



ASHDOWN VALE – BARNHAM, WEST SUSSEX

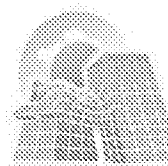


Energy Statement

6th October 2016

R&P: SEC/65/DC/EN/3484/

ARUN DISTRICT COUNCIL BN/52/16/RES



Southern Energy
Consultants
Energy & Sustainability Solutions

About Southern Energy Consultants Ltd

Southern Energy Consultants Ltd are a construction consultancy specialising in sustainability, energy conservation, the application of renewable technologies and statutory utilities infrastructure design and management. As a consultancy we do not sell or have financial interest in any products so are able to take an objective view of developments to assist developers with incorporating cost effective and practical solutions.

Our services include Planning Energy Statements, energy calculations for Building Regulation compliance, Code for Sustainable Homes assessments and utilities design and management. Our team of consultants include registered SAP, SBEM and Code for Sustainable Homes assessors, Planning Specialists, Renewable Energy Specialists, CAD Specialist, Utilities Specialists and Civil Engineers.

Within SEC Ltd we have over 25 years experience working with and for National Developers, Construction and Design and Build Contractors we apply our expertise not only to assist with developers understanding of new energy and sustainability obligations but also in a way that ensures that the needs and responsibilities of all stakeholders are wholly respected.

Report prepared by:
QA:

David Cook
Steve Smith

6th October 2016

Report type:

Planning Application; Supporting Document

Contents

1.0	Introduction	3
2.0	Energy Demand Baseline and Energy Efficiency Proposals	4
3.0	Renewable Energy and Low Carbon Technologies	7
4.0	Conclusion	12
Appendix		13
	Example SAP calculations:	
	Type Cambridge (Plot 2)	
	Type Tweed (Plot 51)	

1.0 Introduction

1.1 This Energy Statement has been commissioned by Redrow Homes (the Applicant) and carried out by Southern Energy Consultants as part of a comprehensive analysis of available opportunities to reduce carbon dioxide emissions and energy consumption at the Ashdown Vale, Barnham development. The site falls under the Arun District Council jurisdiction and the Applicant has secured outline planning consent (Reference: BN/21/14/PL) for the development of up to 107 dwellings of mixed type and tenure, together with provision of associated landscaping, open space, drainage and other infrastructure works.

1.2 This Statement provides a comprehensive response to Planning Condition 15 of the Outline Consent, as expressed in the Decision Notice. Condition 15 states the following:

“At least 10% of the energy supply of the development shall be secured from decentralised and renewable or low carbon energy sources. Details and a timetable showing how this is to be achieved, including details of physical works on site shall be submitted to and approved in writing by the local planning authority (as part of the reserved matters submission required by condition 1). The approved details shall be implemented in accordance with the approved timetable and retained as operational thereafter.”

1.3 The imposition of Condition 15 is underpinned by Policy ECC SP2 (Energy and Climate Change Mitigation) of Arun District Council’s Local Plan (2014). This policy requires all major developments of 10 or more dwellings to incorporate decentralised, renewable and low carbon energy supply systems, which must be responsible for producing at least 10% of the total predicted energy requirements from renewable or low carbon energy generation on site.

1.4 This Statement is structured as follows. In Section 2, the Applicant intends to first set out the energy efficiency measures they will adopt to comply with a baseline scenario for carbon dioxide emissions, as determined by Part L1a of Building Regulations (2013). The equivalent energy demand relating to the baseline standard is then calculated, along with the required 10% reduction in from renewable and low carbon energy technologies. Section 3 conducts a feasibility study concerning the most suitable renewable and low carbon technology for the Ashdown Vale site, before demonstrating the reductions in energy demand that will accrue from its installation.

2.0 Energy Demand Baseline and Energy Efficiency Proposals

Building Regulations (2013) Baseline

- 2.1 In order that an energy assessment can be conducted, a Building Regulation (2013) baseline for energy demand first has to be calculated for the 107 dwellings proposed at Ashdown Vale. The predicted energy demand for the dwellings has been calculated by an accredited energy assessor using SAP (2012) methodology and Elmhurst approved software. This baseline will then be used as a standard to demonstrate the reductions in energy demand that will result from renewable and/or low carbon technology installations.
- 2.2 Corresponding to the baseline emissions standard, the predicted annual energy demand for the development is **864,252 kWh/year**. Table 1 below and overleaf sets out the energy demand for each house type, with detailed SAP calculation examples provided in the Appendix to this Statement.

Table 1: Baseline Energy Demand (kWh/year) for Ashdown Vale, Barnham

	Carbon Dioxide Emissions (kgCO ₂ /year)	Energy Demand Per Dwelling Type (kWh/year)	Number of Dwellings	Total Energy Demand (kWh/year)
Private dwelling types				
Worcester SP	1,813	7,601	15	114,015
Windsor SP	1,799	7,512	1	7,512
Oxford SP	1,856	7,745	14	108,430
Cambridge	2,101	8,636	8	69,088
Canterbury	2,174	9,475	2	18,950
Sunningdale	2,306	10,041	17	170,697
Henley	2,399	10,426	9	93,834
Highgate	2,533	11,039	9	99,351
Sub-total			75	681,877
Affordable dwelling types				
SP2	1,166	5,070	12	60,840
Tavy	1,431	6,015	18	108,270

Dart	1,505	6,347	1	6,347
Tweed	1,638	6,918	1	6,918
Sub-total			32	182,375
TOTAL			107	864,252

- 2.3 In accordance with the Applicant's intentions set out in the Introduction, this Statement will now continue by detailing the range of best practice energy efficiency measures to comply with the baseline scenario.

Best Practice Energy Efficiency Measures

- 2.4 As a first energy efficiency measure, the proposed dwellings will incorporate sufficient insulation in the building envelope (walls, roofs, floors and glazing) to achieve average U-values considerably better than the limiting standards demanded by Part L1a of 2013 Building Regulations. Table 2 below illustrates the proposed U-values and the limiting area-weighted values set by Part L1a of 2013 Building Regulations.

Table 2: Insulation Enhancement Proposals

Thermal Element	Maximum Area-Weighted U-value (W/m²K) Allowable Under 2013 Building Regulations	Developer's Proposed U-Value (W/m²K) Required to Meet 2013 Building Regulations Baseline	% Improvement on 2013 Allowable U-Value Standard
Main external walls	0.30	0.25	16.67
Roof (joists)	0.20	0.11	45.00
Roof (rafters)	0.20	0.15	25.00
Ground floor	0.25	0.16	36.00
Windows	2.00	1.40	30.00

- 2.5 The Applicant intends to meet the U-value performance standards detailed in Table 2 through the following construction specification for the main thermal elements:

Table 3: Fabric Enhancement Construction Specification

Construction Element	Delivered U-Value	Insulation Specification
Main external walls	0.25	Masonry faced aircrete blockwork cavity walls with 0.034 W/m.K blown fibre insulation.
Roof (joists)	0.11	One layer of 100mm mineral wool quilt laid between ceiling joists and one layer of 300mm mineral wool laid over, providing a total thickness of 400mm.
Ground floor	0.16	Beam and block construction with 100mm PIR insulation.
Windows	1.40	PVCu double-glazed windows with low 'e' soft coat glazing to specialist BFRC approved manufacturers design and specification.

- 2.6 The space heating requirement of the development will be reduced by the fabric measures detailed above. Furthermore, there are passive solar gains deriving from the southerly orientation of the majority of dwellings. Passive solar gains reduce the space heating demand of dwellings, particularly during the winter months.
- 2.7 All dwellings will be heated with gas boilers possessing a SEDBUK (2009) energy efficiency of at least 88.9%. The dwellings will also benefit from advanced Time and Temperature Zone Controls. As such, it will be possible for future occupants to minimise the energy demand associated with the heating operation of their home in two defined localities.
- 2.8 Air tightness standards will be improved by the Applicant adopting a mixture of Aircrete Product Association, LABC and Accredited Construction Details for non-repeating thermal bridges. These details incorporate an improvement over Building Regulations (2013) requirements by reducing air leakage loss and convective bypass of insulation. The Applicant will reduce the dwelling's design air permeability from 10m³/hm² to between 5m³/hm² and 7m³/hm² to further reduce space heating requirements.

- 2.9 It is not proposed to provide any mechanical cooling to the proposed dwellings. Instead it is the intention of the Applicant to reduce the need for active cooling as far as possible. This will be achieved through the specification of mainly non-mechanical measures such as good thermal insulation and an air tight build. Ventilation to the dwellings will be facilitated via the installation of highly efficient intermittent extract fans. In addition, the development will adopt a range of passive ventilation measures. Openable windows will be installed as a necessary fixture to facilitate natural ventilation. These will help facilitate cross-ventilation, convective-ventilation and night purging.
- 2.10 All of the internal lighting throughout the development will be of the dedicated low energy type. External lighting will also be low energy and some will be controlled through PIR sensors or daylight cut-off devices.

10% Energy Supply Target

- 2.11 The energy efficiency measures detailed in Paragraphs 2.4 to 2.10 will ensure the Applicant complies with the baseline scenario for energy demand of **864,252 kWh/year**. In order to comply with Condition 15, the Applicant must satisfy at least 10% of this demand through the incorporation of an appropriate renewable and low carbon energy generating technology. This is equivalent to energy generation of at least **86,425 kWh/year**.

3.0 Renewable Energy and Low Carbon Technologies

Renewable Energy Technologies

- 3.1 This section of the Statement conducts a thorough review of the renewable energy and low carbon technologies that could theoretically be applied to the Ashdown Vale development. Renewable energy is defined as *“those energy flows that occur naturally and repeatedly in the environment – from the wind, the fall of water, the movement of oceans, from the sun and also from biomass”* (London Plan, 2015). This definition has been widened by the UK Government through the use of the term ‘Low or Zero Carbon Technologies’ (LZC), which include heat pumps and gas-fired CHP – technologies not always considered as being renewable. The technologies to be evaluated in this Statement are as follows:

- Combined Heat and Power
- Biomass
- Heat pumps (ground source and air source)
- Hydroelectric power
- Wind energy
- Solar thermal panels
- Solar photovoltaic panels

Combined Heat and Power

- 3.2 CHP is a form of decentralised energy generation that generally uses gas to generate electricity for local consumption, reducing the need for grid electricity and its associated high carbon dioxide emissions. As the CHP system is close to the point of energy demand, it is possible to use the heat that is generated during the electricity generation process. As both the electricity and heat from the generator is used, the efficiency of the system is increased above that of a conventional power plant where the heat is not utilised. However, the overall efficiency of approximately 75% is still lower than the 90% efficiency of a heat only gas boiler. CHP is suitable for dense, mixed-use developments where there is a high, constant and varied heat demand. This is not the case at the Ashdown Vale development, which is entirely residential and only relates to a total of one hundred and seven dwellings. As such, any CHP engine would deliver an over-generation and subsequent dumping of heat, and represent a very expensive heating solution for the future residents. There are also no existing CHP operations in close vicinity to the Ashdown Vale development which could offer a connection to this site.

Biomass

- 3.3 Biomass community heating is an alternative to conventional fossil fuel heating but, as per the reasons used against the installation of gas-fuelled CHP, should largely be discounted as an option for the proposed dwellings. Biomass boilers burn woodchip, wood pellets, cereal waste or a combination of organic fuels, and are virtually a carbon neutral option. Using biomass as an energy source creates a 'closed carbon cycle' i.e. as a biomass energy source grows it absorbs carbon dioxide from the atmosphere. When it is burnt, the carbon dioxide stored by the biomass is released, making it carbon neutral.

- 3.4 Where individual biomass boilers are installed in a dwelling, they also require a standard gas boiler as back-up in case the occupant runs out of fuel. Although they are reducing in size, they are still large enough to require a dedicated room in a dwelling with additional space for the fuel. The management of fuel deliveries and ash dispersal is also complex, necessitating a dedicated operative as opposed to residents of the future dwellings. The current proposed layout for all of the affordable dwelling types permits insufficient space for a plant room and fuel store. Furthermore, the emissions of Nitrous Oxide and particulate matter that are associated with biomass installations would have the capacity to worsen local air pollution. Indeed, Nitrous Oxide emissions from biomass boilers are typically five to ten times greater than the proposed gas boiler alternative.

Ground Source Heat Pumps (GSHPs)

- 3.5 The most efficient GSHPs are now able to deliver 90% of a typical homes' heating and hot water needs, although the majority of systems still require an electric immersion back-up system to keep up with demand in the winter. However, the typical ground temperature in the UK of 12 degrees Celsius is insufficient to provide sufficient heat to satisfy the requirements of larger houses (e.g. the Henley and Highgate types) without the use of electric immersion heaters as back-up for the majority of the time. Furthermore, ground source heat pumps rely on electricity, which has much higher carbon intensity than the Applicant's proposed gas boiler solution.

Air Source Heat Pumps (ASHPs)

- 3.6 Air Source Heat Pumps (ASHPs) operate similarly to their ground source counterparts and in much the same way as a refrigerator, converting low grade heat from a large 'reservoir' into higher temperature heat for input into a smaller space. Electricity drives the pump which extracts heat from the air as it flows over the coils in the heat pump unit. A compressor in the heat pump upgrades the temperature of the extracted energy which can then be used for space heating and hot water. However, due to the fact that an ASHP is also driven by electricity, and despite greater technological efficiency than its GSHP counterpart (around 300%), it still results in higher carbon dioxide emissions than the Applicant's proposed gas boiler alternative.

Hydroelectric power

- 3.7 Hydroelectric power plants generate electricity using the gravitational force of flowing or falling water. The running water drives a turbine and in turn a generator. The amount of energy which can

be generated is determined by the 'head' and 'flow' of the water, as well as the equipment installed. The head is the vertical fall between the source and outflow of the water at the power plant. The flow is the rate at which a volume of water can pass through the turbine. There are no rivers of sufficient scale in the vicinity of the Ashdown Vale development to facilitate a hydroelectric power installation.

Wind Turbines

- 3.8 Wind turbines are a modern, high-technology descendant of the windmills that have been around for centuries. In modern windmills the kinetic energy of the wind is used to turn a turbine to generate electricity as opposed to moving water or turning a grist mill wheel. A site with an average wind speed of 5m/s or more is generally considered to be suitable for installing a wind turbine. The average wind speed at the Ashdown Vale development is 4.2m/s at 10m AOD, and is thus below the level necessary to generate 10% of the site's energy or support commercial take-up. In addition, any such installation would have the potential to present a visual blight to the local community.

Solar thermal panels

- 3.9 Solar thermal heating panels contribute to the hot water demand of a dwelling. Water or glycol (heat transfer liquid) is circulated to roof level where it is heated using solar energy before being returned to a thermal store where heat is exchanged with water from the conventional system. Due to the seasonal availability of heat, the energy generation potential of their installation is constrained by variations in solar radiations. This means that solar thermal panels can deliver a 50-60% contribution to the annual hot water demand of the proposed houses, which would be sufficient to generate 10% of the development's energy supply. However, despite generally favourable orientations and pitch angles, there is insufficient space available in the smaller affordable types to accommodate large 250 litre hot water cylinders, which include dedicated solar storage. In these properties, the specification of gas Combi boilers is a much more suitable space-saving solution.

Solar photovoltaic (PV) panels

- 3.10 Solar PV cells convert energy from daylight into electricity using a semi-conductor material such as silicon. When light hits the semiconductor, the energy in the light is absorbed, increasing the energy in the semi-conductor. The resultant flow of electrons through the semi-conductor material produces electricity. PV systems are available in a range of forms such as bolt-on panels, solar tiles

and glass-glass laminates. All dwelling types incorporate sufficient pitched roof-space of optimal pitch and suitable angle with a very low over-shading risk, and thus the Ashdown Vale development is ideally suited to installations of solar PV panels. The energy generating capability of solar PV panels is only limited by the available roof area for an installation, as well as financial viability considerations.

Solar PV Installations

3.11 Given the constraints of the site, the only recommended technology for the Ashdown Vale development is solar PV. This is the only technology that can deliver compliance with Condition 15 of the outline consent. For each dwelling type, further SAP calculations have been undertaken to verify the precise solar PV output required to satisfy 10% of the energy supply. The required allocation of solar PV is as follows for each dwelling type:

- Worcester SP = 1 kWp from 4 panels
- Windsor SP = 1 kWp from 4 panels
- Oxford SP = 1 kWp from 4 panels
- Cambridge = 1 kWp from 4 panels
- Canterbury = 1 kWp from 4 panels
- Sunningdale = 1.25 kWp from 5 panels
- Henley = 1.25 kWp from 5 panels
- Highgate = 1.25 kWp from 5 panels
- SP2 = 0.75 kWp from 3 panels
- Tavy = 0.75 kWp from 3 panels
- Dart = 0.75 kWp from 3 panels
- Tweed = 0.75 kWp from 3 panels

3.12 The total allocation of solar PV required across the Ashdown Vale site is 107.75 kWp, which is equivalent to approximately 431 panels and 750 m² in total panel area. Detailed examples of the results of this analysis are included in Appendix A to this Statement, with a summary reproduced in Table 4 overleaf. Table 4 confirms that the introduction of 107.75 kWp of solar PV output across the site will generate **88,572 kWh/year** of renewable energy. This is equivalent to **10.25%** of the site's predicted annual energy requirements.

Table 4: Energy Generation from Solar PV Installations at Ashdown Vale, Barnham

	Average Energy Generation Per Dwelling Type (kWh/year)	Number of Dwellings	Total Energy Generation (kWh/year)
Private types			
Worcester SP	822	15	12,330
Windsor SP	822	1	822
Oxford SP	822	14	11,508
Cambridge	822	8	6,576
Canterbury	822	2	1,644
Sunningdale	1,028	17	17,476
Henley	1,028	9	9,252
Highgate	1,028	9	9,252
Sub-total		75	68,860
Affordable types			
SP2	616	12	7,392
Tavy	616	18	11,088
Dart	616	1	616
Tweed	616	1	616
Sub-total		32	19,712
TOTAL		107	88,572

4.0 Conclusion

- 4.1 This Energy Statement has set out the Applicant's detailed energy strategy pertaining to their forthcoming development at Ashdown Vale, Barnham. The strategy has been developed to comply in full with the requirements of Planning Condition 15 and the underpinning policies of the Arun District Council Local Plan (2014). The focus of the Applicant's strategy has been, in the first instance, to reduce energy consumption at the point of demand by introducing a robust fabric specification and efficient heating and ventilation systems. SAP calculations, carried out by an

accredited energy assessor, have verified that the Applicant's proposed approach will be sufficient to deliver compliance with the carbon dioxide emissions standard set by Part L1a of Building Regulations.

- 4.2 The Applicant has also satisfied the requirements of Condition 15 by proposing sufficient installations of solar PV panels – 107.75 kWp across the site – to generate **10.25%** of the supplied energy to the development. All solar PV panels will be installed and operational prior to the occupancy of each new dwelling.

Appendix

Example SAP calculations:
Type Cambridge (Plot 2)
Type Tweed (Plot 51)

Full SAP Calculation Printout

Property Reference: SECASH002
Survey Reference: 001

Issued on Date: 06.Oct.2016
Prop Type Ref: Cambridge

Property: Plot 2, Ashdown Vale, Barnham, Bognor Regis, West Sussex, PO22

SAP Rating: 89 B CO2 Emissions (t/year): 1.07 DER: 12.76 Pass TER: 16.17 Percentage DER<TER: 21.09 %
Environmental: 89 B General Requirements Compliance: Pass DFEE: 48.53 Pass TFEE: 52.81 Percentage DFEE<TFEE: 8.12 %

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

Surveyor: Stephen Smith, Tel: 01635 261582 Surveyor ID: D168-0001
Address: The Enterprise Centre, Greenham Business Park, Newbury, Berkshire, RG19 6HS
Client: Redrow Homes

Software Version: Elmhurst Energy Systems SAP2012 Calculator (Design System) version 3.06r08
SAP version: SAP 2012, Regs Region: England (Part L1A 2013), Calculation Type: New Build (As Designed)

CALCULATION DETAILS for survey reference no '001'

SAP2012 - 9.92 input data (DesignData) -

Page: 1 of 31

SAP2012 Input Data (House) 06/10/2016

FullRefNo: 001

Regs Region: England
SAP Region: South East England
Postcode: PO22
DwellingOrientation: North
Property Type: House, Detached
Storeys: 2
Date Built: 2016
Sheltered Sides: 2
Sunlight Shade: Average or unknown
Measurements
1st Storey: 33.17, 62.79, 2.31
2nd Storey: 33.17, 62.79, 2.69
Living Area: 15.5 m2, fraction: 12.3%
Thermal Mass: Simple calculation
Thermal Mass Simple: Medium
Thermal MassValue: 250
External Walls
External Wall 1
External Roofs
External Roof 1
Heat Loss Floors
Heat Loss Floor 1
Description
Opening Type 1
Opening Type 2
Openings
Opening 1
Opening 2
Opening 3
Opening 4
Opening 5
Conservatory:
Draught Proofing:
Draught Lobby:
Thermal Bridges
Bridging:
Y
List of Bridges
0.
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
19.
20.
21.
22.
23.
24.
25.
26.
27.
28.
29.
30.
31.
32.
33.
34.
35.
36.
Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
139.59, 165.85, 0, Other, Cavity, 0, 0.25, Calculate
Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
62.79, 62.79, 9, Plasterboard, insulated at ceiling level, 0.11
Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
62.79, 0, Other, Ground Floor - Solid, 0, 0.16
Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
Manufacturer, Solid Door, , , , , ,
Manufacturer, Window, Double Low-E Soft 0.05, , , 0.63, , 0.7,
Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
Solid Door, External Wall 1, North, , , , 0, 0, 2.12,
Window, External Wall 1, North, , None, 0, , 0, 0, 0, 9.51,
Window, External Wall 1, South, , None, 0, , 0, 0, 0, 12.11,
Window, External Wall 1, West, , None, 0, , 0, 0, 0, 1.26,
Window, External Wall 1, East, , None, 0, , 0, 0, 0, 1.26,
None
100
No
Calculate Bridges
0.023
Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
External wall, E1 Steel lintel with perforated steel base plate, , No, 0, 0, 0, 0.00,
External wall, E2 Other lintels (including other steel lintels), Independently assessed, Yes, 16.81, 0.05, 0.05, 0.84,
External wall, E3 Sill, Independently assessed, Yes, 16.81, 0.034, 0.034, 0.57,
External wall, E4 Jamb, Independently assessed, Yes, 10.2, 0.04, 0.04, 0.41,
External wall, E5 Ground floor (normal), Independently assessed, Yes, 33.17, 0.052, 0.052, 1.72,
External wall, E19 Ground floor (inverted), , No, 0, 0, 0, 0.00,
External wall, E20 Exposed floor (normal), , No, 0, 0, 0, 0.00,
External wall, E21 Exposed floor (inverted), , No, 0, 0, 0, 0.00,
External wall, E22 Basement floor, , No, 0, 0, 0, 0.00,
External wall, E6 Intermediate floor within a dwelling, Independently assessed, Yes, 33.17, 0, 0, 0.00,
External wall, E7 Party floor between dwellings (in blocks of flats), , No, 0, 0, 0, 0.00,
External wall, E8 Balcony within a dwelling, wall insulation continuous, , No, 0, 0, 0, 0.00,
External wall, E9 Balcony between dwellings, wall insulation continuous, , No, 0, 0, 0, 0.00,
External wall, E23 Balcony within or between dwellings, balcony support penetrates wall insulation, , No, 0, 0, 0, 0.00,
External wall, E10 Eaves (insulation at ceiling level), Table K1 - Approved, No, 29.6, 0.06, 0.06, 1.78,
External wall, E24 Eaves (insulation at ceiling level - inverted), , No, 0, 0, 0, 0.00,
External wall, E11 Eaves (insulation at rafter level), , No, 0, 0, 0, 0.00,
External wall, E12 Gable (insulation at ceiling level), Independently assessed, No, 3.4, 0.081, 0.081, 0.28,
External wall, E13 Gable (insulation at rafter level), , No, 0, 0, 0, 0.00,
External wall, E14 Flat roof, , No, 0, 0, 0, 0.00,
External wall, E15 Flat roof with parapet, , No, 0, 0, 0, 0.00,
External wall, E16 Corner (normal), Independently assessed, Yes, 20, 0.05, 0.05, 1.00,
External wall, E17 Corner (inverted - internal area greater than external area), , No, 0, 0, 0, 0.00,
External wall, E18 Party wall between dwellings, , No, 0, 0, 0, 0.00,
External wall, E25 Staggered party wall between dwellings, , No, 0, 0, 0, 0.00,
Party wall, P1 Party wall - Ground floor, , No, 0, 0, 0, 0.00,
Party wall, P6 Party wall - Ground floor (inverted), , No, 0, 0, 0, 0.00,
Party wall, P2 Party wall - Intermediate floor within a dwelling, , No, 0, 0, 0, 0.00,
Party wall, P3 Party wall - Intermediate floor between dwellings (in blocks of flats), , No, 0, 0, 0, 0.00,
Party wall, P7 Party Wall - Exposed floor (normal), , No, 0, 0, 0, 0.00,
Party wall, P8 Party Wall - Exposed floor (inverted), , No, 0, 0, 0, 0.00,
Party wall, P4 Party wall - Roof (insulation at ceiling level), , No, 0, 0, 0, 0.00,
Party wall, P5 Party wall - Roof (insulation at rafter level), , No, 0, 0, 0, 0.00,
External roof, R1 Head of roof window, , No, 0, 0, 0, 0.00,
External roof, R2 Sill of roof window, , No, 0, 0, 0, 0.00,
External roof, R3 Jamb of roof window, , No, 0, 0, 0, 0.00,
External roof, R4 Ridge (vaulted ceiling), , No, 0, 0, 0, 0.00,

```

37.      External roof, R5 Ridge (inverted), , No, 0, 0, 0, 0.00,
38.      External roof, R6 Flat ceiling, , No, 0, 0, 0, 0.00,
39.      External roof, R7 Flat ceiling (inverted), , No, 0, 0, 0, 0.00,
40.      External roof, R8 Roof to wall (rafter), , No, 0, 0, 0, 0.00,
41.      External roof, R9 Roof to wall (flat ceiling), , No, 0, 0, 0, 0.00,
Pressure Test:      True
Designed q50:      5
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:      19
LEL Fittings:      19
Percentage of LEL Fittings:      100
External Lights Fitted:      No
External LELs Fitted:      No
Electricity Tariff:      Standard
Main Heating 1
  Description
  Percentage      100
  Sedbuk ID      17045
  Fuel Type      Mains gas
  MHS      Mains gas BGW Post 98 Combi condens. with auto ign.
  SAP Code      104
  Boiler Efficiency Type      Split Efficiencies
  Efficiency Winter      89.8
  Efficiency Summer      87.3
  Controls by PCDF      0
  MHS