:		
Store volume	300.0000	(47)
b) If manufacturer declared loss factor is not known :		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0103	(51)
Volume factor from Table 2a	0.7368	(52)
Temperature factor from Table 2b	0.5400	(53)
Enter (49) or (54) in (55)	1.2281	(55)

Total storage loss
38.0698 34.3856 38.0698 36.8417 38.0698 36.8417 38.0698 38.0698 36.8417 38.0698 36.8417 38.0698 (56)
If cylinder contains dedicated solar storage
28.5523 25.7892 28.5523 27.6313 28.5523 27.6313 28.5523 28.5523 27.6313 28.5523 27.6313 28.5523 (57)
Primary loss 23.2624 21.0112 21.8667 15.7584 10.4681 9.9053 10.2355 11.1660 17.1091 21.8667 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
217.5469 191.7508 199.9948 173.7935 164.1460 145.5104 138.8414 154.5313 160.9247 185.8205 197.9447 212.3175 (62)
Aperture area of solar collector 3.0000 (H1)
Zero-loss collector efficiency 0.7000 (H2)
Collector heat loss coefficient 1.8000 (H3)
Collector 2nd order heat loss coefficient 0.0050 (H3a)
Collector effective heat loss coefficient 1.8063 (H3b)
Collector performance ratio 2.5804 (H4)
Annual solar radiation per m2 1079.5246 (H5)
Overshading factor 0.8000 (H6)
Solar energy available 1813.6014 (H7)
Adjustment factor for showers 1.0000 (H7a)
Solar-to-load ratio 1.1346 (H8)
Utilisation factor 0.5858 (H9)
Collector performance factor 0.8793 (H10)
Dedicated solar storage volume 75.0000 (H11)
Effective solar volume 142.5000 (H13)
Daily hot water demand 101.5971 (H14)
Volume ratio Veff/V 1.4026 (H15)
Solar storage volume factor 1.0000 (H16)
Solar input -934.1675 (H17)
Solar input -27.0890 -45.2037 -76.9872 -103.1780 -127.4677 -125.3210 -123.6649 -108.0466 -84.6222 -57.7870 -32.1314 -22.6689 (63)
Solar input (sum of months) = Sum(63)m = -934.1675 (63)
Output from w/h
190.4579 146.5470 123.0076 70.6155 36.6783 20.1894 15.1766 46.4847 76.3025 128.0336 165.8132 189.6486 (64)
Total per year (kWh/year) = Sum(64)m = 1208.9549 (64)
Heat gains from water heating, kWh/month
96.5577 85.6363 90.0692 78.0710 72.8206 65.9306 64.2981 69.9500 74.4236 85.3562 89.2586 94.8189 (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	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
61.8358 54.9220 44.6656 33.8147 25.2769 21.3398 23.0584 29.9722 40.2286 51.0795 59.6173 63.5544 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
414.0952 418.3922 407.5639 384.5116 355.4123 328.0631 309.7921 305.4951 316.3234 339.3757 368.4750 395.8242 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 (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)
-113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 (71)
Water heating gains (Table 5)
129.7819 127.4350 121.0607 108.4320 97.8771 91.5702 86.4221 94.0188 103.3661 114.7261 123.9703 127.4448 (72)
Total internal gains
720.3327 715.3691 687.9100 641.3782 593.1862 555.5930 533.8925 544.1059 574.5380 619.8011 666.6824 701.4433 (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	7.1000	11.2829	0.5700	0.7000	0.7700	22.1507	(75)
Southeast	15.2100	36.7938	0.5700	0.7000	0.7700	154.7428	(77)
Northwest	6.8900	11.2829	0.5700	0.7000	0.7700	21.4955	(81)
Southeast	5.2000	26.0000	0.5700	0.7000	1.0000	48.5503	(82)
Northeast	2.0300	11.2829	0.5700	0.7000	0.7700	6.3332	(75)
Southwest	4.7300	36.7938	0.5700	0.7000	0.7700	48.1218	(79)
Northwest	4.0500	11.2829	0.5700	0.7000	0.7700	12.6352	(81)

Solar gains	314.0296	573.8427	881.6955	1243.0425	1521.6211	1565.3253	1486.5338	1271.7742	1006.4951	660.9121	383.3920	263.9578	(83)
Total gains	1034.3623	1289.2118	1569.6055	1884.4207	2114.8074	2120.9183	2020.4263	1815.8801	1581.0331	1280.7132	1050.0744	965.4011	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.6021	55.6728	55.7424	56.0714	56.1334	56.4238	56.4238	56.4779	56.3116	56.1334	56.0081	55.8778	
alpha	4.7068	4.7115	4.7162	4.7381	4.7422	4.7616	4.7616	4.7652	4.7541	4.7422	4.7339	4.7252	
util living area													
	0.9887	0.9698	0.9166	0.7837	0.5949	0.4200	0.3053	0.3540	0.5897	0.8773	0.9755	0.9916	(86)
MIT	20.1189	20.3104	20.5642	20.8005	20.9090	20.9377	20.9421	20.9412	20.9190	20.7330	20.3700	20.0771	(87)
Th 2	19.8810	19.8823	19.8835	19.8893	19.8904	19.8955	19.8955	19.8964	19.8935	19.8904	19.8882	19.8859	(88)
util rest of house													
	0.9852	0.9610	0.8943	0.7380	0.5325	0.3493	0.2291	0.2700	0.5050	0.8358	0.9667	0.9890	(89)
MIT 2	18.7290	19.0034	19.3552	19.6602	19.7791	19.8091	19.8118	19.8124	19.7945	19.5914	19.0972	18.6724	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	19.0358	19.2919	19.6221	19.9119	20.0286	20.0583	20.0613	20.0616	20.0428	19.8434	19.3782	18.9825	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0358	19.2919	19.6221	19.9119	20.0286	20.0583	20.0613	20.0616	20.0428	19.8434	19.3782	18.9825	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9816	0.9551	0.8882	0.7390	0.5405	0.3599	0.2406	0.2826	0.5169	0.8338	0.9614	0.9860	(94)
Useful gains	1015.3544	1231.3101	1394.1940	1392.6525	1143.0422	763.2369	486.0365	513.2143	817.2224	1067.8136	1009.5884	951.9306	(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													

	2101.5970	2049.9387	1866.7338	1557.3569	1176.5590	767.1104	486.4562	514.1166	836.8656	1305.8036	1738.3936	2097.8522 (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												
	808.1645	550.1185	351.5696	118.5872	24.9365	0.0000	0.0000	0.0000	0.0000	177.0645	524.7397	852.5656 (98)
Space heating												3407.7461 (98)
Space heating per m2											(98) / (4) =	29.8428 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3786.3845 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	808.1645	550.1185	351.5696	118.5872	24.9365	0.0000	0.0000	0.0000	0.0000	177.0645	524.7397	852.5656 (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)													
	897.9606	611.2428	390.6329	131.7635	27.7072	0.0000	0.0000	0.0000	0.0000	196.7383	583.0441	947.2951 (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													
	190.4579	146.5470	123.0076	70.6155	36.6783	20.1894	15.1766	46.4847	76.3025	128.0336	165.8132	189.6486 (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													
	211.6199	162.8300	136.6752	78.4617	40.7537	22.4327	16.8629	51.6497	84.7806	142.2595	184.2369	210.7207 (219)	
Water heating fuel used													1343.2833 (219)
Annual totals kWh/year													
Space heating fuel - main system													3786.3845 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													80.0000 (231)
Electricity for lighting (calculated in Appendix L)													436.8157 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
Total delivered energy for all uses													5646.4835 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3786.3845	3.4800	131.7662	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1343.2833	3.4800	46.7463	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	436.8157	13.1900	57.6160	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-962.0000	13.1900	-126.8878	(252)
Total energy cost			239.7926	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6327 (257)
SAP value		91.1744
SAP rating (Section 12)		91 (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	3786.3845	0.2160	817.8591	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1343.2833	0.2160	290.1492	(264)
Space and water heating			1108.0082	(265)
Pumps and fans	80.0000	0.5190	41.5200	(267)
Energy for lighting	436.8157	0.5190	226.7074	(268)
Energy saving/generation technologies				
PV Unit	-962.0000	0.5190	-499.2780	(269)
Total kg/year			876.9576	(272)
CO2 emissions per m2			7.6800	(273)
EI value			92.6181	
EI rating			93	(274)
EI band			A	

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	39.8000 (1b)	x	2.4000 (2b)	=	95.5200 (1b) - (3b)	
First floor	45.6200 (1c)	x	2.7800 (2c)	=	126.8236 (1c) - (3c)	
Second floor	28.7700 (1d)	x	2.7800 (2d)	=	79.9806 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	114.1900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	302.3242	(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							4 * 10	=	40.0000	(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) =	40.0000	/ (5) =	0.1323	(8)
Pressure test			Yes	
Measured/design q50			3.0000	
Infiltration rate			0.2823	(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) =		0.2400	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.5000	3.4000	3.4000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8750	0.8500	0.8500	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.2580	0.2460	0.2460	0.2280	0.2340	0.2040	0.2100	0.2040	0.2040	0.2220	0.2160	0.2400	(22b)
Effective ac	0.5333	0.5302	0.5302	0.5260	0.5274	0.5208	0.5220	0.5208	0.5208	0.5246	0.5233	0.5288	(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	
Door			2.3500	1.2000	2.8200			(26)
Windows (Uw = 0.80)			29.2000	0.7752	22.6357			(27)
French Doors (Uw = 0.80)			10.8100	0.7752	8.3798			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1000	3.9800			(28a)
Exposed Floor			5.8200	0.1000	0.5820			(28b)
External Wall 1	104.4300	31.7600	72.6700	0.1700	12.3539			(29a)
Clad Wall	50.3500	10.6000	39.7500	0.1700	6.7575			(29a)
Flat Roof	52.8200	5.2000	47.6200	0.1300	6.1906			(30)
Total net area of external elements Aum(A, m2)			253.2200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.7305			(33)
Party Wall 1			64.6000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	20.3347	(36)
Total fabric heat loss (33) + (36) =	88.0652	(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	53.2029	52.9013	52.9013	52.4758	52.6140	51.9588	52.0827	51.9588	51.9588	52.3412	52.2101	52.7559	(38)
Heat transfer coeff	141.2681	140.9665	140.9665	140.5410	140.6793	140.0240	140.1479	140.0240	140.0240	140.4064	140.2753	140.8211	(39)
Average = Sum(39)m / 12 =												140.5120	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2371	1.2345	1.2345	1.2308	1.2320	1.2262	1.2273	1.2262	1.2262	1.2296	1.2284	1.2332	(40)
HLP (average)												1.2305	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.8378	(42)
Average daily hot water use (litres/day)	101.5971	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	111.7568	107.6929	103.6290	99.5652	95.5013	91.4374	91.4374	95.5013	99.5652	103.6290	107.6929	111.7568	(44)
Energy conte	165.7321	144.9504	149.5758	130.4038	125.1256	107.9738	100.0536	114.8130	116.1842	135.4015	147.8014	160.5027	(45)
Energy content (annual)										Total = Sum(45)m =		1598.5180	(45)
Distribution loss (46)m = 0.15 x (45)m	24.8598	21.7426	22.4364	19.5606	18.7688	16.1961	15.0080	17.2220	17.4276	20.3102	22.1702	24.0754	(46)
Water storage loss:													
Store volume												300.0000	(47)
b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												1.2281	(55)

Total storage loss
38.0698 34.3856 38.0698 36.8417 38.0698 36.8417 38.0698 38.0698 36.8417 38.0698 36.8417 38.0698 (56)
If cylinder contains dedicated solar storage
28.5523 25.7892 28.5523 27.6313 28.5523 27.6313 28.5523 28.5523 27.6313 28.5523 27.6313 28.5523 (57)
Primary loss 23.2624 21.0112 21.8667 15.7584 10.4681 9.9053 10.2355 11.1660 17.1091 21.8667 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
217.5469 191.7508 199.9948 173.7935 164.1460 145.5104 138.8414 154.5313 160.9247 185.8205 197.9447 212.3175 (62)
Aperture area of solar collector 3.0000 (H1)
Zero-loss collector efficiency 0.7000 (H2)
Collector heat loss coefficient 1.8000 (H3)
Collector 2nd order heat loss coefficient 0.0050 (H3a)
Collector effective heat loss coefficient 1.8063 (H3b)
Collector performance ratio 2.5804 (H4)
Annual solar radiation per m2 1118.1552 (H5)
Overshading factor 0.8000 (H6)
Solar energy available 1878.5008 (H7)
Adjustment factor for showers 1.0000 (H7a)
Solar-to-load ratio 1.1752 (H8)
Utilisation factor 0.5730 (H9)
Collector performance factor 0.8793 (H10)
Dedicated solar storage volume 75.0000 (H11)
Effective solar volume 142.5000 (H13)
Daily hot water demand 101.5971 (H14)
Volume ratio Veff/V 1.4026 (H15)
Solar storage volume factor 1.0000 (H16)
Solar input -946.4426 (H17)
Solar input -28.6694 -42.9890 -73.5662 -101.8581 -122.5253 -128.6332 -126.6006 -114.0655 -88.8145 -60.0469 -35.1267 -23.5474 (63)
Solar input (sum of months) = Sum(63)m = -946.4426 (63)
Output from w/h
188.8775 148.7618 126.4286 71.9354 41.6207 16.8772 12.2409 40.4659 72.1101 125.7737 162.8180 188.7701 (64)
Total per year (kWh/year) = Sum(64)m = 1196.6798 (64)
Heat gains from water heating, kWh/month
96.5577 85.6363 90.0692 78.0710 72.8206 65.9306 64.2981 69.9500 74.4236 85.3562 89.2586 94.8189 (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	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	170.2664	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
61.8358 54.9220 44.6656 33.8147 25.2769 21.3398 23.0584 29.9722 40.2286 51.0795 59.6173 63.5544 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
414.0952 418.3922 407.5639 384.5116 355.4123 328.0631 309.7921 305.4951 316.3234 339.3757 368.4750 395.8242 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 54.8644 (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)
-113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 -113.5109 (71)
Water heating gains (Table 5)
129.7819 127.4350 121.0607 108.4320 97.8771 91.5702 86.4221 94.0188 103.3661 114.7261 123.9703 127.4448 (72)
Total internal gains
720.3327 715.3691 687.9100 641.3782 593.1862 555.5930 533.8925 544.1059 574.5380 619.8011 666.6824 701.4433 (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	7.1000	12.4885	0.5700	0.7000	0.7700	24.5174	(75)
Southeast	15.2100	39.0225	0.5700	0.7000	0.7700	164.1157	(77)
Northwest	6.8900	12.4885	0.5700	0.7000	0.7700	23.7923	(81)
Southeast	5.2000	29.0000	0.5700	0.7000	1.0000	54.1523	(82)
Northeast	2.0300	12.4885	0.5700	0.7000	0.7700	7.0099	(75)
Southwest	4.7300	39.0225	0.5700	0.7000	0.7700	51.0366	(79)
Northwest	4.0500	12.4885	0.5700	0.7000	0.7700	13.9853	(81)

Solar gains	338.6095	557.0700	862.8518	1260.5061	1503.9990	1652.1925	1564.9580	1379.9906	1083.3225	701.8614	427.2371	279.2287	(83)
Total gains	1058.9422	1272.4390	1550.7618	1901.8843	2097.1852	2207.7855	2098.8505	1924.0965	1657.8605	1321.6625	1093.9195	980.6720	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.1334	56.2535	56.2535	56.4238	56.3684	56.6322	56.5821	56.6322	56.6322	56.4779	56.5307	56.3116	
alpha	4.7422	4.7502	4.7502	4.7616	4.7579	4.7755	4.7721	4.7755	4.7755	4.7652	4.7687	4.7541	
util living area													
	0.9828	0.9614	0.8848	0.7035	0.4873	0.2786	0.1602	0.1892	0.4343	0.7925	0.9576	0.9873	(86)
MIT	20.2538	20.4101	20.6718	20.8678	20.9314	20.9426	20.9431	20.9431	20.9383	20.8372	20.5138	20.2135	(87)
Th 2	19.8904	19.8925	19.8925	19.8955	19.8945	19.8991	19.8982	19.8991	19.8991	19.8964	19.8973	19.8935	(88)
util rest of house													
	0.9771	0.9495	0.8535	0.6463	0.4182	0.2091	0.0867	0.1091	0.3448	0.7280	0.9418	0.9829	(89)
MIT 2	18.9315	19.1539	19.5075	19.7432	19.8034	19.8157	19.8150	19.8159	19.8138	19.7200	19.3076	18.8765	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	19.2234	19.4312	19.7645	19.9915	20.0525	20.0645	20.0640	20.0648	20.0620	19.9667	19.5739	19.1717	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2234	19.4312	19.7645	19.9915	20.0525	20.0645	20.0640	20.0648	20.0620	19.9667	19.5739	19.1717	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9727	0.9433	0.8494	0.6515	0.4282	0.2196	0.0978	0.1211	0.3582	0.7325	0.9360	0.9791	(94)
Useful gains	1029.9857	1200.3233	1317.1715	1239.1109	898.0712	484.8390	205.1785	233.0964	593.8747	968.1709	1023.8838	960.2192	(95)
Ext temp.	5.6000	6.1000	8.1000	10.6000	13.6000	16.6000	18.6000	18.4000	15.8000	12.3000	8.5000	5.6000	(96)
Heat loss rate W													

	1924.5556	1879.2565	1644.3043	1319.8932	907.7278	485.1115	205.1813	233.1050	596.7867	1076.4510	1553.3956	1911.1768 (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												
	665.5600	456.2431	243.3868	58.1633	7.1845	0.0000	0.0000	0.0000	0.0000	80.5604	381.2486	707.5125 (98)
Space heating												2599.8592 (98)
Space heating per m2											(98) / (4) =	22.7678 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2888.7324 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	665.5600	456.2431	243.3868	58.1633	7.1845	0.0000	0.0000	0.0000	0.0000	80.5604	381.2486	707.5125 (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)													
	739.5111	506.9368	270.4298	64.6258	7.9828	0.0000	0.0000	0.0000	0.0000	89.5115	423.6095	786.1250 (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													
	188.8775	148.7618	126.4286	71.9354	41.6207	16.8772	12.2409	40.4659	72.1101	125.7737	162.8180	188.7701 (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													
	209.8639	165.2909	140.4762	79.9282	46.2452	18.7525	13.6010	44.9621	80.1224	139.7485	180.9089	209.7445 (219)	
Water heating fuel used													1329.6442 (219)
Annual totals kWh/year													
Space heating fuel - main system													2888.7324 (211)
Space heating fuel - secondary													0.0000 (215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													80.0000 (231)
Electricity for lighting (calculated in Appendix L)													436.8157 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
Total delivered energy for all uses													4735.1924 (238)

10a. Fuel costs - using BEDF prices (394)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2888.7324	4.3200	124.7932 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1329.6442	4.3200	57.4406 (247)
Pumps and fans for heating	30.0000	15.3200	4.5960 (249)
Pump for solar water heating	50.0000	15.3200	7.6600 (249)
Energy for lighting	436.8157	15.3200	66.9202 (250)
Additional standing charges			95.0000 (251)
Energy saving/generation technologies			
PV Unit	-962.0000	15.3200	-147.3784 (252)
Total energy cost			209.0316 (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	2888.7324	0.2160	623.9662 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1329.6442	0.2160	287.2032 (264)
Space and water heating			911.1694 (265)
Pumps and fans	80.0000	0.5190	41.5200 (267)
Energy for lighting	436.8157	0.5190	226.7074 (268)
Energy saving/generation technologies			
PV Unit	-962.0000	0.5190	-499.2780 (269)
Total kg/year			680.1187 (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	2888.7324	1.2200	3524.2535 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1329.6442	1.2200	1622.1659 (264)
Space and water heating			5146.4195 (265)
Pumps and fans	80.0000	3.0700	245.6000 (267)
Energy for lighting	436.8157	3.0700	1341.0243 (268)
Energy saving/generation technologies			
PV Unit	-962.0000	3.0700	-2953.3400 (269)
Primary energy kWh/year			3779.7038 (272)
Primary energy kWh/m2/year			33.1001 (273)

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

Overheating Calculation Input Data

Dwelling type	MidTerrace House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South East
Overshading	Average or unknown
Thermal mass parameter	250.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	798.14 (P1)
Transmission heat loss coefficient	88.07 (37)
Summer heat loss coefficient	886.20 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South East	0.000	1.000	None
South West	0.000	1.000	None
North 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 East	1.000	1.00	1.000	1.000 (P8)
South East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)
North West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	7.1000	98.8453	0.5700	0.7000	0.9000	226.8152
South East	15.2100	119.9223	0.5700	0.7000	0.9000	589.5047
North West	6.8900	98.8453	0.5700	0.7000	0.9000	220.1066
South East	5.2000	203.0000	0.5700	0.7000	1.0000	379.0660
North East	2.0300	98.8453	0.5700	0.7000	0.9000	64.8500
South West	4.7300	119.9223	0.5700	0.7000	0.9000	183.3239
North West	4.0500	98.8453	0.5700	0.7000	0.9000	129.3805
total:						1793.0468

	Jun	Jul	Aug	
Solar gains	1909	1793	1569	(P3)
Internal gains	577	555	564	
Total summer gains	2485	2348	2133	(P5)
Summer gain/loss ratio	2.80	2.65	2.41	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	19.05	20.80	20.46	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight