PRICE&MYERS

97 Camden Mews, Camden

Energy Strategy Report

CIBSE LOW CARBON ENERGY ASSESSORS

Date: 27 July 2016

Project ref: 25220

Prepared by: Tom Lodge

Reviewed by: Jessica James

37 Alfred Place London WC1E 7DP 020 7631 5128 mail@pricemyers.com www.pricemyers.com

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 31% 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 15.8% 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, for each house. 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 2016, requires compliance with the following policies relating to climate change:

Policy 5.2: Minimising Carbon Dioxide Emissions

Planning Decisions

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

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

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.

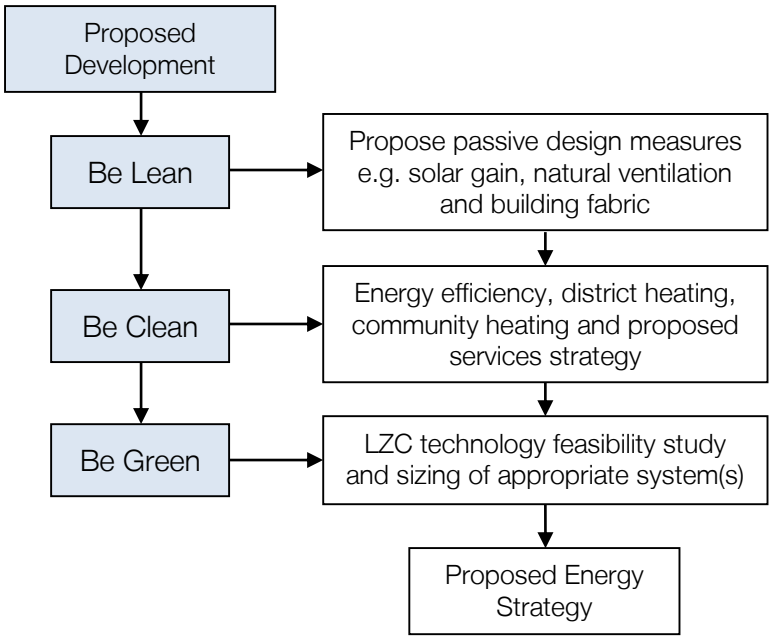
3 Approach

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 a 19% 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	10,342	5,400	15,741	3,400	0	0	0	150	874	1,024	531	16,765	3,931	5,055	2623

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 (Main roof and 2nd floor terrace)	0.13 W/m^{2}K
Ground Floor	0.11 W/m^{2}K
Exposed Floor (First Floor)	0.11 W/m^{2}K
Windows/ Rooflights	0.8 W/m^{2}K (Triple Glazing)
French Doors	1.20 W/m^{2}K (Double Glazing)
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: 4 m^3/m^2/h
Thermal Bridging	Independently assessed, designed to be equivalent to accredited detail figures Details to be calculated at the detailed design stage

Table 5-1 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 1% improvement over Building Regulations Part L 2013.

Site Wide	CO_2 Emissions (tonnes /annum)	CO_2 Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	3.93		
Be Lean (after demand reduction)	3.90	0.03	1%

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

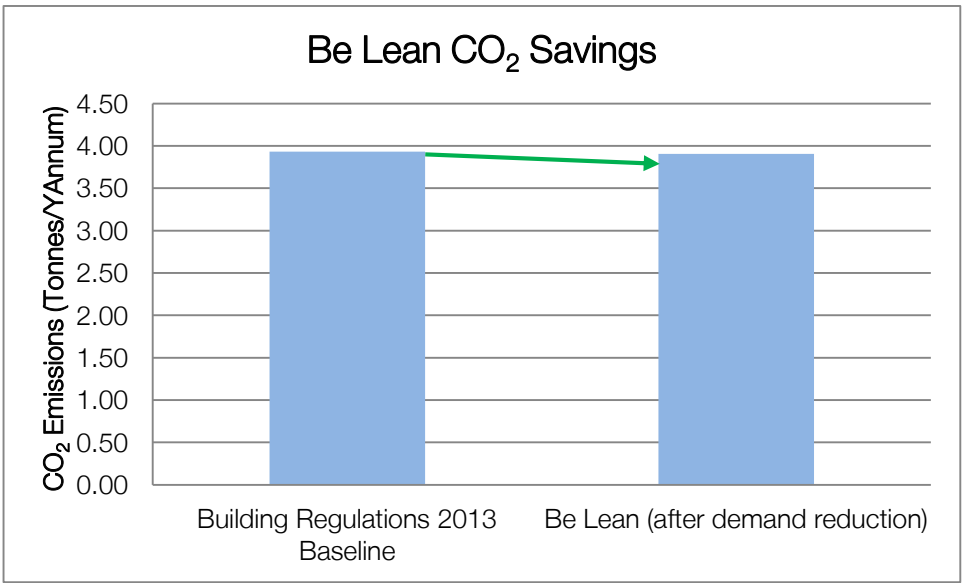


Figure 5-1 Improvement over Building Regulations Part L 2013 through the Energy Hierarchy at the Be Lean Stage

The Be Lean stage has the potential to provide 1% 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	9,910	5,399	15,309	3,307	0	0	0	60	1,092	1,152	598	16,461	3,905	5,055	2623

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

6 Be Clean: Energy Efficiency

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

6.1 District Energy Systems

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

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

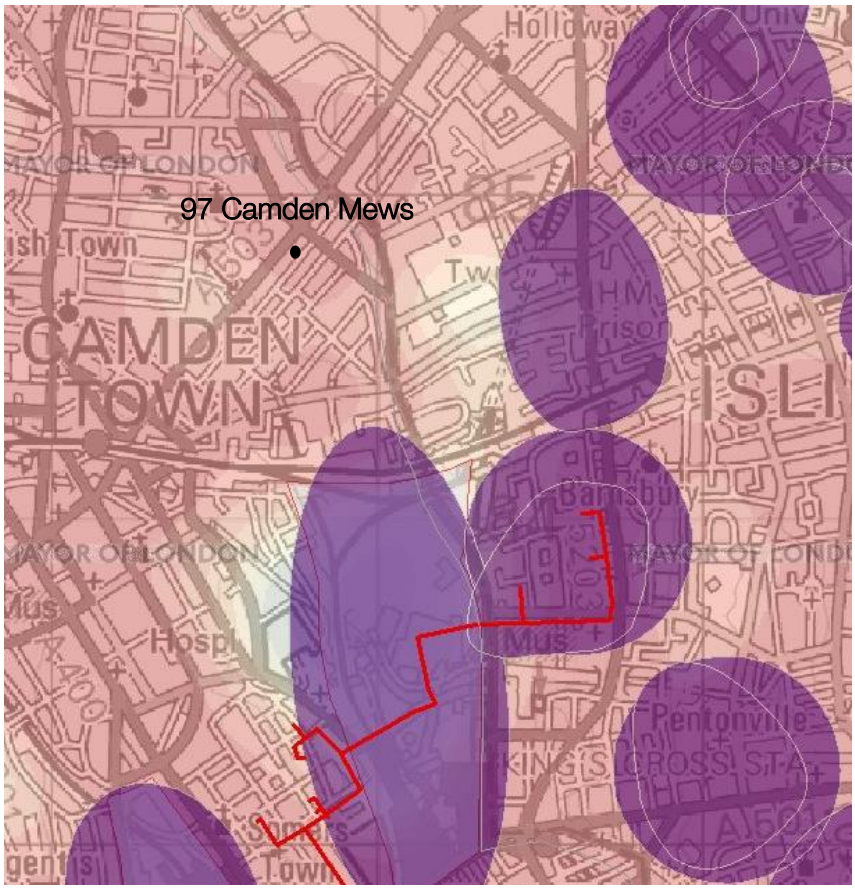


Figure 6-1 London Heat Map ©

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

6.2 Community Heating

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

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

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

6.3 Services Strategy

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

Services	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 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.

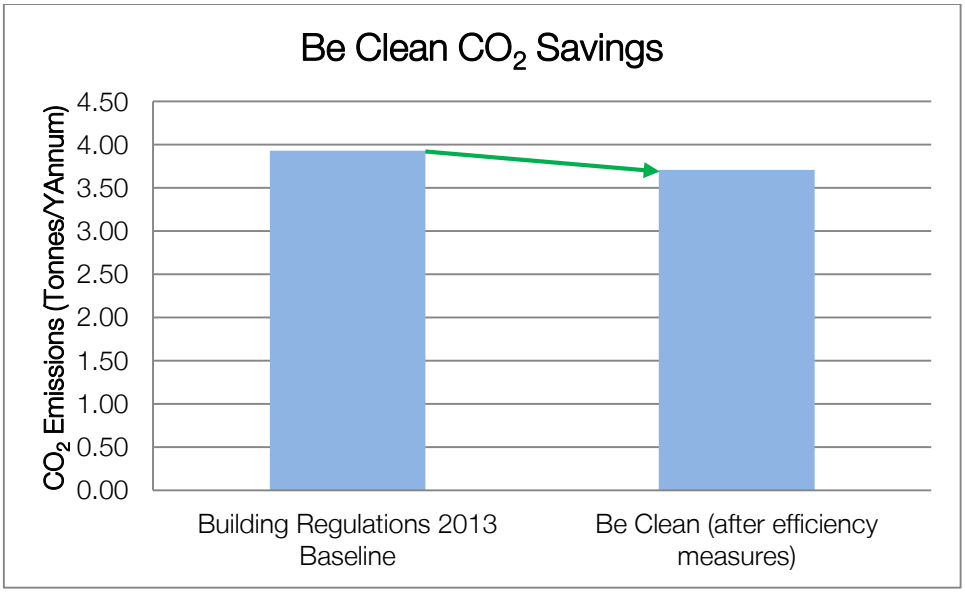


Figure 6-2 Improvement over Building Regulations Part L 2013 with a Communal Gas Boiler

Site Wide	CO_2 Emissions (tonnes /annum)	CO_2 Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	3.93		
Be Lean (after demand reduction)	3.90	0.03	1%
Be Clean (after efficiency measures)	3.71	0.20	5%
Total Cumulative Savings		0.22	6%

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	9,771	5,157	14,928	3,224	0	0	0	60	874	934	485	15,862	3,709	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. 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	9.19%	998	15.8%	24,938

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

7.2 Improvement Over Part L with LZCs

Figure 7-1 demonstrate the percentage improvement over the notional baseline levels for the development incorporating the Solar PV. Table 7-3 and Figure 7-2 confirm that the development can achieve 31% improvement over the Part L 2013 target emissions with proposed strategy.

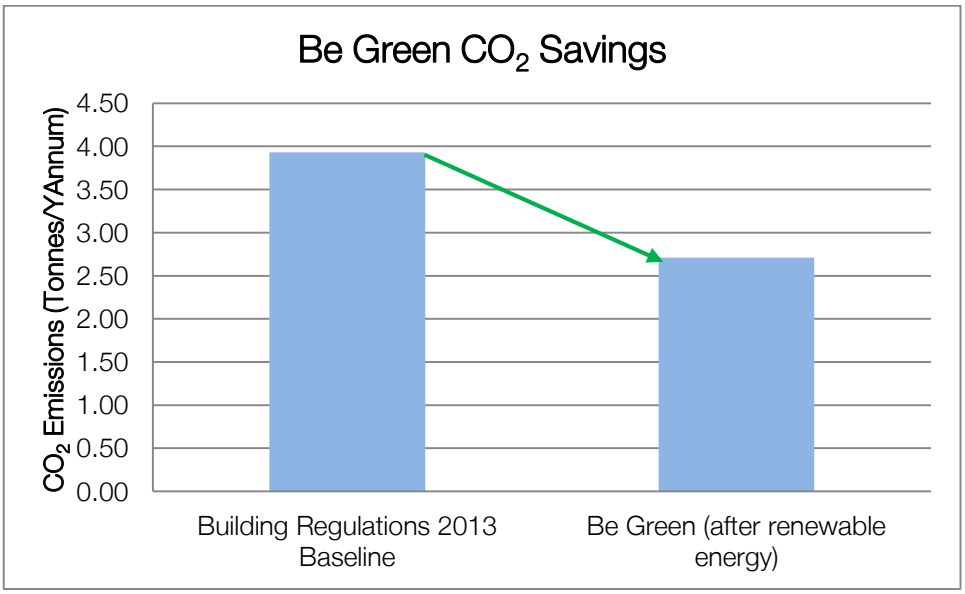


Figure 7-1 % Improvement over Building Regulations Part L 2013 after LZCs

Site Wide	CO_2 Emissions (tonnes /annum)	CO_2 Savings (tonnes /annum)	% Saving
Building Regulations 2013 Baseline	3.93		
Be Lean (after demand reduction)	3.90	0.03	1%
Be Clean (after efficiency measures)	3.71	0.20	5%
Be Green (after renewable energy)	2.71	1.00	25%
Total Cumulative Savings		1.22	31%

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

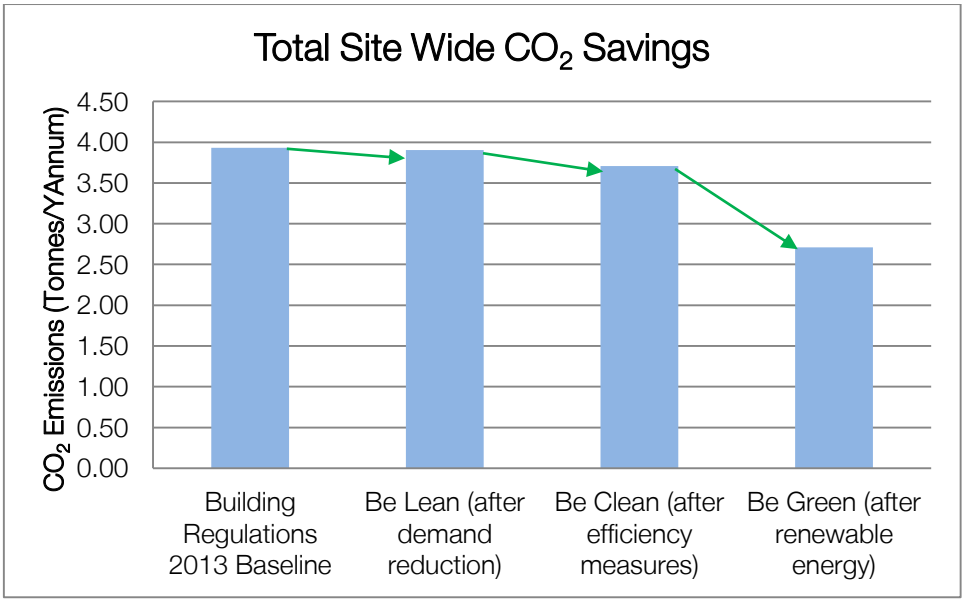


Figure 7-2 Summary of CO_2 savings (tonnes CO_2/annum) over Building Regulations 2013 baseline

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

Be Green Emission Breakdown																
Regulated Energy & CO_2															Unregulated Energy & CO_2	
Type	Gas Demand				Electricity Demand								Total Energy (kWh/yr)	Total CO_2 (kg/yr)		
	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Space Heating (kWh/yr)	Hot Water (kWh/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Cooling (kWh/yr)	PV (kWh/yr)	Total (kWh/yr)	Electricity CO_2 ($kgCO_2$/yr)			Energy (kWh/yr)	CO_2 (kg/yr)
Residential	9,771	5,157	14,928	3,224	0	0	0	60	874	-1,922	-988	-513	15,862	2,712	5,055	2,623

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

8 Sustainability

8.1 Water quality, saving and drainage

Flood risk and surface water drainage

The Environment Agency flood map (Figure 8-1) shows that the development site is not located within a zone at risk of flooding (Zone 1), with less than a 0.1 per cent (1 in 1000) chance of flooding occurring each year.

As the whole site is currently occupied by the existing commercial workshop, the proposed development will not increase in the impermeable surface area and the subsequent volume of surface water inflow from surface run-off. With new outdoor green areas being provided and a green roof proposed, the proposals will improve the current drainage for the site.

Figure 8-1 Flood risk map (© Environmental Agency)

Water Consumption

Internal potable water use will be limited to a maximum of 105 l/person/day, as per Camden Planning requirements. 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 - 9 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

8.2 Materials

The design team have put a strong focus on sustainability and durability when considering construction profiles and building materials for the development. High Green Guide ratings will be achieved wherever possible for the parts of the external envelope and internal build elements and materials will be assessed for suitability with regards to environmental performance.

The possibility of using recycled and secondary aggregates within the concrete foundations, core structure and floor slabs will be investigated to reduce the impact of these build elements.

New insulating materials will be specified to maximise thermal performance whilst still paying attention to the environmental impact of the materials used. The incorporation of recycled products will be pursued wherever feasible and the use of other low embodied energy products will be further investigated.

Responsible sourcing will also be pursued. All timber used on site during the construction phase and within the building will be from FSC sources or equivalent. Other materials, including insulation, will be sourced from manufacturers who employ environmental management systems such as ISO 14001 or BES 6001. Where possible, materials will be sourced locally.

Non-toxic materials will be used wherever possible, including the specification of products with low VOC content in line with European testing standards.

8.3 Ecology

The design team have proposed that green spaces be provided for the development. The rear ground floor terrace and second floor terrace shall both include planting and the roof is to be specified as a green roof. This will be landscaped to include native shrubs and trees to help enhance the natural environment and provide ecological habitat. This will greatly improve the ecology of the site over the existing commercial workshop space.

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 31% improvement over the Building Regulations Part L 2013 Target Emissions Rate (TER) and overall 15.8% 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 A-1 Energy intensity values

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

Table A-2 Natural Gas and Electricity fuel prices

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

Table A-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 - Up Window
Property: 97a, London, NW1 9BU

Issued on Date: 26.Jul.2016
Prop Type Ref:

SAP Rating:	84 B	**CO2 Emissions (t/year):**	1.54	**DER:**	16.86 Pass	**TER:**	17.08	**Percentage DER<TER:**	1.30 %
Environmental:	85 B	**General Requirements Compliance:**	Pass	**DFEE:**	45.86 Pass	**TFEE:**	56.66	**Percentage DFEE<TFEE:**	19.07 %

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 - Up Window'
SAP2012 - 9.92 input data (DesignData) -


```
SAP2012 Input Data (House)     26/07/2016

FullRefNo:                     Be Lean - Up Window

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                 41.5, 46.7, 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, 0.11
    Exposed Floor             5.82, 0, Other, Exposed Floor - Solid, 0, 0.11
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, Double Low-E Soft 0.1, , , 0.63, , 0.7,
Openings                       Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    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                         0.082
    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:                  4
AsBuilt q50:                   15
Property Tested:               False
Mechanical Ventilation         None
Chimneys MHS:                  0
Chimneys SHS:                  0
Chimneys Other:                0
Chimneys Total:                0
Open Flues MHS:                0
Open Flues SHS:                0
Open Flues Other:              0
Open Flues Total:              0
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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

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) 17.08 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.86 kg/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.7 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)45.9 kWh/m²OK

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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	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	0.91 (max. 2.00)	1.20 (max. 3.30)	OK

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

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

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc

Efficiency: 88%
Minimum: 88% OK

Secondary heating system: None

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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

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10 Key features

Party wall U-value	0.00 W/m^2K
Floor U-value	0.11 W/m^2K
Exposed floor U-value	0.11 W/m^2K
Window U-value	0.80 W/m^2K
Roof window U-value	0.80 W/m^2K

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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3601	0.3531	0.3460	0.3107	0.3036	0.2683	0.2683	0.2613	0.2825	0.3036	0.3178	0.3319	(22b)
Effective ac	0.5649	0.5623	0.5599	0.5483	0.5461	0.5360	0.5360	0.5341	0.5399	0.5461	0.5505	0.5551	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	56.3534	56.1022	55.8559	54.6992	54.4828	53.4754	53.4754	53.2888	53.8634	54.4828	54.9206	55.3783	(38)
Heat transfer coeff	148.0772	147.8260	147.5797	146.4231	146.2066	145.1992	145.1992	145.0127	145.5873	146.2066	146.6444	147.1021	(39)
Average = Sum(39)m / 12 =												146.4220	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2968	1.2946	1.2924	1.2823	1.2804	1.2716	1.2716	1.2699	1.2750	1.2804	1.2842	1.2882	(40)
HLP (average)												1.2823	(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	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	0.6300	0.7000	0.7700	6.9999	(75)
Southwest	4.7300	36.7938	0.6300	0.7000	0.7700	53.1873	(79)
Northwest	4.0500	11.2829	0.6300	0.7000	0.7700	13.9653	(81)

Solar gains	321.0917	586.5353	900.8237	1269.6961	1554.1705	1598.8248	1518.3375	1298.9981	1028.2009	675.4152	391.9716	269.9234	(83)
Total gains	843.0456	1105.5644	1402.5961	1743.9725	2000.3800	2018.6849	1921.6673	1709.5019	1453.4315	1128.3738	876.4391	778.1579	(84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.5522	53.6432	53.7327	54.1572	54.2374	54.6137	54.6137	54.6839	54.4681	54.2374	54.0754	53.9072	
alpha	4.5701	4.5762	4.5822	4.6105	4.6158	4.6409	4.6409	4.6456	4.6312	4.6158	4.6050	4.5938	
util living area	0.9952	0.9837	0.9451	0.8282	0.6384	0.4535	0.3311	0.3872	0.6471	0.9199	0.9882	0.9966	(86)
MIT	19.9591	20.1640	20.4512	20.7440	20.8914	20.9332	20.9400	20.9385	20.9028	20.6505	20.2353	19.9206	(87)
Th 2	19.8434	19.8451	19.8468	19.8547	19.8562	19.8632	19.8632	19.8645	19.8605	19.8562	19.8532	19.8501	(88)
util rest of house	0.9935	0.9785	0.9285	0.7858	0.5727	0.3760	0.2463	0.2932	0.5570	0.8877	0.9836	0.9955	(89)
MIT 2	18.4683	18.7659	19.1724	19.5625	19.7289	19.7730	19.7771	19.7779	19.7491	19.4599	18.8779	18.4175	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	18.7974	19.0745	19.4548	19.8233	19.9856	20.0291	20.0339	20.0342	20.0038	19.7228	19.1776	18.7493	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7974	19.0745	19.4548	19.8233	19.9856	20.0291	20.0339	20.0342	20.0038	19.7228	19.1776	18.7493	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9915	0.9739	0.9217	0.7845	0.5805	0.3875	0.2591	0.3074	0.5690	0.8832	0.9798	0.9939	(94)
Useful gains	835.8596	1076.7486	1292.7349	1368.1010	1161.2181	782.1584	497.8912	525.4568	826.9930	996.5333	858.7504	773.3955	(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	2146.7342	2095.3664	1911.8596	1599.4270	1211.4048	788.3045	498.5964	526.9990	859.5142	1333.8074	1771.1110	2140.2381	(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	975.2907	684.5112	460.6287	166.5547	37.3389	0.0000	0.0000	0.0000	0.0000	250.9320	656.8997	1016.9309	(98)
Space heating												4249.0868	(98)
Space heating per m2											(98) / (4) =	37.2107	(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	4828.5078 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	975.2907	684.5112	460.6287	166.5547	37.3389	0.0000	0.0000	0.0000	0.0000	250.9320	656.8997	1016.9309	(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)													
	1108.2849	777.8536	523.4418	189.2667	42.4306	0.0000	0.0000	0.0000	0.0000	285.1500	746.4769	1155.6033	(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												4828.5078	(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	8103.9743 (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	4828.5078	0.2160	1042.9577	(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			1626.0382	(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			1924.9924	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.8600	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES			
DER		16.8600	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		32.8963	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		32.8963	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	46.7000	3.0200	43.6800	0.1300	5.6784			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.7736			(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) =	85.8778 (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	144.3247	143.9921	143.6662	142.1353	141.8488	140.5154	140.5154	140.2685	141.0290	141.8488	142.4283	143.0341	(39)
Average = Sum(39)m / 12 =												142.1339	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2639	1.2610	1.2581	1.2447	1.2422	1.2305	1.2305	1.2284	1.2350	1.2422	1.2473	1.2526	(40)
HLP (average)												1.2447	(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	54.9446	55.0715	55.1964	55.7909	55.9036	56.4341	56.4341	56.5334	56.2286	55.9036	55.6762	55.4404	
alpha	4.6630	4.6714	4.6798	4.7194	4.7269	4.7623	4.7623	4.7689	4.7486	4.7269	4.7117	4.6960	
util living area													
	0.9976	0.9935	0.9792	0.9260	0.7965	0.6074	0.4532	0.5187	0.7896	0.9654	0.9947	0.9983	(86)
MIT	19.6280	19.8306	20.1526	20.5526	20.8420	20.9667	20.9933	20.9877	20.8887	20.4810	19.9759	19.5944	(87)
Th 2	19.8692	19.8715	19.8738	19.8844	19.8864	19.8956	19.8956	19.8974	19.8921	19.8864	19.8824	19.8782	(88)
util rest of house													
	0.9968	0.9912	0.9718	0.9008	0.7367	0.5145	0.3427	0.4007	0.7053	0.9486	0.9925	0.9977	(89)
MIT 2	18.0516	18.3483	18.8146	19.3793	19.7422	19.8754	19.8934	19.8927	19.8086	19.2963	18.5689	18.0087	(90)
Living area fraction										fLA = Living area / (4) =		0.2208	(91)
MIT	18.3997	18.6755	19.1100	19.6383	19.9850	20.1164	20.1362	20.1345	20.0471	19.5578	18.8795	18.3588	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3997	18.6755	19.1100	19.6383	19.9850	20.1164	20.1362	20.1345	20.0471	19.5578	18.8795	18.3588	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9952	0.9878	0.9652	0.8941	0.7425	0.5339	0.3672	0.4268	0.7186	0.9420	0.9895	0.9964	(94)
Useful gains	705.7139	862.7002	1017.7704	1126.2588	1047.7367	754.4357	494.1596	518.3895	760.4998	813.4723	708.7997	660.7655	(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													
	2034.9291	1983.5704	1811.6321	1526.2900	1175.2148	775.1325	496.8931	523.8285	838.7108	1270.6581	1677.7407	2025.1886	(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													
	988.9361	753.2248	590.6331	288.0225	94.8437	0.0000	0.0000	0.0000	0.0000	340.1463	697.6375	1015.1308	(98)
Space heating												4768.5748	(98)
Space heating per m2											(98) / (4) =	41.7600	(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	5100.0800 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	988.9361	753.2248	590.6331	288.0225	94.8437	0.0000	0.0000	0.0000	0.0000	340.1463	697.6375	1015.1308	(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)													
	1057.6857	805.5880	631.6932	308.0454	101.4371	0.0000	0.0000	0.0000	0.0000	363.7928	746.1364	1085.7014	(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	88.3104	88.0436	87.4441	85.9605	83.1467	79.8000	79.8000	79.8000	79.8000	86.2970	87.8300	88.3957	(217)
Fuel for water heating, kWh/month													
	254.0596	224.7811	238.1003	217.7062	221.0003	206.4053	198.8502	217.3456	216.6940	224.8402	232.8804	247.8984	(219)
Water heating fuel used												2700.5618	(219)
Annual totals kWh/year													
Space heating fuel - main system												5100.0800	(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												8312.4575	(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	5100.0800	0.2160	1101.6173	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2700.5618	0.2160	583.3213	(264)
Space and water heating			1684.9386	(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			1950.5710	(272)
Emissions per m2 for space and water heating			14.7556	(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) = (14.7556 * 1.00) + 1.9854 + 0.3409, rounded to 2 d.p.			17.0800	(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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3601	0.3531	0.3460	0.3107	0.3036	0.2683	0.2683	0.2613	0.2825	0.3036	0.3178	0.3319	(22b)
Effective ac	0.5649	0.5623	0.5599	0.5483	0.5461	0.5360	0.5360	0.5341	0.5399	0.5461	0.5505	0.5551	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	56.3534	56.1022	55.8559	54.6992	54.4828	53.4754	53.4754	53.2888	53.8634	54.4828	54.9206	55.3783	(38)
Heat transfer coeff	148.0772	147.8260	147.5797	146.4231	146.2066	145.1992	145.1992	145.0127	145.5873	146.2066	146.6444	147.1021	(39)
Average = Sum(39)m / 12 =												146.4220	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2968	1.2946	1.2924	1.2823	1.2804	1.2716	1.2716	1.2699	1.2750	1.2804	1.2842	1.2882	(40)
HLP (average)												1.2823	(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	0.6300	0.7000	0.7700	6.9999	(75)
Southwest	4.7300	36.7938	0.6300	0.7000	0.7700	53.1873	(79)
Northwest	4.0500	11.2829	0.6300	0.7000	0.7700	13.9653	(81)

Solar gains	321.0917	586.5353	900.8237	1269.6961	1554.1705	1598.8248	1518.3375	1298.9981	1028.2009	675.4152	391.9716	269.9234	(83)
Total gains	736.1725	1000.2297	1300.0459	1644.8986	1903.7123	1924.5968	1829.2653	1614.0280	1356.0861	1027.4684	771.8853	671.9565	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.5522	53.6432	53.7327	54.1572	54.2374	54.6137	54.6137	54.6839	54.4681	54.2374	54.0754	53.9072	
alpha	4.5701	4.5762	4.5822	4.6105	4.6158	4.6409	4.6409	4.6456	4.6312	4.6158	4.6050	4.5938	
util living area													
	0.9972	0.9889	0.9574	0.8509	0.6634	0.4742	0.3475	0.4093	0.6821	0.9403	0.9929	0.9982	(86)
MIT	19.6072	19.8854	20.2823	20.7011	20.9222	20.9866	20.9975	20.9948	20.9360	20.5546	19.9788	19.5555	(87)
Th 2	19.8434	19.8451	19.8468	19.8547	19.8562	19.8632	19.8632	19.8645	19.8605	19.8562	19.8532	19.8501	(88)
util rest of house													
	0.9963	0.9853	0.9438	0.8113	0.5973	0.3938	0.2587	0.3103	0.5911	0.9142	0.9900	0.9975	(89)
MIT 2	18.5872	18.8644	19.2514	19.6383	19.8117	19.8581	19.8626	19.8632	19.8307	19.5236	18.9652	18.5409	(90)
Living area fraction											fLA = Living area / (4) =	0.2208	(91)
MIT	18.8124	19.0898	19.4790	19.8729	20.0569	20.1072	20.1132	20.1130	20.0747	19.7512	19.1890	18.7649	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8124	19.0898	19.4790	19.8729	20.0569	20.1072	20.1132	20.1130	20.0747	19.7512	19.1890	18.7649	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9951	0.9821	0.9385	0.8120	0.6094	0.4113	0.2783	0.3322	0.6094	0.9113	0.9876	0.9967	(94)
Useful gains	732.5443	982.2849	1220.1274	1335.6081	1160.2091	791.6525	509.1291	536.2468	826.3869	936.2967	762.3239	669.7116	(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													
	2148.9522	2097.6250	1915.4345	1606.6862	1221.8301	799.6419	510.1110	538.4388	869.8459	1337.9730	1772.7868	2142.5255	(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													
	1053.8075	749.5085	517.3085	195.1762	45.8460	0.0000	0.0000	0.0000	0.0000	298.8471	727.5333	1095.7735	(98)
Space heating												4683.8007	(98)
Space heating per m2											(98) / (4) =	41.0176	(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	1364.8727	1074.4742	1102.0962	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9618	0.9809	0.9680	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1312.7693	1053.9473	1066.7773	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2298.5939	2188.1433	1948.6932	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	709.7937	843.8418	656.1454	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												2209.7810	(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	177.4484	210.9605	164.0364	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												552.4452	(107)
Space cooling per m2												4.8379	(108)
Energy for space heating												41.0176	(99)

Energy for space cooling	4.8379 (108)
Total	45.8556 (109)
Dwelling Fabric Energy Efficiency (DFEE)	45.9 (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	46.7000	3.0200	43.6800	0.1300	5.6784			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		72.7736			(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) =	85.8778 (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	144.3247	143.9921	143.6662	142.1353	141.8488	140.5154	140.5154	140.2685	141.0290	141.8488	142.4283	143.0341	(39)
Average = Sum(39)m / 12 =												142.1339	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2639	1.2610	1.2581	1.2447	1.2422	1.2305	1.2305	1.2284	1.2350	1.2422	1.2473	1.2526	(40)
HLP (average)												1.2447	(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	54.9446	55.0715	55.1964	55.7909	55.9036	56.4341	56.4341	56.5334	56.2286	55.9036	55.6762	55.4404	
alpha	4.6630	4.6714	4.6798	4.7194	4.7269	4.7623	4.7623	4.7689	4.7486	4.7269	4.7117	4.6960	
util living area	0.9987	0.9959	0.9852	0.9413	0.8236	0.6386	0.4808	0.5533	0.8261	0.9767	0.9970	0.9991	(86)
MIT	19.5540	19.7585	20.0861	20.5014	20.8155	20.9590	20.9914	20.9839	20.8629	20.4195	19.9042	19.5207	(87)
Th 2	19.8692	19.8715	19.8738	19.8844	19.8864	19.8956	19.8956	19.8974	19.8921	19.8864	19.8824	19.8782	(88)
util rest of house	0.9983	0.9944	0.9798	0.9201	0.7670	0.5438	0.3645	0.4294	0.7470	0.9647	0.9957	0.9988	(89)
MIT 2	18.5544	18.7601	19.0862	19.4939	19.7690	19.8783	19.8936	19.8931	19.8191	19.4261	18.9145	18.5282	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	18.7751	18.9805	19.3069	19.7163	20.0000	20.1169	20.1360	20.1339	20.0495	19.6454	19.1330	18.7473	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7751	18.9805	19.3069	19.7163	20.0000	20.1169	20.1360	20.1339	20.0495	19.6454	19.1330	18.7473	(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	0.9762	0.9162	0.7734	0.5638	0.3904	0.4570	0.7598	0.9612	0.9945	0.9983	(94)
Useful gains	614.8697	775.8558	941.4141	1073.7500	1024.6316	749.2508	493.3076	516.4906	739.3094	745.5388	622.1706	570.2398	(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	2089.1156	2027.4824	1839.9200	1537.3811	1177.3493	775.2041	496.8609	523.7525	839.0582	1283.0821	1713.8392	2080.7646	(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	1096.8390	841.0931	668.4884	333.8144	113.6220	0.0000	0.0000	0.0000	0.0000	399.9322	786.0014	1123.8304	(98)
Space heating												5363.6208	(98)
Space heating per m2											(98) / (4) =	46.9710	(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	1320.8451	1039.8142	1066.0407	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8999	0.9452	0.9181	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1188.6638	982.7930	978.7108	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	314.2125	420.8322	314.0704	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1049.1150	(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	78.5531	105.2080	78.5176	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												262.2788	(107)
Space cooling per m2												2.2969	(108)
Energy for space heating												46.9710	(99)
Energy for space cooling												2.2969	(108)
Total												49.2679	(109)
Target Fabric Energy Efficiency (TFEE)												56.7	(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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3036	0.2895	0.2895	0.2683	0.2754	0.2401	0.2472	0.2401	0.2401	0.2613	0.2542	0.2825	(22b)
Effective ac	0.5461	0.5419	0.5419	0.5360	0.5379	0.5288	0.5305	0.5288	0.5288	0.5341	0.5323	0.5399	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	54.4828	54.0649	54.0649	53.4754	53.6669	52.7590	52.9306	52.7590	52.7590	53.2888	53.1072	53.8634	(38)
Heat transfer coeff	146.2066	145.7888	145.7888	145.1992	145.3908	144.4828	144.6545	144.4828	144.4828	145.0127	144.8311	145.5873	(39)
Average = Sum(39)m / 12 =												145.1590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2804	1.2767	1.2767	1.2716	1.2732	1.2653	1.2668	1.2653	1.2653	1.2699	1.2683	1.2750	(40)
HLP (average)												1.2712	(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	0.6300	0.7000	0.7700	7.7478	(75)
Southwest	4.7300	39.0225	0.6300	0.7000	0.7700	56.4089	(79)
Northwest	4.0500	12.4885	0.6300	0.7000	0.7700	15.4574	(81)

Solar gains	346.1918	569.3430	881.5201	1287.5073	1536.1750	1687.5671	1598.4503	1409.5174	1106.6375	717.2078	436.7574	285.5122	(83)
Total gains	1097.2272	1313.6863	1597.3410	1960.0869	2164.6814	2277.7462	2167.3586	1989.3670	1712.4796	1366.5233	1133.5878	1018.0878	(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	54.2374	54.3928	54.3928	54.6137	54.5417	54.8845	54.8193	54.8845	54.8845	54.6839	54.7525	54.4681	
alpha	4.6158	4.6262	4.6262	4.6409	4.6361	4.6590	4.6546	4.6590	4.6590	4.6456	4.6502	4.6312	
util living area													
	0.9811	0.9590	0.8822	0.7020	0.4870	0.2786	0.1602	0.1888	0.4334	0.7885	0.9544	0.9857	(86)
MIT	20.2332	20.3913	20.6571	20.8606	20.9285	20.9411	20.9417	20.9417	20.9363	20.8305	20.5018	20.1945	(87)
Th 2	19.8562	19.8591	19.8591	19.8632	19.8619	19.8681	19.8669	19.8681	19.8681	19.8645	19.8657	19.8605	(88)
util rest of house													
	0.9748	0.9463	0.8500	0.6436	0.4161	0.2072	0.0846	0.1066	0.3417	0.7225	0.9375	0.9809	(89)
MIT 2	18.8747	19.0997	19.4584	19.7038	19.7677	19.7827	19.7816	19.7829	19.7805	19.6820	19.2644	18.8229	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	19.1746	19.3849	19.7231	19.9592	20.0240	20.0384	20.0377	20.0387	20.0357	19.9356	19.5376	19.1257	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1746	19.3849	19.7231	19.9592	20.0240	20.0384	20.0377	20.0387	20.0357	19.9356	19.5376	19.1257	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9699	0.9398	0.8456	0.6488	0.4264	0.2180	0.0960	0.1190	0.3555	0.7270	0.9313	0.9767	(94)
Useful gains	1064.2277	1234.6343	1350.7786	1271.7567	923.1142	496.4706	207.9728	236.7580	608.7200	993.5253	1055.7457	994.3415	(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													
	1984.7003	1936.7853	1694.5121	1358.9511	933.9909	496.7929	207.9762	236.7683	611.9857	1107.2537	1598.5804	1969.1739	(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													
	684.8316	471.8454	255.7377	62.7800	8.0923	0.0000	0.0000	0.0000	0.0000	84.6140	390.8410	725.2753	(98)
Space heating												2684.0173	(98)
RHI space heating demand												2684	(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			4.0000	
Infiltration rate			0.3323	(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)	=	0.2825	(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	0.3601	0.3531	0.3460	0.3107	0.3036	0.2683	0.2683	0.2613	0.2825	0.3036	0.3178	0.3319	(22b)
Effective ac	0.5649	0.5623	0.5599	0.5483	0.5461	0.5360	0.5360	0.5341	0.5399	0.5461	0.5505	0.5551	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	56.3534	56.1022	55.8559	54.6992	54.4828	53.4754	53.4754	53.2888	53.8634	54.4828	54.9206	55.3783	(38)
Heat transfer coeff	148.0772	147.8260	147.5797	146.4231	146.2066	145.1992	145.1992	145.0127	145.5873	146.2066	146.6444	147.1021	(39)
Average = Sum(39)m / 12 =												146.4220	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2968	1.2946	1.2924	1.2823	1.2804	1.2716	1.2716	1.2699	1.2750	1.2804	1.2842	1.2882	(40)
HLP (average)												1.2823	(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	0.6300	0.7000	0.7700	6.9999	(75)
Southwest	4.7300	36.7938	0.6300	0.7000	0.7700	53.1873	(79)
Northwest	4.0500	11.2829	0.6300	0.7000	0.7700	13.9653	(81)

Solar gains	321.0917	586.5353	900.8237	1269.6961	1554.1705	1598.8248	1518.3375	1298.9981	1028.2009	675.4152	391.9716	269.9234	(83)
Total gains	1072.1271	1330.8786	1616.6446	1942.2757	2182.6770	2189.0039	2087.2458	1878.8477	1634.0429	1324.7307	1088.8021	1002.4990	(84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.5522	53.6432	53.7327	54.1572	54.2374	54.6137	54.6137	54.6839	54.4681	54.2374	54.0754	53.9072	
alpha	4.5701	4.5762	4.5822	4.6105	4.6158	4.6409	4.6409	4.6456	4.6312	4.6158	4.6050	4.5938	
util living area	0.9875	0.9679	0.9145	0.7820	0.5945	0.4199	0.3052	0.3532	0.5882	0.8735	0.9733	0.9905	(86)
MIT	20.0911	20.2846	20.5431	20.7890	20.9039	20.9355	20.9405	20.9395	20.9152	20.7223	20.3519	20.0515	(87)
Th 2	19.8434	19.8451	19.8468	19.8547	19.8562	19.8632	19.8632	19.8645	19.8605	19.8562	19.8532	19.8501	(88)
util rest of house	0.9835	0.9584	0.8915	0.7354	0.5306	0.3474	0.2268	0.2670	0.5016	0.8306	0.9636	0.9875	(89)
MIT 2	18.6591	18.9364	19.2947	19.6137	19.7399	19.7743	19.7773	19.7783	19.7580	19.5469	19.0430	18.6072	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	18.9752	19.2341	19.5703	19.8731	19.9969	20.0306	20.0341	20.0347	20.0134	19.8064	19.3320	18.9261	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9752	19.2341	19.5703	19.8731	19.9969	20.0306	20.0341	20.0347	20.0134	19.8064	19.3320	18.9261	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9795	0.9522	0.8850	0.7362	0.5387	0.3582	0.2387	0.2800	0.5137	0.8284	0.9580	0.9842	(94)
Useful gains	1050.1856	1267.1961	1430.7764	1429.9511	1175.8775	784.0966	498.1332	526.0361	839.3944	1097.4421	1043.0708	986.6532	(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	2173.0645	2118.9461	1928.9148	1606.7204	1213.0567	788.5255	498.6271	527.0706	860.9230	1346.0417	1793.7481	2166.2405	(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	835.4219	572.3760	370.6150	127.2739	27.6613	0.0000	0.0000	0.0000	0.0000	184.9580	540.4876	877.6130	(98)
Space heating												3536.4067	(98)
Space heating per m2											(98) / (4) =	30.9695	(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	4018.6439 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	835.4219	572.3760	370.6150	127.2739	27.6613	0.0000	0.0000	0.0000	0.0000	184.9580	540.4876	877.6130	(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)													
	949.3431	650.4273	421.1534	144.6294	31.4333	0.0000	0.0000	0.0000	0.0000	210.1796	614.1905	997.2874	(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												4018.6439	(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												7294.1105	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4018.6439	3.4800	139.8488	(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			429.7666	(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] =	1.1339 (257)
SAP value		84.1824
SAP rating (Section 12)		84 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4018.6439	0.2160	868.0271	(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			1451.1076	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	546.0197	0.5190	283.3842	(268)
Total kg/year			1750.0618	(272)
CO2 emissions per m2			15.3300	(273)
EI value			85.2687	
EI rating			85	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.25) / 0.8800 = 4.241, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.25) / 0.8800 = 0.2633, stars = 4
Water heating energy efficiency	3.48 / 0.8800 = 3.955, stars = 4
Water heating environmental impact	0.216 / 0.8800 = 0.2455, stars = 4

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3036	0.2895	0.2895	0.2683	0.2754	0.2401	0.2472	0.2401	0.2401	0.2613	0.2542	0.2825	(22b)
Effective ac	0.5461	0.5419	0.5419	0.5360	0.5379	0.5288	0.5305	0.5288	0.5288	0.5341	0.5323	0.5399	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	54.4828	54.0649	54.0649	53.4754	53.6669	52.7590	52.9306	52.7590	52.7590	53.2888	53.1072	53.8634	(38)
Heat transfer coeff	146.2066	145.7888	145.7888	145.1992	145.3908	144.4828	144.6545	144.4828	144.4828	145.0127	144.8311	145.5873	(39)
Average = Sum(39)m / 12 =												145.1590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2804	1.2767	1.2767	1.2716	1.2732	1.2653	1.2668	1.2653	1.2653	1.2699	1.2683	1.2750	(40)
HLP (average)												1.2712	(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	0.6300	0.7000	0.7700	7.7478	(75)
Southwest	4.7300	39.0225	0.6300	0.7000	0.7700	56.4089	(79)
Northwest	4.0500	12.4885	0.6300	0.7000	0.7700	15.4574	(81)

Solar gains	346.1918	569.3430	881.5201	1287.5073	1536.1750	1687.5671	1598.4503	1409.5174	1106.6375	717.2078	436.7574	285.5122	(83)
Total gains	1097.2272	1313.6863	1597.3410	1960.0869	2164.6814	2277.7462	2167.3586	1989.3670	1712.4796	1366.5233	1133.5878	1018.0878	(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	54.2374	54.3928	54.3928	54.6137	54.5417	54.8845	54.8193	54.8845	54.8845	54.6839	54.7525	54.4681	
alpha	4.6158	4.6262	4.6262	4.6409	4.6361	4.6590	4.6546	4.6590	4.6590	4.6456	4.6502	4.6312	
util living area	0.9811	0.9590	0.8822	0.7020	0.4870	0.2786	0.1602	0.1888	0.4334	0.7885	0.9544	0.9857	(86)
MIT	20.2332	20.3913	20.6571	20.8606	20.9285	20.9411	20.9417	20.9417	20.9363	20.8305	20.5018	20.1945	(87)
Th 2	19.8562	19.8591	19.8591	19.8632	19.8619	19.8681	19.8669	19.8681	19.8681	19.8645	19.8657	19.8605	(88)
util rest of house	0.9748	0.9463	0.8500	0.6436	0.4161	0.2072	0.0846	0.1066	0.3417	0.7225	0.9375	0.9809	(89)
MIT 2	18.8747	19.0997	19.4584	19.7038	19.7677	19.7827	19.7816	19.7829	19.7805	19.6820	19.2644	18.8229	(90)
Living area fraction										fLA = Living area / (4) =		0.2208	(91)
MIT	19.1746	19.3849	19.7231	19.9592	20.0240	20.0384	20.0377	20.0387	20.0357	19.9356	19.5376	19.1257	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1746	19.3849	19.7231	19.9592	20.0240	20.0384	20.0377	20.0387	20.0357	19.9356	19.5376	19.1257	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9699	0.9398	0.8456	0.6488	0.4264	0.2180	0.0960	0.1190	0.3555	0.7270	0.9313	0.9767	(94)
Useful gains	1064.2277	1234.6343	1350.7786	1271.7567	923.1142	496.4706	207.9728	236.7580	608.7200	993.5253	1055.7457	994.3415	(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	1984.7003	1936.7853	1694.5121	1358.9511	933.9909	496.7929	207.9762	236.7683	611.9857	1107.2537	1598.5804	1969.1739	(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	684.8316	471.8454	255.7377	62.7800	8.0923	0.0000	0.0000	0.0000	0.0000	84.6140	390.8410	725.2753	(98)
Space heating												2684.0173	(98)
Space heating per m2											(98) / (4) =	23.5048	(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	3050.0196 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	684.8316	471.8454	255.7377	62.7800	8.0923	0.0000	0.0000	0.0000	0.0000	84.6140	390.8410	725.2753	(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)													
	778.2177	536.1880	290.6110	71.3409	9.1958	0.0000	0.0000	0.0000	0.0000	96.1522	444.1375	824.1765	(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												3050.0196	(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	6325.4862 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3050.0196	4.2800	130.5408	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2699.4469	4.2800	115.5363	(247)
Pumps and fans for heating	30.0000	15.4400	4.6320	(249)
Energy for lighting	546.0197	15.4400	84.3054	(250)
Additional standing charges			92.0000	(251)
Total energy cost			427.0146	(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	3050.0196	0.2160	658.8042	(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			1241.8848	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	546.0197	0.5190	283.3842	(268)
Total kg/year			1540.8390	(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	3050.0196	1.2200	3721.0240	(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			7014.3492	(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			8782.7295	(272)
Primary energy kWh/m2/year			76.9133	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 84
Current environmental impact rating:	B 85

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	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	-£ 46	-245 kg (15.9%)
U Solar photovoltaic panels	+ 8.4	-£ 276	-929 kg (71.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£46	2.15 kg/m²	B 86	B 87
Solar photovoltaic panels	£276	8.13 kg/m²	A 94	A 95
Total Savings	£322	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 395 TEST (24 Jun 2016)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£89	£97	-£8
Mains gas	£338	£284	£54
Space heating	£227	£229	-£2
Water heating	£116	£68	£48
Lighting	£84	£84	£0
Generated (PV)	-£0	-£276	£276
Total cost of fuels	£427	£105	£322
Total cost of uses	£427	£105	£322
Delivered energy	55 kWh/m²	29 kWh/m²	26 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.4 tonnes	1.2 tonnes
CO2 emissions per m²	13 kg/m²	3 kg/m²	10 kg/m²
Primary energy	77 kWh/m²	17 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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3601	0.3531	0.3460	0.3107	0.3036	0.2683	0.2683	0.2613	0.2825	0.3036	0.3178	0.3319	(22b)
Effective ac	0.5649	0.5623	0.5599	0.5483	0.5461	0.5360	0.5360	0.5341	0.5399	0.5461	0.5505	0.5551	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	56.3534	56.1022	55.8559	54.6992	54.4828	53.4754	53.4754	53.2888	53.8634	54.4828	54.9206	55.3783	(38)
Heat transfer coeff	148.0772	147.8260	147.5797	146.4231	146.2066	145.1992	145.1992	145.0127	145.5873	146.2066	146.6444	147.1021	(39)
Average = Sum(39)m / 12 =												146.4220	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2968	1.2946	1.2924	1.2823	1.2804	1.2716	1.2716	1.2699	1.2750	1.2804	1.2842	1.2882	(40)
HLP (average)												1.2823	(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	0.6300	0.7000	0.7700	6.9999	(75)
Southwest	4.7300	36.7938	0.6300	0.7000	0.7700	53.1873	(79)
Northwest	4.0500	11.2829	0.6300	0.7000	0.7700	13.9653	(81)

Solar gains	321.0917	586.5353	900.8237	1269.6961	1554.1705	1598.8248	1518.3375	1298.9981	1028.2009	675.4152	391.9716	269.9234	(83)
Total gains	1060.6408	1319.3923	1603.6575	1923.2854	2157.4333	2163.5101	2061.7521	1854.3545	1616.5534	1311.7436	1077.3158	991.0127	(84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.5522	53.6432	53.7327	54.1572	54.2374	54.6137	54.6137	54.6839	54.4681	54.2374	54.0754	53.9072	
alpha	4.5701	4.5762	4.5822	4.6105	4.6158	4.6409	4.6409	4.6456	4.6312	4.6158	4.6050	4.5938	
util living area													
	0.9880	0.9689	0.9165	0.7865	0.6003	0.4246	0.3089	0.3577	0.5935	0.8768	0.9743	0.9909	(86)
MIT	20.0846	20.2787	20.5379	20.7851	20.9024	20.9352	20.9404	20.9394	20.9143	20.7181	20.3458	20.0449	(87)
Th 2	19.8434	19.8451	19.8468	19.8547	19.8562	19.8632	19.8632	19.8645	19.8605	19.8562	19.8532	19.8501	(88)
util rest of house													
	0.9842	0.9597	0.8939	0.7402	0.5361	0.3514	0.2296	0.2705	0.5065	0.8345	0.9650	0.9880	(89)
MIT 2	18.6497	18.9281	19.2879	19.6094	19.7386	19.7741	19.7773	19.7782	19.7573	19.5420	19.0345	18.5977	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	18.9665	19.2263	19.5639	19.8690	19.9955	20.0305	20.0341	20.0346	20.0127	19.8016	19.3240	18.9172	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9665	19.2263	19.5639	19.8690	19.9955	20.0305	20.0341	20.0346	20.0127	19.8016	19.3240	18.9172	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9803	0.9534	0.8874	0.7408	0.5442	0.3623	0.2416	0.2836	0.5187	0.8322	0.9594	0.9848	(94)
Useful gains	1039.7396	1257.9527	1423.0646	1424.7290	1174.1331	783.8521	498.1023	525.9684	838.4321	1091.5845	1033.5871	975.9877	(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													

	2171.7764	2117.7992	1927.9652	1606.1089	1212.8606	788.4976	498.6232	527.0622	860.8138	1345.3368	1792.5800	2164.9354 (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												
	842.2354	577.8169	375.6461	130.5935	28.8133	0.0000	0.0000	0.0000	0.0000	188.7917	546.4749	884.5771 (98)
Space heating												3574.9488 (98)
Space heating per m2											(98) / (4) =	31.3070 (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	4062.4419 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	842.2354	577.8169	375.6461	130.5935	28.8133	0.0000	0.0000	0.0000	0.0000	188.7917	546.4749	884.5771	(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)													
	957.0857	656.6101	426.8705	148.4017	32.7424	0.0000	0.0000	0.0000	0.0000	214.5360	620.9942	1005.2012	(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												4062.4419	(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												4381.7887	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4062.4419	3.4800	141.3730	(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			165.5578	(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] =	0.4368 (257)
SAP value		93.9066
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	4062.4419	0.2160	877.4874	(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			1184.3298	(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			612.7968	(272)
CO2 emissions per m2			5.3700	(273)
EI value			94.8417	
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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3036	0.2895	0.2895	0.2683	0.2754	0.2401	0.2472	0.2401	0.2401	0.2613	0.2542	0.2825	(22b)
Effective ac	0.5461	0.5419	0.5419	0.5360	0.5379	0.5288	0.5305	0.5288	0.5288	0.5341	0.5323	0.5399	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	54.4828	54.0649	54.0649	53.4754	53.6669	52.7590	52.9306	52.7590	52.7590	53.2888	53.1072	53.8634	(38)
Heat transfer coeff	146.2066	145.7888	145.7888	145.1992	145.3908	144.4828	144.6545	144.4828	144.4828	145.0127	144.8311	145.5873	(39)
Average = Sum(39)m / 12 =												145.1590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2804	1.2767	1.2767	1.2716	1.2732	1.2653	1.2668	1.2653	1.2653	1.2699	1.2683	1.2750	(40)
HLP (average)												1.2712	(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	0.6300	0.7000	0.7700	7.7478	(75)
Southwest	4.7300	39.0225	0.6300	0.7000	0.7700	56.4089	(79)
Northwest	4.0500	12.4885	0.6300	0.7000	0.7700	15.4574	(81)

Solar gains	346.1918	569.3430	881.5201	1287.5073	1536.1750	1687.5671	1598.4503	1409.5174	1106.6375	717.2078	436.7574	285.5122	(83)
Total gains	1085.7409	1302.2000	1584.3539	1941.0966	2139.4378	2252.2525	2141.8648	1964.8738	1694.9901	1353.5362	1122.1015	1006.6015	(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	54.2374	54.3928	54.3928	54.6137	54.5417	54.8845	54.8193	54.8845	54.8845	54.6839	54.7525	54.4681	
alpha	4.6158	4.6262	4.6262	4.6409	4.6361	4.6590	4.6546	4.6590	4.6590	4.6456	4.6502	4.6312	
util living area													
	0.9818	0.9602	0.8848	0.7068	0.4923	0.2817	0.1621	0.1911	0.4376	0.7928	0.9559	0.9863	(86)
MIT	20.2269	20.3856	20.6527	20.8583	20.9279	20.9410	20.9417	20.9417	20.9360	20.8278	20.4962	20.1881	(87)
Th 2	19.8562	19.8591	19.8591	19.8632	19.8619	19.8681	19.8669	19.8681	19.8681	19.8645	19.8657	19.8605	(88)
util rest of house													
	0.9758	0.9479	0.8531	0.6485	0.4208	0.2095	0.0856	0.1080	0.3451	0.7271	0.9395	0.9817	(89)
MIT 2	18.8657	19.0919	19.4529	19.7015	19.7673	19.7827	19.7816	19.7829	19.7804	19.6793	19.2568	18.8137	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	19.1662	19.3775	19.7178	19.9569	20.0236	20.0384	20.0377	20.0387	20.0356	19.9329	19.5305	19.1171	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1662	19.3775	19.7178	19.9569	20.0236	20.0384	20.0377	20.0387	20.0356	19.9329	19.5305	19.1171	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9710	0.9414	0.8486	0.6536	0.4312	0.2204	0.0971	0.1205	0.3590	0.7315	0.9334	0.9776	(94)
Useful gains	1054.2296	1225.9007	1344.4161	1268.7611	922.5418	496.4519	207.9725	236.7572	608.5608	990.1663	1047.3429	984.0373	(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													

	1983.4750	1935.7128	1693.7444	1358.6103	933.9266	496.7905	207.9761	236.7681	611.9669	1106.8635	1597.5545	1967.9185 (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												
	691.3586	476.9938	259.9002	64.6914	8.4703	0.0000	0.0000	0.0000	0.0000	86.8228	396.1524	732.0075 (98)
Space heating												2716.3970 (98)
Space heating per m2											(98) / (4) =	23.7884 (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													3086.8148 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	691.3586	476.9938	259.9002	64.6914	8.4703	0.0000	0.0000	0.0000	0.0000	86.8228	396.1524	732.0075 (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)													
	785.6348	542.0384	295.3412	73.5130	9.6253	0.0000	0.0000	0.0000	0.0000	98.6622	450.1731	831.8268 (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													3086.8148 (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													3330.4036 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3086.8148	4.2800	132.1157 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1406.6175	4.2800	60.2032 (247)
Pumps and fans for heating	30.0000	15.4400	4.6320 (249)
Pump for solar water heating	50.0000	15.4400	7.7200 (249)
Energy for lighting	546.0197	15.4400	84.3054 (250)
Additional standing charges			92.0000 (251)
Energy saving/generation technologies			
PV Unit	-1789.0484	15.4400	-276.2291 (252)
Total energy cost			104.7473 (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	3086.8148	0.2160	666.7520 (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			970.5814 (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			366.9695 (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	3086.8148	1.2200	3765.9141 (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			5481.9875 (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			1911.4894 (272)

Primary energy kWh/m2/year 16.7396 (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	91.72 (37)
Summer heat loss coefficient	889.86 (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	0.6300	0.7000	0.9000	71.6763
South West	4.7300	119.9223	0.6300	0.7000	0.9000	202.6212
North West	4.0500	98.8453	0.6300	0.7000	0.9000	142.9995
total:						1832.7894

	Jun	Jul	Aug	
Solar gains	1951	1833	1603	(P3)
Internal gains	587	566	577	
Total summer gains	2538	2399	2180	(P5)
Summer gain/loss ratio	2.85	2.70	2.45	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	19.10	20.85	20.50	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight

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Sample Report Ltd
1 Sample Street
Sampletown

Full SAP Calculation Printout

Property Reference: 25220 - 97a Camden Mews
Survey Reference: Be Clean - Up Window
Property: 97a, London, NW1 9BU

Issued on Date: 26.Jul.2016
Prop Type Ref:

SAP Rating:	85 B	**CO2 Emissions (t/year):**	1.46	**DER:** 16.01 Pass	**TER:** 17.08	**Percentage DER<TER:**	6.27 %
Environmental:	86 B	**General Requirements Compliance:**	Pass	**DFEE:** 45.86 Pass	**TFEE:** 56.66	**Percentage DFEE<TFEE:**	19.07 %

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

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

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

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


```
SAP2012 Input Data (House)     26/07/2016

FullRefNo:                     Be Clean - Up Window

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                 41.5, 46.7, 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, 0.11
    Exposed Floor             5.82, 0, Other, Exposed Floor - Solid, 0, 0.11
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, Double Low-E Soft 0.1, , , 0.63, , 0.7,
Openings                       Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    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                         0.082
    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:                  4
AsBuilt q50:                   15
Property Tested:               False
Mechanical Ventilation         None
Chimneys MHS:                  0
Chimneys SHS:                  0
Chimneys Other:                0
Chimneys Total:                0
Open Flues MHS:                0
Open Flues SHS:                0
Open Flues Other:              0
Open Flues Total:              0
```

```
Intermittent Fans:            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                       None
Wind Turbine                  None
Terrain Type:                 Urban
Small Scale Hydro             None
Special Features              None


-------------------------------------------------------------------------------------------------------
REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS DESIGNED

Mid-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) 17.08 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.01 kg/m²OK
-------------------------------------------------------------------------------------------------------
1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.7 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)45.9 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           0.11 (max. 0.25)       0.11 (max. 0.70)          OK
Roof            0.13 (max. 0.20)       0.13 (max. 0.35)          OK
Openings        0.91 (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:        4.00 (design value)
Maximum                                10.0                                          OK
-------------------------------------------------------------------------------------------------------
4 Heating efficiency
Main heating system:                   Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc

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
```

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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:100%

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	

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10 Key features

Party wall U-value	0.00 W/m^2K
Floor U-value	0.11 W/m^2K
Exposed floor U-value	0.11 W/m^2K
Window U-value	0.80 W/m^2K
Roof window U-value	0.80 W/m^2K

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			4.0000	
Infiltration rate			0.3323	(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)	=	0.2825	(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	0.3601	0.3531	0.3460	0.3107	0.3036	0.2683	0.2683	0.2613	0.2825	0.3036	0.3178	0.3319	(22b)
Effective ac	0.5649	0.5623	0.5599	0.5483	0.5461	0.5360	0.5360	0.5341	0.5399	0.5461	0.5505	0.5551	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	56.3534	56.1022	55.8559	54.6992	54.4828	53.4754	53.4754	53.2888	53.8634	54.4828	54.9206	55.3783	(38)
Heat transfer coeff	148.0772	147.8260	147.5797	146.4231	146.2066	145.1992	145.1992	145.0127	145.5873	146.2066	146.6444	147.1021	(39)
Average = Sum(39)m / 12 =												146.4220	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2968	1.2946	1.2924	1.2823	1.2804	1.2716	1.2716	1.2699	1.2750	1.2804	1.2842	1.2882	(40)
HLP (average)												1.2823	(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	0.6300	0.7000	0.7700	6.9999	(75)
Southwest	4.7300	36.7938	0.6300	0.7000	0.7700	53.1873	(79)
Northwest	4.0500	11.2829	0.6300	0.7000	0.7700	13.9653	(81)

Solar gains	321.0917	586.5353	900.8237	1269.6961	1554.1705	1598.8248	1518.3375	1298.9981	1028.2009	675.4152	391.9716	269.9234	(83)
Total gains	831.8521	1095.0623	1393.1196	1735.5812	1992.8424	2011.5410	1914.3516	1701.4948	1444.3987	1118.2560	865.4674	766.7926	(84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.5522	53.6432	53.7327	54.1572	54.2374	54.6137	54.6137	54.6839	54.4681	54.2374	54.0754	53.9072	
alpha	4.5701	4.5762	4.5822	4.6105	4.6158	4.6409	4.6409	4.6456	4.6312	4.6158	4.6050	4.5938	
util living area	0.9954	0.9843	0.9463	0.8301	0.6403	0.4550	0.3324	0.3890	0.6502	0.9221	0.9888	0.9968	(86)
MIT	19.9525	20.1582	20.4468	20.7418	20.8908	20.9331	20.9400	20.9385	20.9020	20.6464	20.2291	19.9139	(87)
Th 2	19.8434	19.8451	19.8468	19.8547	19.8562	19.8632	19.8632	19.8645	19.8605	19.8562	19.8532	19.8501	(88)
util rest of house	0.9939	0.9793	0.9300	0.7879	0.5746	0.3773	0.2472	0.2945	0.5600	0.8905	0.9843	0.9957	(89)
MIT 2	18.4587	18.7575	19.1665	19.5600	19.7284	19.7729	19.7771	19.7779	19.7485	19.4547	18.8690	18.4077	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	18.7885	19.0668	19.4492	19.8209	19.9850	20.0290	20.0339	20.0341	20.0032	19.7178	19.1693	18.7402	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7885	19.0668	19.4492	19.8209	19.9850	20.0290	20.0339	20.0341	20.0032	19.7178	19.1693	18.7402	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9919	0.9748	0.9232	0.7865	0.5823	0.3888	0.2601	0.3088	0.5720	0.8858	0.9807	0.9942	(94)
Useful gains	825.1107	1067.4367	1286.0858	1365.1012	1160.4968	782.0592	497.8779	525.4218	826.2040	990.5899	848.7618	762.3598	(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	2145.4190	2094.2169	1911.0359	1599.0706	1211.3233	788.2932	498.5947	526.9947	859.4244	1333.0819	1769.8890	2138.8975	(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	982.3093	689.9963	464.9628	168.4580	37.8149	0.0000	0.0000	0.0000	0.0000	254.8140	663.2116	1024.1441	(98)
Space heating												4285.7110	(98)
Space heating per m2											(98) / (4) =	37.5314	(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	4761.9011 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	982.3093	689.9963	464.9628	168.4580	37.8149	0.0000	0.0000	0.0000	0.0000	254.8140	663.2116	1024.1441	(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)													
	1091.4548	766.6625	516.6254	187.1755	42.0166	0.0000	0.0000	0.0000	0.0000	283.1267	736.9017	1137.9379	(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												4761.9011	(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)
Total delivered energy for all uses	7807.2225 (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	4761.9011	0.2160	1028.5706	(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			1585.5279	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	436.8157	0.5190	226.7074	(268)
Total CO2, kg/year			1827.8052	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.0100	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES			
DER		16.0100	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		32.0463	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		32.0463	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	46.7000	3.0200	43.6800	0.1300	5.6784			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.7736			(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) =	85.8778 (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	144.3247	143.9921	143.6662	142.1353	141.8488	140.5154	140.5154	140.2685	141.0290	141.8488	142.4283	143.0341	(39)

Average = Sum(39)m / 12 =		142.1339 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2639	1.2610	1.2581	1.2447	1.2422	1.2305	1.2305	1.2284	1.2350	1.2422	1.2473	1.2526	(40)
HLP (average)												1.2447	(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	54.9446	55.0715	55.1964	55.7909	55.9036	56.4341	56.4341	56.5334	56.2286	55.9036	55.6762	55.4404	
alpha	4.6630	4.6714	4.6798	4.7194	4.7269	4.7623	4.7623	4.7689	4.7486	4.7269	4.7117	4.6960	
util living area													
	0.9976	0.9935	0.9792	0.9260	0.7965	0.6074	0.4532	0.5187	0.7896	0.9654	0.9947	0.9983	(86)
MIT	19.6280	19.8306	20.1526	20.5526	20.8420	20.9667	20.9933	20.9877	20.8887	20.4810	19.9759	19.5944	(87)
Th 2	19.8692	19.8715	19.8738	19.8844	19.8864	19.8956	19.8956	19.8974	19.8921	19.8864	19.8824	19.8782	(88)
util rest of house													
	0.9968	0.9912	0.9718	0.9008	0.7367	0.5145	0.3427	0.4007	0.7053	0.9486	0.9925	0.9977	(89)
MIT 2	18.0516	18.3483	18.8146	19.3793	19.7422	19.8754	19.8934	19.8927	19.8086	19.2963	18.5689	18.0087	(90)
Living area fraction										fLA = Living area / (4) =		0.2208	(91)
MIT	18.3997	18.6755	19.1100	19.6383	19.9850	20.1164	20.1362	20.1345	20.0471	19.5578	18.8795	18.3588	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3997	18.6755	19.1100	19.6383	19.9850	20.1164	20.1362	20.1345	20.0471	19.5578	18.8795	18.3588	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9952	0.9878	0.9652	0.8941	0.7425	0.5339	0.3672	0.4268	0.7186	0.9420	0.9895	0.9964	(94)
Useful gains	705.7139	862.7002	1017.7704	1126.2588	1047.7367	754.4357	494.1596	518.3895	760.4998	813.4723	708.7997	660.7655	(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													
	2034.9291	1983.5704	1811.6321	1526.2900	1175.2148	775.1325	496.8931	523.8285	838.7108	1270.6581	1677.7407	2025.1886	(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													
	988.9361	753.2248	590.6331	288.0225	94.8437	0.0000	0.0000	0.0000	0.0000	340.1463	697.6375	1015.1308	(98)
Space heating												4768.5748	(98)
Space heating per m2											(98) / (4) =	41.7600	(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	5100.0800 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	988.9361	753.2248	590.6331	288.0225	94.8437	0.0000	0.0000	0.0000	0.0000	340.1463	697.6375	1015.1308	(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)													
	1057.6857	805.5880	631.6932	308.0454	101.4371	0.0000	0.0000	0.0000	0.0000	363.7928	746.1364	1085.7014	(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	88.3104	88.0436	87.4441	85.9605	83.1467	79.8000	79.8000	79.8000	79.8000	86.2970	87.8300	88.3957	(217)
Fuel for water heating, kWh/month													
	254.0596	224.7811	238.1003	217.7062	221.0003	206.4053	198.8502	217.3456	216.6940	224.8402	232.8804	247.8984	(219)
Water heating fuel used												2700.5618	(219)
Annual totals kWh/year													
Space heating fuel - main system												5100.0800	(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												8312.4575	(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	5100.0800	0.2160	1101.6173	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2700.5618	0.2160	583.3213	(264)
Space and water heating			1684.9386	(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			1950.5710	(272)
Emissions per m2 for space and water heating			14.7556	(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) = (14.7556 * 1.00) + 1.9854 + 0.3409, rounded to 2 d.p.			17.0800	(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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3601	0.3531	0.3460	0.3107	0.3036	0.2683	0.2683	0.2613	0.2825	0.3036	0.3178	0.3319	(22b)
Effective ac	0.5649	0.5623	0.5599	0.5483	0.5461	0.5360	0.5360	0.5341	0.5399	0.5461	0.5505	0.5551	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	56.3534	56.1022	55.8559	54.6992	54.4828	53.4754	53.4754	53.2888	53.8634	54.4828	54.9206	55.3783	(38)
Heat transfer coeff	148.0772	147.8260	147.5797	146.4231	146.2066	145.1992	145.1992	145.0127	145.5873	146.2066	146.6444	147.1021	(39)
Average = Sum(39)m / 12 =												146.4220	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2968	1.2946	1.2924	1.2823	1.2804	1.2716	1.2716	1.2699	1.2750	1.2804	1.2842	1.2882	(40)
HLP (average)												1.2823	(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	0.6300	0.7000	0.7700	6.9999	(75)
Southwest	4.7300	36.7938	0.6300	0.7000	0.7700	53.1873	(79)
Northwest	4.0500	11.2829	0.6300	0.7000	0.7700	13.9653	(81)

Solar gains	321.0917	586.5353	900.8237	1269.6961	1554.1705	1598.8248	1518.3375	1298.9981	1028.2009	675.4152	391.9716	269.9234	(83)
Total gains	736.1725	1000.2297	1300.0459	1644.8986	1903.7123	1924.5968	1829.2653	1614.0280	1356.0861	1027.4684	771.8853	671.9565	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.5522	53.6432	53.7327	54.1572	54.2374	54.6137	54.6137	54.6839	54.4681	54.2374	54.0754	53.9072	
alpha	4.5701	4.5762	4.5822	4.6105	4.6158	4.6409	4.6409	4.6456	4.6312	4.6158	4.6050	4.5938	
util living area													
	0.9972	0.9889	0.9574	0.8509	0.6634	0.4742	0.3475	0.4093	0.6821	0.9403	0.9929	0.9982	(86)
MIT	19.6072	19.8854	20.2823	20.7011	20.9222	20.9866	20.9975	20.9948	20.9360	20.5546	19.9788	19.5555	(87)
Th 2	19.8434	19.8451	19.8468	19.8547	19.8562	19.8632	19.8632	19.8645	19.8605	19.8562	19.8532	19.8501	(88)
util rest of house													
	0.9963	0.9853	0.9438	0.8113	0.5973	0.3938	0.2587	0.3103	0.5911	0.9142	0.9900	0.9975	(89)
MIT 2	18.5872	18.8644	19.2514	19.6383	19.8117	19.8581	19.8626	19.8632	19.8307	19.5236	18.9652	18.5409	(90)
Living area fraction										fLA = Living area / (4) =		0.2208	(91)
MIT	18.8124	19.0898	19.4790	19.8729	20.0569	20.1072	20.1132	20.1130	20.0747	19.7512	19.1890	18.7649	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8124	19.0898	19.4790	19.8729	20.0569	20.1072	20.1132	20.1130	20.0747	19.7512	19.1890	18.7649	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9951	0.9821	0.9385	0.8120	0.6094	0.4113	0.2783	0.3322	0.6094	0.9113	0.9876	0.9967	(94)
Useful gains	732.5443	982.2849	1220.1274	1335.6081	1160.2091	791.6525	509.1291	536.2468	826.3869	936.2967	762.3239	669.7116	(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													
	2148.9522	2097.6250	1915.4345	1606.6862	1221.8301	799.6419	510.1110	538.4388	869.8459	1337.9730	1772.7868	2142.5255	(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													
	1053.8075	749.5085	517.3085	195.1762	45.8460	0.0000	0.0000	0.0000	0.0000	298.8471	727.5333	1095.7735	(98)
Space heating												4683.8007	(98)
Space heating per m2											(98) / (4) =	41.0176	(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	1364.8727	1074.4742	1102.0962	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9618	0.9809	0.9680	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1312.7693	1053.9473	1066.7773	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2298.5939	2188.1433	1948.6932	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	709.7937	843.8418	656.1454	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												2209.7810	(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	177.4484	210.9605	164.0364	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												552.4452	(107)
Space cooling per m2												4.8379	(108)
Energy for space heating												41.0176	(99)

Energy for space cooling	4.8379 (108)
Total	45.8556 (109)
Dwelling Fabric Energy Efficiency (DFEE)	45.9 (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	46.7000	3.0200	43.6800	0.1300	5.6784			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.7736			(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) =	85.8778 (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	144.3247	143.9921	143.6662	142.1353	141.8488	140.5154	140.5154	140.2685	141.0290	141.8488	142.4283	143.0341	(39)
Average = Sum(39)m / 12 =												142.1339	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2639	1.2610	1.2581	1.2447	1.2422	1.2305	1.2305	1.2284	1.2350	1.2422	1.2473	1.2526	(40)
HLP (average)												1.2447	(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	54.9446	55.0715	55.1964	55.7909	55.9036	56.4341	56.4341	56.5334	56.2286	55.9036	55.6762	55.4404	
alpha	4.6630	4.6714	4.6798	4.7194	4.7269	4.7623	4.7623	4.7689	4.7486	4.7269	4.7117	4.6960	
util living area													
	0.9987	0.9959	0.9852	0.9413	0.8236	0.6386	0.4808	0.5533	0.8261	0.9767	0.9970	0.9991	(86)
MIT	19.5540	19.7585	20.0861	20.5014	20.8155	20.9590	20.9914	20.9839	20.8629	20.4195	19.9042	19.5207	(87)
Th 2	19.8692	19.8715	19.8738	19.8844	19.8864	19.8956	19.8956	19.8974	19.8921	19.8864	19.8824	19.8782	(88)
util rest of house													
	0.9983	0.9944	0.9798	0.9201	0.7670	0.5438	0.3645	0.4294	0.7470	0.9647	0.9957	0.9988	(89)
MIT 2	18.5544	18.7601	19.0862	19.4939	19.7690	19.8783	19.8936	19.8931	19.8191	19.4261	18.9145	18.5282	(90)
Living area fraction										fLA = Living area / (4) =		0.2208	(91)
MIT	18.7751	18.9805	19.3069	19.7163	20.0000	20.1169	20.1360	20.1339	20.0495	19.6454	19.1330	18.7473	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7751	18.9805	19.3069	19.7163	20.0000	20.1169	20.1360	20.1339	20.0495	19.6454	19.1330	18.7473	(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	0.9762	0.9162	0.7734	0.5638	0.3904	0.4570	0.7598	0.9612	0.9945	0.9983	(94)
Useful gains	614.8697	775.8558	941.4141	1073.7500	1024.6316	749.2508	493.3076	516.4906	739.3094	745.5388	622.1706	570.2398	(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													
	2089.1156	2027.4824	1839.9200	1537.3811	1177.3493	775.2041	496.8609	523.7525	839.0582	1283.0821	1713.8392	2080.7646	(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													
	1096.8390	841.0931	668.4884	333.8144	113.6220	0.0000	0.0000	0.0000	0.0000	399.9322	786.0014	1123.8304	(98)
Space heating												5363.6208	(98)
Space heating per m2											(98) / (4) =	46.9710	(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	1320.8451	1039.8142	1066.0407	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8999	0.9452	0.9181	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1188.6638	982.7930	978.7108	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	314.2125	420.8322	314.0704	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1049.1150	(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	78.5531	105.2080	78.5176	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												262.2788	(107)
Space cooling per m2												2.2969	(108)
Energy for space heating												46.9710	(99)
Energy for space cooling												2.2969	(108)
Total												49.2679	(109)
Target Fabric Energy Efficiency (TFEE)												56.7	(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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3036	0.2895	0.2895	0.2683	0.2754	0.2401	0.2472	0.2401	0.2401	0.2613	0.2542	0.2825	(22b)
Effective ac	0.5461	0.5419	0.5419	0.5360	0.5379	0.5288	0.5305	0.5288	0.5288	0.5341	0.5323	0.5399	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	54.4828	54.0649	54.0649	53.4754	53.6669	52.7590	52.9306	52.7590	52.7590	53.2888	53.1072	53.8634	(38)
Heat transfer coeff	146.2066	145.7888	145.7888	145.1992	145.3908	144.4828	144.6545	144.4828	144.4828	145.0127	144.8311	145.5873	(39)
Average = Sum(39)m / 12 =												145.1590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2804	1.2767	1.2767	1.2716	1.2732	1.2653	1.2668	1.2653	1.2653	1.2699	1.2683	1.2750	(40)
HLP (average)												1.2712	(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	0.6300	0.7000	0.7700	7.7478	(75)
Southwest	4.7300	39.0225	0.6300	0.7000	0.7700	56.4089	(79)
Northwest	4.0500	12.4885	0.6300	0.7000	0.7700	15.4574	(81)

Solar gains	346.1918	569.3430	881.5201	1287.5073	1536.1750	1687.5671	1598.4503	1409.5174	1106.6375	717.2078	436.7574	285.5122	(83)
Total gains	1076.7583	1294.9459	1581.1647	1946.6233	2153.3523	2267.4014	2156.5841	1976.8641	1697.4125	1348.7435	1113.6736	997.1893	(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	54.2374	54.3928	54.3928	54.6137	54.5417	54.8845	54.8193	54.8845	54.8845	54.6839	54.7525	54.4681	
alpha	4.6158	4.6262	4.6262	4.6409	4.6361	4.6590	4.6546	4.6590	4.6590	4.6456	4.6502	4.6312	
util living area													
	0.9824	0.9610	0.8855	0.7054	0.4894	0.2798	0.1610	0.1900	0.4370	0.7943	0.9571	0.9868	(86)
MIT	20.2220	20.3820	20.6516	20.8590	20.9282	20.9411	20.9417	20.9417	20.9361	20.8268	20.4921	20.1828	(87)
Th 2	19.8562	19.8591	19.8591	19.8632	19.8619	19.8681	19.8669	19.8681	19.8681	19.8645	19.8657	19.8605	(88)
util rest of house													
	0.9765	0.9488	0.8538	0.6471	0.4182	0.2081	0.0850	0.1073	0.3447	0.7289	0.9409	0.9823	(89)
MIT 2	18.8587	19.0869	19.4516	19.7022	19.7676	19.7827	19.7816	19.7829	19.7805	19.6783	19.2513	18.8061	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	19.1597	19.3728	19.7165	19.9576	20.0238	20.0384	20.0377	20.0387	20.0356	19.9319	19.5252	19.1100	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1597	19.3728	19.7165	19.9576	20.0238	20.0384	20.0377	20.0387	20.0356	19.9319	19.5252	19.1100	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9718	0.9424	0.8493	0.6522	0.4286	0.2190	0.0964	0.1198	0.3585	0.7332	0.9349	0.9783	(94)
Useful gains	1046.3778	1220.3528	1342.8397	1269.6431	922.8611	496.4631	207.9727	236.7576	608.5834	988.9040	1041.1277	975.5621	(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													
	1982.5130	1935.0316	1693.5541	1358.7107	933.9625	496.7919	207.9762	236.7682	611.9696	1106.7168	1596.7957	1966.8862	(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													
	696.4846	480.2642	260.9315	64.1287	8.2594	0.0000	0.0000	0.0000	0.0000	87.6527	400.0809	737.5451	(98)
Space heating												2735.3473	(98)
RHI space heating demand												2735	(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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3601	0.3531	0.3460	0.3107	0.3036	0.2683	0.2683	0.2613	0.2825	0.3036	0.3178	0.3319	(22b)
Effective ac	0.5649	0.5623	0.5599	0.5483	0.5461	0.5360	0.5360	0.5341	0.5399	0.5461	0.5505	0.5551	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	56.3534	56.1022	55.8559	54.6992	54.4828	53.4754	53.4754	53.2888	53.8634	54.4828	54.9206	55.3783	(38)
Heat transfer coeff	148.0772	147.8260	147.5797	146.4231	146.2066	145.1992	145.1992	145.0127	145.5873	146.2066	146.6444	147.1021	(39)
Average = Sum(39)m / 12 =												146.4220	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2968	1.2946	1.2924	1.2823	1.2804	1.2716	1.2716	1.2699	1.2750	1.2804	1.2842	1.2882	(40)
HLP (average)												1.2823	(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	0.6300	0.7000	0.7700	6.9999	(75)
Southwest	4.7300	36.7938	0.6300	0.7000	0.7700	53.1873	(79)
Northwest	4.0500	11.2829	0.6300	0.7000	0.7700	13.9653	(81)

Solar gains	321.0917	586.5353	900.8237	1269.6961	1554.1705	1598.8248	1518.3375	1298.9981	1028.2009	675.4152	391.9716	269.9234	(83)
Total gains	1051.6583	1312.1382	1600.4683	1928.8121	2171.3479	2178.6590	2076.4713	1866.3448	1618.9759	1306.9509	1068.8879	981.6005	(84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.5522	53.6432	53.7327	54.1572	54.2374	54.6137	54.6137	54.6839	54.4681	54.2374	54.0754	53.9072	
alpha	4.5701	4.5762	4.5822	4.6105	4.6158	4.6409	4.6409	4.6456	4.6312	4.6158	4.6050	4.5938	
util living area	0.9884	0.9695	0.9170	0.7852	0.5971	0.4218	0.3068	0.3555	0.5928	0.8780	0.9750	0.9913	(86)
MIT	20.0795	20.2749	20.5366	20.7862	20.9032	20.9354	20.9405	20.9395	20.9144	20.7165	20.3413	20.0395	(87)
Th 2	19.8434	19.8451	19.8468	19.8547	19.8562	19.8632	19.8632	19.8645	19.8605	19.8562	19.8532	19.8501	(88)
util rest of house	0.9847	0.9604	0.8945	0.7388	0.5331	0.3490	0.2280	0.2687	0.5058	0.8360	0.9659	0.9885	(89)
MIT 2	18.6424	18.9229	19.2862	19.6106	19.7393	19.7742	19.7773	19.7783	19.7574	19.5401	19.0282	18.5899	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	18.9597	19.2214	19.5623	19.8702	19.9963	20.0306	20.0341	20.0346	20.0128	19.7998	19.3181	18.9099	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9597	19.2214	19.5623	19.8702	19.9963	20.0306	20.0341	20.0346	20.0128	19.7998	19.3181	18.9099	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9809	0.9542	0.8880	0.7395	0.5412	0.3599	0.2399	0.2818	0.5180	0.8335	0.9604	0.9854	(94)
Useful gains	1031.5456	1252.0878	1421.1578	1426.2630	1175.1047	783.9991	498.1204	526.0021	838.5680	1089.3949	1026.5903	967.2246	(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	2170.7664	2117.0716	1927.7304	1606.2886	1212.9698	788.5143	498.6255	527.0664	860.8293	1345.0731	1791.7184	2163.8634	(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	847.5802	581.2691	376.8900	129.6184	28.1716	0.0000	0.0000	0.0000	0.0000	190.2246	550.8923	890.2993	(98)
Space heating												3594.9456	(98)
Space heating per m2											(98) / (4) =	31.4821	(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	3994.3840 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	847.5802	581.2691	376.8900	129.6184	28.1716	0.0000	0.0000	0.0000	0.0000	190.2246	550.8923	890.2993	(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)													
	941.7558	645.8546	418.7667	144.0205	31.3018	0.0000	0.0000	0.0000	0.0000	211.3607	612.1025	989.2214	(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												3994.3840	(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)
Total delivered energy for all uses												7039.7054	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3994.3840	3.4800	139.0046	(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)
Total energy cost			410.3096	(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] =	1.0825 (257)
SAP value		84.8985
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	3994.3840	0.2160	862.7869	(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			1419.7442	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	436.8157	0.5190	226.7074	(268)
Total kg/year			1662.0215	(272)
CO2 emissions per m2			14.5500	(273)
EI value			86.0097	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

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

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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3036	0.2895	0.2895	0.2683	0.2754	0.2401	0.2472	0.2401	0.2401	0.2613	0.2542	0.2825	(22b)
Effective ac	0.5461	0.5419	0.5419	0.5360	0.5379	0.5288	0.5305	0.5288	0.5288	0.5341	0.5323	0.5399	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	54.4828	54.0649	54.0649	53.4754	53.6669	52.7590	52.9306	52.7590	52.7590	53.2888	53.1072	53.8634	(38)
Heat transfer coeff	146.2066	145.7888	145.7888	145.1992	145.3908	144.4828	144.6545	144.4828	144.4828	145.0127	144.8311	145.5873	(39)
Average = Sum(39)m / 12 =												145.1590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2804	1.2767	1.2767	1.2716	1.2732	1.2653	1.2668	1.2653	1.2653	1.2699	1.2683	1.2750	(40)
HLP (average)												1.2712	(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	0.6300	0.7000	0.7700	7.7478	(75)
Southwest	4.7300	39.0225	0.6300	0.7000	0.7700	56.4089	(79)
Northwest	4.0500	12.4885	0.6300	0.7000	0.7700	15.4574	(81)

Solar gains	346.1918	569.3430	881.5201	1287.5073	1536.1750	1687.5671	1598.4503	1409.5174	1106.6375	717.2078	436.7574	285.5122	(83)
Total gains	1076.7583	1294.9459	1581.1647	1946.6233	2153.3523	2267.4014	2156.5841	1976.8641	1697.4125	1348.7435	1113.6736	997.1893	(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	54.2374	54.3928	54.3928	54.6137	54.5417	54.8845	54.8193	54.8845	54.8845	54.6839	54.7525	54.4681	
alpha	4.6158	4.6262	4.6262	4.6409	4.6361	4.6590	4.6546	4.6590	4.6590	4.6456	4.6502	4.6312	
util living area	0.9824	0.9610	0.8855	0.7054	0.4894	0.2798	0.1610	0.1900	0.4370	0.7943	0.9571	0.9868	(86)
MIT	20.2220	20.3820	20.6516	20.8590	20.9282	20.9411	20.9417	20.9417	20.9361	20.8268	20.4921	20.1828	(87)
Th 2	19.8562	19.8591	19.8591	19.8632	19.8619	19.8681	19.8669	19.8681	19.8681	19.8645	19.8657	19.8605	(88)
util rest of house	0.9765	0.9488	0.8538	0.6471	0.4182	0.2081	0.0850	0.1073	0.3447	0.7289	0.9409	0.9823	(89)
MIT 2	18.8587	19.0869	19.4516	19.7022	19.7676	19.7827	19.7816	19.7829	19.7805	19.6783	19.2513	18.8061	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	19.1597	19.3728	19.7165	19.9576	20.0238	20.0384	20.0377	20.0387	20.0356	19.9319	19.5252	19.1100	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1597	19.3728	19.7165	19.9576	20.0238	20.0384	20.0377	20.0387	20.0356	19.9319	19.5252	19.1100	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9718	0.9424	0.8493	0.6522	0.4286	0.2190	0.0964	0.1198	0.3585	0.7332	0.9349	0.9783	(94)
Useful gains	1046.3778	1220.3528	1342.8397	1269.6431	922.8611	496.4631	207.9727	236.7576	608.5834	988.9040	1041.1277	975.5621	(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	1982.5130	1935.0316	1693.5541	1358.7107	933.9625	496.7919	207.9762	236.7682	611.9696	1106.7168	1596.7957	1966.8862	(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	696.4846	480.2642	260.9315	64.1287	8.2594	0.0000	0.0000	0.0000	0.0000	87.6527	400.0809	737.5451	(98)
Space heating												2735.3473	(98)
Space heating per m2											(98) / (4) =	23.9544	(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	3039.2748 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	696.4846	480.2642	260.9315	64.1287	8.2594	0.0000	0.0000	0.0000	0.0000	87.6527	400.0809	737.5451	(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)													
	773.8718	533.6269	289.9239	71.2541	9.1771	0.0000	0.0000	0.0000	0.0000	97.3919	444.5344	819.4946	(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												3039.2748	(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)
Total delivered energy for all uses												6084.5961	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3039.2748	4.2800	130.0810	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2578.5057	4.2800	110.3600	(247)
Pumps and fans for heating	30.0000	15.4400	4.6320	(249)
Energy for lighting	436.8157	15.4400	67.4443	(250)
Additional standing charges			92.0000	(251)
Total energy cost			404.5174	(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	3039.2748	0.2160	656.4833	(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			1213.4406	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	436.8157	0.5190	226.7074	(268)
Total kg/year			1455.7179	(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	3039.2748	1.2200	3707.9152	(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			6853.6921	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	436.8157	3.0700	1341.0243	(268)
Primary energy kWh/year			8286.8164	(272)
Primary energy kWh/m2/year			72.5704	(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	-£ 44	-237 kg (16.3%)
U Solar photovoltaic panels	+ 8.4	-£ 276	-929 kg (76.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£44	2.07 kg/m²	B 86	B 88
Solar photovoltaic panels	£276	8.13 kg/m²	A 95	A 96
Total Savings	£321	10.20 kg/m²		

Potential energy efficiency rating: A 95
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 395 TEST (24 Jun 2016)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£72	£80	-£8
Mains gas	£332	£280	£52
Space heating	£227	£228	-£1
Water heating	£110	£65	£46
Lighting	£67	£67	£0
Generated (PV)	-£0	-£276	£276
Total cost of fuels	£404	£84	£320
Total cost of uses	£404	£84	£321
Delivered energy	53 kWh/m²	27 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	73 kWh/m²	13 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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3601	0.3531	0.3460	0.3107	0.3036	0.2683	0.2683	0.2613	0.2825	0.3036	0.3178	0.3319	(22b)
Effective ac	0.5649	0.5623	0.5599	0.5483	0.5461	0.5360	0.5360	0.5341	0.5399	0.5461	0.5505	0.5551	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	56.3534	56.1022	55.8559	54.6992	54.4828	53.4754	53.4754	53.2888	53.8634	54.4828	54.9206	55.3783	(38)
Heat transfer coeff	148.0772	147.8260	147.5797	146.4231	146.2066	145.1992	145.1992	145.0127	145.5873	146.2066	146.6444	147.1021	(39)
Average = Sum(39)m / 12 =												146.4220	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2968	1.2946	1.2924	1.2823	1.2804	1.2716	1.2716	1.2699	1.2750	1.2804	1.2842	1.2882	(40)
HLP (average)												1.2823	(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	0.6300	0.7000	0.7700	6.9999	(75)
Southwest	4.7300	36.7938	0.6300	0.7000	0.7700	53.1873	(79)
Northwest	4.0500	11.2829	0.6300	0.7000	0.7700	13.9653	(81)

Solar gains	321.0917	586.5353	900.8237	1269.6961	1554.1705	1598.8248	1518.3375	1298.9981	1028.2009	675.4152	391.9716	269.9234	(83)
Total gains	1041.4244	1301.9044	1588.7337	1911.0743	2147.3567	2154.4177	2052.2300	1843.1041	1602.7389	1295.2163	1058.6540	971.3667	(84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.5522	53.6432	53.7327	54.1572	54.2374	54.6137	54.6137	54.6839	54.4681	54.2374	54.0754	53.9072	
alpha	4.5701	4.5762	4.5822	4.6105	4.6158	4.6409	4.6409	4.6456	4.6312	4.6158	4.6050	4.5938	
util living area													
	0.9888	0.9703	0.9188	0.7893	0.6027	0.4263	0.3104	0.3599	0.5978	0.8810	0.9759	0.9916	(86)
MIT	20.0737	20.2696	20.5319	20.7826	20.9018	20.9351	20.9404	20.9393	20.9135	20.7126	20.3358	20.0336	(87)
Th 2	19.8434	19.8451	19.8468	19.8547	19.8562	19.8632	19.8632	19.8645	19.8605	19.8562	19.8532	19.8501	(88)
util rest of house													
	0.9852	0.9615	0.8966	0.7432	0.5384	0.3528	0.2307	0.2721	0.5105	0.8395	0.9671	0.9889	(89)
MIT 2	18.6341	18.9154	19.2800	19.6066	19.7381	19.7741	19.7773	19.7782	19.7567	19.5355	19.0206	18.5814	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	18.9519	19.2144	19.5564	19.8662	19.9950	20.0304	20.0341	20.0346	20.0121	19.7953	19.3109	18.9020	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9519	19.2144	19.5564	19.8662	19.9950	20.0304	20.0341	20.0346	20.0121	19.7953	19.3109	18.9020	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9815	0.9554	0.8901	0.7437	0.5464	0.3638	0.2427	0.2854	0.5226	0.8369	0.9616	0.9859	(94)
Useful gains	1022.1839	1243.7781	1414.0974	1421.2977	1173.4136	783.7615	498.0903	525.9357	837.6408	1083.9694	1018.0513	957.6731	(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													

	2169.6128	2116.0409	1926.8605	1605.7067	1212.7797	788.4872	498.6217	527.0582	860.7241	1344.4193	1790.6671	2162.6954 (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												
	853.6870	586.1606	381.4958	132.7745	29.2884	0.0000	0.0000	0.0000	0.0000	193.7747	556.2834	896.5366 (98)
Space heating												3630.0010 (98)
Space heating per m2											(98) / (4) =	31.7891 (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													4033.3345 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	853.6870	586.1606	381.4958	132.7745	29.2884	0.0000	0.0000	0.0000	0.0000	193.7747	556.2834	896.5366 (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)													
	948.5412	651.2896	423.8842	147.5272	32.5427	0.0000	0.0000	0.0000	0.0000	215.3052	618.0926	996.1518 (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													4033.3345 (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)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =											-1727.2394		-1727.2394 (233)
Total delivered energy for all uses													4166.1941 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4033.3345	3.4800	140.3600	(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	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			147.4514	(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] =	0.3890 (257)
SAP value		94.5730
SAP rating (Section 12)		95 (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	4033.3345	0.2160	871.2002	(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			1161.3494	(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	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			533.1395	(272)
CO2 emissions per m2			4.6700	(273)
EI value			95.5122	
EI rating			96	(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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3036	0.2895	0.2895	0.2683	0.2754	0.2401	0.2472	0.2401	0.2401	0.2613	0.2542	0.2825	(22b)
Effective ac	0.5461	0.5419	0.5419	0.5360	0.5379	0.5288	0.5305	0.5288	0.5288	0.5341	0.5323	0.5399	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	54.4828	54.0649	54.0649	53.4754	53.6669	52.7590	52.9306	52.7590	52.7590	53.2888	53.1072	53.8634	(38)
Heat transfer coeff	146.2066	145.7888	145.7888	145.1992	145.3908	144.4828	144.6545	144.4828	144.4828	145.0127	144.8311	145.5873	(39)
Average = Sum(39)m / 12 =												145.1590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2804	1.2767	1.2767	1.2716	1.2732	1.2653	1.2668	1.2653	1.2653	1.2699	1.2683	1.2750	(40)
HLP (average)												1.2712	(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)

---
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)

---
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	0.6300	0.7000	0.7700	7.7478	(75)
Southwest	4.7300	39.0225	0.6300	0.7000	0.7700	56.4089	(79)
Northwest	4.0500	12.4885	0.6300	0.7000	0.7700	15.4574	(81)

Solar gains	346.1918	569.3430	881.5201	1287.5073	1536.1750	1687.5671	1598.4503	1409.5174	1106.6375	717.2078	436.7574	285.5122	(83)
Total gains	1066.5245	1284.7121	1569.4301	1928.8855	2129.3612	2243.1601	2132.3428	1953.6233	1681.1755	1337.0089	1103.4398	986.9555	(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	54.2374	54.3928	54.3928	54.6137	54.5417	54.8845	54.8193	54.8845	54.8845	54.6839	54.7525	54.4681	
alpha	4.6158	4.6262	4.6262	4.6409	4.6361	4.6590	4.6546	4.6590	4.6590	4.6456	4.6502	4.6312	
util living area													
	0.9830	0.9620	0.8878	0.7100	0.4945	0.2828	0.1628	0.1922	0.4410	0.7982	0.9584	0.9874	(86)
MIT	20.2163	20.3769	20.6476	20.8567	20.9277	20.9410	20.9417	20.9417	20.9359	20.8243	20.4871	20.1770	(87)
Th 2	19.8562	19.8591	19.8591	19.8632	19.8619	19.8681	19.8669	19.8681	19.8681	19.8645	19.8657	19.8605	(88)
util rest of house													
	0.9773	0.9502	0.8565	0.6517	0.4227	0.2104	0.0859	0.1086	0.3479	0.7331	0.9427	0.9830	(89)
MIT 2	18.8506	19.0799	19.4465	19.6999	19.7672	19.7827	19.7816	19.7829	19.7804	19.6758	19.2445	18.7978	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	19.1521	19.3662	19.7116	19.9553	20.0234	20.0384	20.0377	20.0387	20.0355	19.9293	19.5188	19.1023	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1521	19.3662	19.7116	19.9553	20.0234	20.0384	20.0377	20.0387	20.0355	19.9293	19.5188	19.1023	(93)

---
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9727	0.9438	0.8519	0.6567	0.4331	0.2213	0.0975	0.1212	0.3619	0.7373	0.9366	0.9791	(94)
Useful gains	1037.3973	1212.4839	1336.9912	1266.7825	922.3046	496.4450	207.9724	236.7569	608.4293	985.7606	1033.5244	966.3152	(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													

	1981.4131	1934.0655	1692.8478	1358.3850	933.9000	496.7896	207.9761	236.7680	611.9514	1106.3511	1595.8673	1965.7603 (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												
	702.3478	484.9028	264.7573	65.9538	8.6270	0.0000	0.0000	0.0000	0.0000	89.7193	404.8869	743.5871 (98)
Space heating												2764.7820 (98)
Space heating per m2											(98) / (4) =	24.2121 (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													3071.9800 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	702.3478	484.9028	264.7573	65.9538	8.6270	0.0000	0.0000	0.0000	0.0000	89.7193	404.8869	743.5871 (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)													
	780.3864	538.7809	294.1748	73.2820	9.5855	0.0000	0.0000	0.0000	0.0000	99.6881	449.8743	826.2079 (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													3071.9800 (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)													
PV Unit 0 (0.80 * 2.50 * 1118 * 0.80) =												-1789.0484	-1789.0484 (233)
Total delivered energy for all uses													3129.3916 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3071.9800	4.2800	131.4807 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1329.6442	4.2800	56.9088 (247)
Pumps and fans for heating	30.0000	15.4400	4.6320 (249)
Pump for solar water heating	50.0000	15.4400	7.7200 (249)
Energy for lighting	436.8157	15.4400	67.4443 (250)
Additional standing charges			92.0000 (251)
Energy saving/generation technologies			
PV Unit	-1789.0484	15.4400	-276.2291 (252)
Total energy cost			83.9568 (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	3071.9800	0.2160	663.5477 (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			950.7508 (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	-1789.0484	0.5190	-928.5161 (269)
Total kg/year			290.4621 (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	3071.9800	1.2200	3747.8156 (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			5369.9816 (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	-1789.0484	3.0700	-5492.3784 (269)
Primary energy kWh/year			1464.2274 (272)

Primary energy kWh/m2/year 12.8227 (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	91.72 (37)
Summer heat loss coefficient	889.86 (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	0.6300	0.7000	0.9000	71.6763
South West	4.7300	119.9223	0.6300	0.7000	0.9000	202.6212
North West	4.0500	98.8453	0.6300	0.7000	0.9000	142.9995
total:						1832.7894

	Jun	Jul	Aug	
Solar gains	1951	1833	1603	(P3)
Internal gains	577	555	564	
Total summer gains	2528	2388	2168	(P5)
Summer gain/loss ratio	2.84	2.68	2.44	(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	19.09	20.83	20.49	(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 - Up Window
Property: 97a, London, NW1 9BU

Issued on Date: 27.Jul.2016
Prop Type Ref:

SAP Rating:	90 B	**CO2 Emissions (t/year):**	0.96	**DER:**	11.63 Pass	**TER:**	17.08	**Percentage DER<TER:**	31.92 %
Environmental:	90 B	**General Requirements Compliance:**	Pass	**DFEE:**	45.86 Pass	**TFEE:**	56.66	**Percentage DFEE<TFEE:**	19.07 %

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 - Up Window'
SAP2012 - 9.92 input data (DesignData) -


```
SAP2012 Input Data (House)     27/07/2016

FullRefNo:                     Be Green - Up Window

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                 41.5, 46.7, 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, 0.11
    Exposed Floor             5.82, 0, Other, Exposed Floor - Solid, 0, 0.11
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, Double Low-E Soft 0.1, , , 0.63, , 0.7,
Openings                       Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
    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                         0.082
    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:                  4
AsBuilt q50:                   15
Property Tested:               False
Mechanical Ventilation         None
Chimneys MHS:                  0
Chimneys SHS:                  0
Chimneys Other:                0
Chimneys Total:                0
Open Flues MHS:                0
Open Flues SHS:                0
Open Flues Other:              0
Open Flues Total:              0
```

```
Intermittent Fans:            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) 17.08 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 11.63 kg/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)56.7 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)45.9 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	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	0.91 (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: 4.00 (design value)
Maximum 10.0 OK

---

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
tbc tbc

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

---

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	0.11 W/m^2K
Exposed floor U-value	0.11 W/m^2K
Window U-value	0.80 W/m^2K
Roof window U-value	0.80 W/m^2K
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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3601	0.3531	0.3460	0.3107	0.3036	0.2683	0.2683	0.2613	0.2825	0.3036	0.3178	0.3319	(22b)
Effective ac	0.5649	0.5623	0.5599	0.5483	0.5461	0.5360	0.5360	0.5341	0.5399	0.5461	0.5505	0.5551	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	56.3534	56.1022	55.8559	54.6992	54.4828	53.4754	53.4754	53.2888	53.8634	54.4828	54.9206	55.3783	(38)
Heat transfer coeff	148.0772	147.8260	147.5797	146.4231	146.2066	145.1992	145.1992	145.0127	145.5873	146.2066	146.6444	147.1021	(39)
Average = Sum(39)m / 12 =												146.4220	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2968	1.2946	1.2924	1.2823	1.2804	1.2716	1.2716	1.2699	1.2750	1.2804	1.2842	1.2882	(40)
HLP (average)												1.2823	(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)

---
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)

---
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	0.6300	0.7000	0.7700	6.9999	(75)
Southwest	4.7300	36.7938	0.6300	0.7000	0.7700	53.1873	(79)
Northwest	4.0500	11.2829	0.6300	0.7000	0.7700	13.9653	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	321.0917	586.5353	900.8237	1269.6961	1554.1705	1598.8248	1518.3375	1298.9981	1028.2009	675.4152	391.9716	269.9234	(83)
Total gains	831.8521	1095.0623	1393.1196	1735.5812	1992.8424	2011.5410	1914.3516	1701.4948	1444.3987	1118.2560	865.4674	766.7926	(84)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.5522	53.6432	53.7327	54.1572	54.2374	54.6137	54.6137	54.6839	54.4681	54.2374	54.0754	53.9072	
alpha	4.5701	4.5762	4.5822	4.6105	4.6158	4.6409	4.6409	4.6456	4.6312	4.6158	4.6050	4.5938	
util living area	0.9954	0.9843	0.9463	0.8301	0.6403	0.4550	0.3324	0.3890	0.6502	0.9221	0.9888	0.9968	(86)
MIT	19.9525	20.1582	20.4468	20.7418	20.8908	20.9331	20.9400	20.9385	20.9020	20.6464	20.2291	19.9139	(87)
Th 2	19.8434	19.8451	19.8468	19.8547	19.8562	19.8632	19.8632	19.8645	19.8605	19.8562	19.8532	19.8501	(88)
util rest of house	0.9939	0.9793	0.9300	0.7879	0.5746	0.3773	0.2472	0.2945	0.5600	0.8905	0.9843	0.9957	(89)
MIT 2	18.4587	18.7575	19.1665	19.5600	19.7284	19.7729	19.7771	19.7779	19.7485	19.4547	18.8690	18.4077	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	18.7885	19.0668	19.4492	19.8209	19.9850	20.0290	20.0339	20.0341	20.0032	19.7178	19.1693	18.7402	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7885	19.0668	19.4492	19.8209	19.9850	20.0290	20.0339	20.0341	20.0032	19.7178	19.1693	18.7402	(93)

---
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9919	0.9748	0.9232	0.7865	0.5823	0.3888	0.2601	0.3088	0.5720	0.8858	0.9807	0.9942	(94)
Useful gains	825.1107	1067.4367	1286.0858	1365.1012	1160.4968	782.0592	497.8779	525.4218	826.2040	990.5899	848.7618	762.3598	(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	2145.4190	2094.2169	1911.0359	1599.0706	1211.3233	788.2932	498.5947	526.9947	859.4244	1333.0819	1769.8890	2138.8975	(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	982.3093	689.9963	464.9628	168.4580	37.8149	0.0000	0.0000	0.0000	0.0000	254.8140	663.2116	1024.1441	(98)
Space heating												4285.7110	(98)
Space heating per m2											(98) / (4) =	37.5314	(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	4761.9011 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	982.3093	689.9963	464.9628	168.4580	37.8149	0.0000	0.0000	0.0000	0.0000	254.8140	663.2116	1024.1441	(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)													
	1091.4548	766.6625	516.6254	187.1755	42.0166	0.0000	0.0000	0.0000	0.0000	283.1267	736.9017	1137.9379	(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												4761.9011	(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	7807.2225 (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	4761.9011	0.2160	1028.5706	(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			1585.5279	(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			1328.5272	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			11.6300	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES			
DER		11.6300	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		27.6663	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		27.6663	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	46.7000	3.0200	43.6800	0.1300	5.6784			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.7736			(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) =	85.8778 (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	144.3247	143.9921	143.6662	142.1353	141.8488	140.5154	140.5154	140.2685	141.0290	141.8488	142.4283	143.0341	(39)

Average = Sum(39)m / 12 = 142.1339 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2639	1.2610	1.2581	1.2447	1.2422	1.2305	1.2305	1.2284	1.2350	1.2422	1.2473	1.2526	(40)
HLP (average)												1.2447	(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	54.9446	55.0715	55.1964	55.7909	55.9036	56.4341	56.4341	56.5334	56.2286	55.9036	55.6762	55.4404	
alpha	4.6630	4.6714	4.6798	4.7194	4.7269	4.7623	4.7623	4.7689	4.7486	4.7269	4.7117	4.6960	
util living area													
	0.9976	0.9935	0.9792	0.9260	0.7965	0.6074	0.4532	0.5187	0.7896	0.9654	0.9947	0.9983	(86)
MIT	19.6280	19.8306	20.1526	20.5526	20.8420	20.9667	20.9933	20.9877	20.8887	20.4810	19.9759	19.5944	(87)
Th 2	19.8692	19.8715	19.8738	19.8844	19.8864	19.8956	19.8956	19.8974	19.8921	19.8864	19.8824	19.8782	(88)
util rest of house													
	0.9968	0.9912	0.9718	0.9008	0.7367	0.5145	0.3427	0.4007	0.7053	0.9486	0.9925	0.9977	(89)
MIT 2	18.0516	18.3483	18.8146	19.3793	19.7422	19.8754	19.8934	19.8927	19.8086	19.2963	18.5689	18.0087	(90)
Living area fraction										fLA = Living area / (4) =		0.2208	(91)
MIT	18.3997	18.6755	19.1100	19.6383	19.9850	20.1164	20.1362	20.1345	20.0471	19.5578	18.8795	18.3588	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3997	18.6755	19.1100	19.6383	19.9850	20.1164	20.1362	20.1345	20.0471	19.5578	18.8795	18.3588	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9952	0.9878	0.9652	0.8941	0.7425	0.5339	0.3672	0.4268	0.7186	0.9420	0.9895	0.9964	(94)
Useful gains	705.7139	862.7002	1017.7704	1126.2588	1047.7367	754.4357	494.1596	518.3895	760.4998	813.4723	708.7997	660.7655	(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													
	2034.9291	1983.5704	1811.6321	1526.2900	1175.2148	775.1325	496.8931	523.8285	838.7108	1270.6581	1677.7407	2025.1886	(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													
	988.9361	753.2248	590.6331	288.0225	94.8437	0.0000	0.0000	0.0000	0.0000	340.1463	697.6375	1015.1308	(98)
Space heating												4768.5748	(98)
Space heating per m2											(98) / (4) =	41.7600	(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	5100.0800	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	988.9361	753.2248	590.6331	288.0225	94.8437	0.0000	0.0000	0.0000	0.0000	340.1463	697.6375	1015.1308	(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)													
	1057.6857	805.5880	631.6932	308.0454	101.4371	0.0000	0.0000	0.0000	0.0000	363.7928	746.1364	1085.7014	(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	88.3104	88.0436	87.4441	85.9605	83.1467	79.8000	79.8000	79.8000	79.8000	86.2970	87.8300	88.3957	(217)
Fuel for water heating, kWh/month													
	254.0596	224.7811	238.1003	217.7062	221.0003	206.4053	198.8502	217.3456	216.6940	224.8402	232.8804	247.8984	(219)
Water heating fuel used												2700.5618	(219)
Annual totals kWh/year													
Space heating fuel - main system												5100.0800	(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												8312.4575	(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	5100.0800	0.2160	1101.6173	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2700.5618	0.2160	583.3213	(264)
Space and water heating			1684.9386	(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			1950.5710	(272)
Emissions per m2 for space and water heating			14.7556	(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) = (14.7556 * 1.00) + 1.9854 + 0.3409, rounded to 2 d.p.			17.0800	(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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3601	0.3531	0.3460	0.3107	0.3036	0.2683	0.2683	0.2613	0.2825	0.3036	0.3178	0.3319	(22b)
Effective ac	0.5649	0.5623	0.5599	0.5483	0.5461	0.5360	0.5360	0.5341	0.5399	0.5461	0.5505	0.5551	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	56.3534	56.1022	55.8559	54.6992	54.4828	53.4754	53.4754	53.2888	53.8634	54.4828	54.9206	55.3783	(38)
Heat transfer coeff	148.0772	147.8260	147.5797	146.4231	146.2066	145.1992	145.1992	145.0127	145.5873	146.2066	146.6444	147.1021	(39)
Average = Sum(39)m / 12 =												146.4220	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2968	1.2946	1.2924	1.2823	1.2804	1.2716	1.2716	1.2699	1.2750	1.2804	1.2842	1.2882	(40)
HLP (average)												1.2823	(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	0.6300	0.7000	0.7700	6.9999	(75)
Southwest	4.7300	36.7938	0.6300	0.7000	0.7700	53.1873	(79)
Northwest	4.0500	11.2829	0.6300	0.7000	0.7700	13.9653	(81)

Solar gains	321.0917	586.5353	900.8237	1269.6961	1554.1705	1598.8248	1518.3375	1298.9981	1028.2009	675.4152	391.9716	269.9234	(83)
Total gains	736.1725	1000.2297	1300.0459	1644.8986	1903.7123	1924.5968	1829.2653	1614.0280	1356.0861	1027.4684	771.8853	671.9565	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.5522	53.6432	53.7327	54.1572	54.2374	54.6137	54.6137	54.6839	54.4681	54.2374	54.0754	53.9072	
alpha	4.5701	4.5762	4.5822	4.6105	4.6158	4.6409	4.6409	4.6456	4.6312	4.6158	4.6050	4.5938	
util living area													
	0.9972	0.9889	0.9574	0.8509	0.6634	0.4742	0.3475	0.4093	0.6821	0.9403	0.9929	0.9982	(86)
MIT	19.6072	19.8854	20.2823	20.7011	20.9222	20.9866	20.9975	20.9948	20.9360	20.5546	19.9788	19.5555	(87)
Th 2	19.8434	19.8451	19.8468	19.8547	19.8562	19.8632	19.8632	19.8645	19.8605	19.8562	19.8532	19.8501	(88)
util rest of house													
	0.9963	0.9853	0.9438	0.8113	0.5973	0.3938	0.2587	0.3103	0.5911	0.9142	0.9900	0.9975	(89)
MIT 2	18.5872	18.8644	19.2514	19.6383	19.8117	19.8581	19.8626	19.8632	19.8307	19.5236	18.9652	18.5409	(90)
Living area fraction											fLA = Living area / (4) =	0.2208	(91)
MIT	18.8124	19.0898	19.4790	19.8729	20.0569	20.1072	20.1132	20.1130	20.0747	19.7512	19.1890	18.7649	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8124	19.0898	19.4790	19.8729	20.0569	20.1072	20.1132	20.1130	20.0747	19.7512	19.1890	18.7649	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9951	0.9821	0.9385	0.8120	0.6094	0.4113	0.2783	0.3322	0.6094	0.9113	0.9876	0.9967	(94)
Useful gains	732.5443	982.2849	1220.1274	1335.6081	1160.2091	791.6525	509.1291	536.2468	826.3869	936.2967	762.3239	669.7116	(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													
	2148.9522	2097.6250	1915.4345	1606.6862	1221.8301	799.6419	510.1110	538.4388	869.8459	1337.9730	1772.7868	2142.5255	(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													
	1053.8075	749.5085	517.3085	195.1762	45.8460	0.0000	0.0000	0.0000	0.0000	298.8471	727.5333	1095.7735	(98)
Space heating												4683.8007	(98)
Space heating per m2											(98) / (4) =	41.0176	(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	1364.8727	1074.4742	1102.0962	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9618	0.9809	0.9680	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1312.7693	1053.9473	1066.7773	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2298.5939	2188.1433	1948.6932	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	709.7937	843.8418	656.1454	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												2209.7810	(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	177.4484	210.9605	164.0364	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												552.4452	(107)
Space cooling per m2												4.8379	(108)
Energy for space heating												41.0176	(99)

Energy for space cooling	4.8379 (108)
Total	45.8556 (109)
Dwelling Fabric Energy Efficiency (DFEE)	45.9 (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	46.7000	3.0200	43.6800	0.1300	5.6784			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		72.7736			(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) =	85.8778 (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	144.3247	143.9921	143.6662	142.1353	141.8488	140.5154	140.5154	140.2685	141.0290	141.8488	142.4283	143.0341	(39)
Average = Sum(39)m / 12 =												142.1339	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2639	1.2610	1.2581	1.2447	1.2422	1.2305	1.2305	1.2284	1.2350	1.2422	1.2473	1.2526	(40)
HLP (average)												1.2447	(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	54.9446	55.0715	55.1964	55.7909	55.9036	56.4341	56.4341	56.5334	56.2286	55.9036	55.6762	55.4404	
alpha	4.6630	4.6714	4.6798	4.7194	4.7269	4.7623	4.7623	4.7689	4.7486	4.7269	4.7117	4.6960	
util living area	0.9987	0.9959	0.9852	0.9413	0.8236	0.6386	0.4808	0.5533	0.8261	0.9767	0.9970	0.9991	(86)
MIT	19.5540	19.7585	20.0861	20.5014	20.8155	20.9590	20.9914	20.9839	20.8629	20.4195	19.9042	19.5207	(87)
Th 2	19.8692	19.8715	19.8738	19.8844	19.8864	19.8956	19.8956	19.8974	19.8921	19.8864	19.8824	19.8782	(88)
util rest of house	0.9983	0.9944	0.9798	0.9201	0.7670	0.5438	0.3645	0.4294	0.7470	0.9647	0.9957	0.9988	(89)
MIT 2	18.5544	18.7601	19.0862	19.4939	19.7690	19.8783	19.8936	19.8931	19.8191	19.4261	18.9145	18.5282	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	18.7751	18.9805	19.3069	19.7163	20.0000	20.1169	20.1360	20.1339	20.0495	19.6454	19.1330	18.7473	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7751	18.9805	19.3069	19.7163	20.0000	20.1169	20.1360	20.1339	20.0495	19.6454	19.1330	18.7473	(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	0.9762	0.9162	0.7734	0.5638	0.3904	0.4570	0.7598	0.9612	0.9945	0.9983	(94)
Useful gains	614.8697	775.8558	941.4141	1073.7500	1024.6316	749.2508	493.3076	516.4906	739.3094	745.5388	622.1706	570.2398	(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	2089.1156	2027.4824	1839.9200	1537.3811	1177.3493	775.2041	496.8609	523.7525	839.0582	1283.0821	1713.8392	2080.7646	(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	1096.8390	841.0931	668.4884	333.8144	113.6220	0.0000	0.0000	0.0000	0.0000	399.9322	786.0014	1123.8304	(98)
Space heating												5363.6208	(98)
Space heating per m2											(98) / (4) =	46.9710	(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	1320.8451	1039.8142	1066.0407	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8999	0.9452	0.9181	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1188.6638	982.7930	978.7108	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	314.2125	420.8322	314.0704	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1049.1150	(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	78.5531	105.2080	78.5176	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												262.2788	(107)
Space cooling per m2												2.2969	(108)
Energy for space heating												46.9710	(99)
Energy for space cooling												2.2969	(108)
Total												49.2679	(109)
Target Fabric Energy Efficiency (TFEE)												56.7	(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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3036	0.2895	0.2895	0.2683	0.2754	0.2401	0.2472	0.2401	0.2401	0.2613	0.2542	0.2825	(22b)
Effective ac	0.5461	0.5419	0.5419	0.5360	0.5379	0.5288	0.5305	0.5288	0.5288	0.5341	0.5323	0.5399	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	54.4828	54.0649	54.0649	53.4754	53.6669	52.7590	52.9306	52.7590	52.7590	53.2888	53.1072	53.8634	(38)
Heat transfer coeff	146.2066	145.7888	145.7888	145.1992	145.3908	144.4828	144.6545	144.4828	144.4828	145.0127	144.8311	145.5873	(39)
Average = Sum(39)m / 12 =												145.1590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2804	1.2767	1.2767	1.2716	1.2732	1.2653	1.2668	1.2653	1.2653	1.2699	1.2683	1.2750	(40)
HLP (average)												1.2712	(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	0.6300	0.7000	0.7700	7.7478	(75)
Southwest	4.7300	39.0225	0.6300	0.7000	0.7700	56.4089	(79)
Northwest	4.0500	12.4885	0.6300	0.7000	0.7700	15.4574	(81)

Solar gains	346.1918	569.3430	881.5201	1287.5073	1536.1750	1687.5671	1598.4503	1409.5174	1106.6375	717.2078	436.7574	285.5122	(83)
Total gains	1076.7583	1294.9459	1581.1647	1946.6233	2153.3523	2267.4014	2156.5841	1976.8641	1697.4125	1348.7435	1113.6736	997.1893	(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	54.2374	54.3928	54.3928	54.6137	54.5417	54.8845	54.8193	54.8845	54.8845	54.6839	54.7525	54.4681	
alpha	4.6158	4.6262	4.6262	4.6409	4.6361	4.6590	4.6546	4.6590	4.6590	4.6456	4.6502	4.6312	
util living area													
	0.9824	0.9610	0.8855	0.7054	0.4894	0.2798	0.1610	0.1900	0.4370	0.7943	0.9571	0.9868	(86)
MIT	20.2220	20.3820	20.6516	20.8590	20.9282	20.9411	20.9417	20.9417	20.9361	20.8268	20.4921	20.1828	(87)
Th 2	19.8562	19.8591	19.8591	19.8632	19.8619	19.8681	19.8669	19.8681	19.8681	19.8645	19.8657	19.8605	(88)
util rest of house													
	0.9765	0.9488	0.8538	0.6471	0.4182	0.2081	0.0850	0.1073	0.3447	0.7289	0.9409	0.9823	(89)
MIT 2	18.8587	19.0869	19.4516	19.7022	19.7676	19.7827	19.7816	19.7829	19.7805	19.6783	19.2513	18.8061	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	19.1597	19.3728	19.7165	19.9576	20.0238	20.0384	20.0377	20.0387	20.0356	19.9319	19.5252	19.1100	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1597	19.3728	19.7165	19.9576	20.0238	20.0384	20.0377	20.0387	20.0356	19.9319	19.5252	19.1100	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9718	0.9424	0.8493	0.6522	0.4286	0.2190	0.0964	0.1198	0.3585	0.7332	0.9349	0.9783	(94)
Useful gains	1046.3778	1220.3528	1342.8397	1269.6431	922.8611	496.4631	207.9727	236.7576	608.5834	988.9040	1041.1277	975.5621	(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													
	1982.5130	1935.0316	1693.5541	1358.7107	933.9625	496.7919	207.9762	236.7682	611.9696	1106.7168	1596.7957	1966.8862	(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													
	696.4846	480.2642	260.9315	64.1287	8.2594	0.0000	0.0000	0.0000	0.0000	87.6527	400.0809	737.5451	(98)
Space heating												2735.3473	(98)
RHI space heating demand												2735	(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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3601	0.3531	0.3460	0.3107	0.3036	0.2683	0.2683	0.2613	0.2825	0.3036	0.3178	0.3319	(22b)
Effective ac	0.5649	0.5623	0.5599	0.5483	0.5461	0.5360	0.5360	0.5341	0.5399	0.5461	0.5505	0.5551	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	56.3534	56.1022	55.8559	54.6992	54.4828	53.4754	53.4754	53.2888	53.8634	54.4828	54.9206	55.3783	(38)
Heat transfer coeff	148.0772	147.8260	147.5797	146.4231	146.2066	145.1992	145.1992	145.0127	145.5873	146.2066	146.6444	147.1021	(39)
Average = Sum(39)m / 12 =												146.4220	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2968	1.2946	1.2924	1.2823	1.2804	1.2716	1.2716	1.2699	1.2750	1.2804	1.2842	1.2882	(40)
HLP (average)												1.2823	(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	0.6300	0.7000	0.7700	6.9999	(75)
Southwest	4.7300	36.7938	0.6300	0.7000	0.7700	53.1873	(79)
Northwest	4.0500	11.2829	0.6300	0.7000	0.7700	13.9653	(81)

Solar gains	321.0917	586.5353	900.8237	1269.6961	1554.1705	1598.8248	1518.3375	1298.9981	1028.2009	675.4152	391.9716	269.9234	(83)
Total gains	1051.6583	1312.1382	1600.4683	1928.8121	2171.3479	2178.6590	2076.4713	1866.3448	1618.9759	1306.9509	1068.8879	981.6005	(84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.5522	53.6432	53.7327	54.1572	54.2374	54.6137	54.6137	54.6839	54.4681	54.2374	54.0754	53.9072	
alpha	4.5701	4.5762	4.5822	4.6105	4.6158	4.6409	4.6409	4.6456	4.6312	4.6158	4.6050	4.5938	
util living area	0.9884	0.9695	0.9170	0.7852	0.5971	0.4218	0.3068	0.3555	0.5928	0.8780	0.9750	0.9913	(86)
MIT	20.0795	20.2749	20.5366	20.7862	20.9032	20.9354	20.9405	20.9395	20.9144	20.7165	20.3413	20.0395	(87)
Th 2	19.8434	19.8451	19.8468	19.8547	19.8562	19.8632	19.8632	19.8645	19.8605	19.8562	19.8532	19.8501	(88)
util rest of house	0.9847	0.9604	0.8945	0.7388	0.5331	0.3490	0.2280	0.2687	0.5058	0.8360	0.9659	0.9885	(89)
MIT 2	18.6424	18.9229	19.2862	19.6106	19.7393	19.7742	19.7773	19.7783	19.7574	19.5401	19.0282	18.5899	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	18.9597	19.2214	19.5623	19.8702	19.9963	20.0306	20.0341	20.0346	20.0128	19.7998	19.3181	18.9099	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9597	19.2214	19.5623	19.8702	19.9963	20.0306	20.0341	20.0346	20.0128	19.7998	19.3181	18.9099	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9809	0.9542	0.8880	0.7395	0.5412	0.3599	0.2399	0.2818	0.5180	0.8335	0.9604	0.9854	(94)
Useful gains	1031.5456	1252.0878	1421.1578	1426.2630	1175.1047	783.9991	498.1204	526.0021	838.5680	1089.3949	1026.5903	967.2246	(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	2170.7664	2117.0716	1927.7304	1606.2886	1212.9698	788.5143	498.6255	527.0664	860.8293	1345.0731	1791.7184	2163.8634	(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	847.5802	581.2691	376.8900	129.6184	28.1716	0.0000	0.0000	0.0000	0.0000	190.2246	550.8923	890.2993	(98)
Space heating												3594.9456	(98)
Space heating per m2											(98) / (4) =	31.4821	(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 3994.3840 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	847.5802	581.2691	376.8900	129.6184	28.1716	0.0000	0.0000	0.0000	0.0000	190.2246	550.8923	890.2993	(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)													
	941.7558	645.8546	418.7667	144.0205	31.3018	0.0000	0.0000	0.0000	0.0000	211.3607	612.1025	989.2214	(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												3994.3840	(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												7039.7054	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3994.3840	3.4800	139.0046	(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			283.4218	(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] = 0.7478 (257)
SAP value 89.5686
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	3994.3840	0.2160	862.7869	(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			1419.7442	(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			1162.7435	(272)
CO2 emissions per m2			10.1800	(273)
EI value			90.2125	
EI rating			90	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency 3.48 × (1 + 0.29 × 0.25) / 0.9000 = 4.147, stars = 4
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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3036	0.2895	0.2895	0.2683	0.2754	0.2401	0.2472	0.2401	0.2401	0.2613	0.2542	0.2825	(22b)
Effective ac	0.5461	0.5419	0.5419	0.5360	0.5379	0.5288	0.5305	0.5288	0.5288	0.5341	0.5323	0.5399	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	54.4828	54.0649	54.0649	53.4754	53.6669	52.7590	52.9306	52.7590	52.7590	53.2888	53.1072	53.8634	(38)
Heat transfer coeff	146.2066	145.7888	145.7888	145.1992	145.3908	144.4828	144.6545	144.4828	144.4828	145.0127	144.8311	145.5873	(39)
Average = Sum(39)m / 12 =												145.1590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2804	1.2767	1.2767	1.2716	1.2732	1.2653	1.2668	1.2653	1.2653	1.2699	1.2683	1.2750	(40)
HLP (average)												1.2712	(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	0.6300	0.7000	0.7700	7.7478	(75)
Southwest	4.7300	39.0225	0.6300	0.7000	0.7700	56.4089	(79)
Northwest	4.0500	12.4885	0.6300	0.7000	0.7700	15.4574	(81)

Solar gains	346.1918	569.3430	881.5201	1287.5073	1536.1750	1687.5671	1598.4503	1409.5174	1106.6375	717.2078	436.7574	285.5122	(83)
Total gains	1076.7583	1294.9459	1581.1647	1946.6233	2153.3523	2267.4014	2156.5841	1976.8641	1697.4125	1348.7435	1113.6736	997.1893	(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	54.2374	54.3928	54.3928	54.6137	54.5417	54.8845	54.8193	54.8845	54.8845	54.6839	54.7525	54.4681	
alpha	4.6158	4.6262	4.6262	4.6409	4.6361	4.6590	4.6546	4.6590	4.6590	4.6456	4.6502	4.6312	
util living area	0.9824	0.9610	0.8855	0.7054	0.4894	0.2798	0.1610	0.1900	0.4370	0.7943	0.9571	0.9868	(86)
MIT	20.2220	20.3820	20.6516	20.8590	20.9282	20.9411	20.9417	20.9417	20.9361	20.8268	20.4921	20.1828	(87)
Th 2	19.8562	19.8591	19.8591	19.8632	19.8619	19.8681	19.8669	19.8681	19.8681	19.8645	19.8657	19.8605	(88)
util rest of house	0.9765	0.9488	0.8538	0.6471	0.4182	0.2081	0.0850	0.1073	0.3447	0.7289	0.9409	0.9823	(89)
MIT 2	18.8587	19.0869	19.4516	19.7022	19.7676	19.7827	19.7816	19.7829	19.7805	19.6783	19.2513	18.8061	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	19.1597	19.3728	19.7165	19.9576	20.0238	20.0384	20.0377	20.0387	20.0356	19.9319	19.5252	19.1100	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1597	19.3728	19.7165	19.9576	20.0238	20.0384	20.0377	20.0387	20.0356	19.9319	19.5252	19.1100	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9718	0.9424	0.8493	0.6522	0.4286	0.2190	0.0964	0.1198	0.3585	0.7332	0.9349	0.9783	(94)
Useful gains	1046.3778	1220.3528	1342.8397	1269.6431	922.8611	496.4631	207.9727	236.7576	608.5834	988.9040	1041.1277	975.5621	(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	1982.5130	1935.0316	1693.5541	1358.7107	933.9625	496.7919	207.9762	236.7682	611.9696	1106.7168	1596.7957	1966.8862	(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	696.4846	480.2642	260.9315	64.1287	8.2594	0.0000	0.0000	0.0000	0.0000	87.6527	400.0809	737.5451	(98)
Space heating												2735.3473	(98)
Space heating per m2											(98) / (4) =	23.9544	(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 3039.2748 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	696.4846	480.2642	260.9315	64.1287	8.2594	0.0000	0.0000	0.0000	0.0000	87.6527	400.0809	737.5451	(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)													
	773.8718	533.6269	289.9239	71.2541	9.1771	0.0000	0.0000	0.0000	0.0000	97.3919	444.5344	819.4946	(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												3039.2748	(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												6084.5961	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3039.2748	4.2800	130.0810	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2578.5057	4.2800	110.3600	(247)
Pumps and fans for heating	30.0000	15.4400	4.6320	(249)
Energy for lighting	436.8157	15.4400	67.4443	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit	-962.0000	15.4400	-148.5328	(252)
Total energy cost			255.9846	(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	3039.2748	0.2160	656.4833	(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			1213.4406	(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			956.4399	(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	3039.2748	1.2200	3707.9152	(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			6853.6921	(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			5333.4764	(272)
Primary energy kWh/m2/year			46.7070	(273)

SAP 2012 EPC IMPROVEMENTS

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

(For testing purposes):

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

F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	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	-£ 44	-237 kg (24.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£44	2.07 kg/m²	B 91	A 92
Total Savings	£44	2.07 kg/m²		

Potential energy efficiency rating: B 91
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 395 TEST (24 Jun 2016)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£72	£80	-£8
Mains gas	£332	£280	£52
Space heating	£227	£228	-£1
Water heating	£110	£65	£46
Lighting	£67	£67	£0
Generated (PV)	-£149	-£149	£0
Total cost of fuels	£255	£211	£44
Total cost of uses	£255	£211	£45
Delivered energy	53 kWh/m²	43 kWh/m²	10 kWh/m²
Carbon dioxide emissions	1.0 tonnes	0.7 tonnes	0.2 tonnes
CO2 emissions per m²	8 kg/m²	6 kg/m²	2 kg/m²
Primary energy	47 kWh/m²	35 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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3601	0.3531	0.3460	0.3107	0.3036	0.2683	0.2683	0.2613	0.2825	0.3036	0.3178	0.3319	(22b)
Effective ac	0.5649	0.5623	0.5599	0.5483	0.5461	0.5360	0.5360	0.5341	0.5399	0.5461	0.5505	0.5551	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	56.3534	56.1022	55.8559	54.6992	54.4828	53.4754	53.4754	53.2888	53.8634	54.4828	54.9206	55.3783	(38)
Heat transfer coeff	148.0772	147.8260	147.5797	146.4231	146.2066	145.1992	145.1992	145.0127	145.5873	146.2066	146.6444	147.1021	(39)
Average = Sum(39)m / 12 =												146.4220	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2968	1.2946	1.2924	1.2823	1.2804	1.2716	1.2716	1.2699	1.2750	1.2804	1.2842	1.2882	(40)
HLP (average)												1.2823	(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	0.6300	0.7000	0.7700	6.9999	(75)
Southwest	4.7300	36.7938	0.6300	0.7000	0.7700	53.1873	(79)
Northwest	4.0500	11.2829	0.6300	0.7000	0.7700	13.9653	(81)

Solar gains	321.0917	586.5353	900.8237	1269.6961	1554.1705	1598.8248	1518.3375	1298.9981	1028.2009	675.4152	391.9716	269.9234	(83)
Total gains	1041.4244	1301.9044	1588.7337	1911.0743	2147.3567	2154.4177	2052.2300	1843.1041	1602.7389	1295.2163	1058.6540	971.3667	(84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	53.5522	53.6432	53.7327	54.1572	54.2374	54.6137	54.6137	54.6839	54.4681	54.2374	54.0754	53.9072	
alpha	4.5701	4.5762	4.5822	4.6105	4.6158	4.6409	4.6409	4.6456	4.6312	4.6158	4.6050	4.5938	
util living area													
	0.9888	0.9703	0.9188	0.7893	0.6027	0.4263	0.3104	0.3599	0.5978	0.8810	0.9759	0.9916	(86)
MIT	20.0737	20.2696	20.5319	20.7826	20.9018	20.9351	20.9404	20.9393	20.9135	20.7126	20.3358	20.0336	(87)
Th 2	19.8434	19.8451	19.8468	19.8547	19.8562	19.8632	19.8632	19.8645	19.8605	19.8562	19.8532	19.8501	(88)
util rest of house													
	0.9852	0.9615	0.8966	0.7432	0.5384	0.3528	0.2307	0.2721	0.5105	0.8395	0.9671	0.9889	(89)
MIT 2	18.6341	18.9154	19.2800	19.6066	19.7381	19.7741	19.7773	19.7782	19.7567	19.5355	19.0206	18.5814	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	18.9519	19.2144	19.5564	19.8662	19.9950	20.0304	20.0341	20.0346	20.0121	19.7953	19.3109	18.9020	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9519	19.2144	19.5564	19.8662	19.9950	20.0304	20.0341	20.0346	20.0121	19.7953	19.3109	18.9020	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9815	0.9554	0.8901	0.7437	0.5464	0.3638	0.2427	0.2854	0.5226	0.8369	0.9616	0.9859	(94)
Useful gains	1022.1839	1243.7781	1414.0974	1421.2977	1173.4136	783.7615	498.0903	525.9357	837.6408	1083.9694	1018.0513	957.6731	(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													

	2169.6128	2116.0409	1926.8605	1605.7067	1212.7797	788.4872	498.6217	527.0582	860.7241	1344.4193	1790.6671	2162.6954 (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												
	853.6870	586.1606	381.4958	132.7745	29.2884	0.0000	0.0000	0.0000	0.0000	193.7747	556.2834	896.5366 (98)

Space heating 3630.0010 (98)
Space heating per m2 (98) / (4) = 31.7891 (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 4033.3345 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	853.6870	586.1606	381.4958	132.7745	29.2884	0.0000	0.0000	0.0000	0.0000	193.7747	556.2834	896.5366	(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)													
	948.5412	651.2896	423.8842	147.5272	32.5427	0.0000	0.0000	0.0000	0.0000	215.3052	618.0926	996.1518	(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 4033.3345 (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 5893.4335 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4033.3345	3.4800	140.3600	(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			248.3865	(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] = 0.6553 (257)
SAP value 90.8581
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	4033.3345	0.2160	871.2002	(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			1161.3494	(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			930.2988	(272)
CO2 emissions per m2			8.1500	(273)
EI value			92.1691	
EI rating			92	(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		4.0000	
Infiltration rate		0.3323	(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) =	0.2825	(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	0.3036	0.2895	0.2895	0.2683	0.2754	0.2401	0.2472	0.2401	0.2401	0.2613	0.2542	0.2825	(22b)
Effective ac	0.5461	0.5419	0.5419	0.5360	0.5379	0.5288	0.5305	0.5288	0.5288	0.5341	0.5323	0.5399	(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 = 1.20)			10.8100	1.1450	12.3779			(27)
Rooflight (Uw = 0.80)			5.2000	0.7752	4.0310			(27a)
Heat Loss Floor 1			39.8000	0.1100	4.3780			(28a)
Exposed Floor			5.8200	0.1100	0.6402			(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	46.7000	5.2000	41.5000	0.1300	5.3950			(30)
Total net area of external elements Aum(A, m2)			247.1000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		71.3891			(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) =	91.7238 (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	54.4828	54.0649	54.0649	53.4754	53.6669	52.7590	52.9306	52.7590	52.7590	53.2888	53.1072	53.8634	(38)
Heat transfer coeff	146.2066	145.7888	145.7888	145.1992	145.3908	144.4828	144.6545	144.4828	144.4828	145.0127	144.8311	145.5873	(39)
Average = Sum(39)m / 12 =												145.1590	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2804	1.2767	1.2767	1.2716	1.2732	1.2653	1.2668	1.2653	1.2653	1.2699	1.2683	1.2750	(40)
HLP (average)												1.2712	(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	0.6300	0.7000	0.7700	7.7478	(75)
Southwest	4.7300	39.0225	0.6300	0.7000	0.7700	56.4089	(79)
Northwest	4.0500	12.4885	0.6300	0.7000	0.7700	15.4574	(81)

Solar gains	346.1918	569.3430	881.5201	1287.5073	1536.1750	1687.5671	1598.4503	1409.5174	1106.6375	717.2078	436.7574	285.5122	(83)
Total gains	1066.5245	1284.7121	1569.4301	1928.8855	2129.3612	2243.1601	2132.3428	1953.6233	1681.1755	1337.0089	1103.4398	986.9555	(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	54.2374	54.3928	54.3928	54.6137	54.5417	54.8845	54.8193	54.8845	54.8845	54.6839	54.7525	54.4681	
alpha	4.6158	4.6262	4.6262	4.6409	4.6361	4.6590	4.6546	4.6590	4.6590	4.6456	4.6502	4.6312	
util living area													
	0.9830	0.9620	0.8878	0.7100	0.4945	0.2828	0.1628	0.1922	0.4410	0.7982	0.9584	0.9874	(86)
MIT	20.2163	20.3769	20.6476	20.8567	20.9277	20.9410	20.9417	20.9417	20.9359	20.8243	20.4871	20.1770	(87)
Th 2	19.8562	19.8591	19.8591	19.8632	19.8619	19.8681	19.8669	19.8681	19.8681	19.8645	19.8657	19.8605	(88)
util rest of house													
	0.9773	0.9502	0.8565	0.6517	0.4227	0.2104	0.0859	0.1086	0.3479	0.7331	0.9427	0.9830	(89)
MIT 2	18.8506	19.0799	19.4465	19.6999	19.7672	19.7827	19.7816	19.7829	19.7804	19.6758	19.2445	18.7978	(90)
Living area fraction									fLA = Living area / (4) =			0.2208	(91)
MIT	19.1521	19.3662	19.7116	19.9553	20.0234	20.0384	20.0377	20.0387	20.0355	19.9293	19.5188	19.1023	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1521	19.3662	19.7116	19.9553	20.0234	20.0384	20.0377	20.0387	20.0355	19.9293	19.5188	19.1023	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9727	0.9438	0.8519	0.6567	0.4331	0.2213	0.0975	0.1212	0.3619	0.7373	0.9366	0.9791	(94)
Useful gains	1037.3973	1212.4839	1336.9912	1266.7825	922.3046	496.4450	207.9724	236.7569	608.4293	985.7606	1033.5244	966.3152	(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													

	1981.4131	1934.0655	1692.8478	1358.3850	933.9000	496.7896	207.9761	236.7680	611.9514	1106.3511	1595.8673	1965.7603 (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												
	702.3478	484.9028	264.7573	65.9538	8.6270	0.0000	0.0000	0.0000	0.0000	89.7193	404.8869	743.5871 (98)
Space heating												2764.7820 (98)
Space heating per m2											(98) / (4) =	24.2121 (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													3071.9800 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	702.3478	484.9028	264.7573	65.9538	8.6270	0.0000	0.0000	0.0000	0.0000	89.7193	404.8869	743.5871 (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)													
	780.3864	538.7809	294.1748	73.2820	9.5855	0.0000	0.0000	0.0000	0.0000	99.6881	449.8743	826.2079 (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													3071.9800 (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													4918.4400 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3071.9800	4.2800	131.4807 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1329.6442	4.2800	56.9088 (247)
Pumps and fans for heating	30.0000	15.4400	4.6320 (249)
Pump for solar water heating	50.0000	15.4400	7.7200 (249)
Energy for lighting	436.8157	15.4400	67.4443 (250)
Additional standing charges			92.0000 (251)
Energy saving/generation technologies			
PV Unit	-962.0000	15.4400	-148.5328 (252)
Total energy cost			211.6531 (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	3071.9800	0.2160	663.5477 (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			950.7508 (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			719.7002 (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	3071.9800	1.2200	3747.8156 (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			5369.9816 (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			4003.2659 (272)
Primary energy kWh/m2/year			35.0579 (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	91.72 (37)
Summer heat loss coefficient	889.86 (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	0.6300	0.7000	0.9000	71.6763
South West	4.7300	119.9223	0.6300	0.7000	0.9000	202.6212
North West	4.0500	98.8453	0.6300	0.7000	0.9000	142.9995
total:						1832.7894

	Jun	Jul	Aug	
Solar gains	1951	1833	1603	(P3)
Internal gains	577	555	564	
Total summer gains	2528	2388	2168	(P5)
Summer gain/loss ratio	2.84	2.68	2.44	(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	19.09	20.83	20.49	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight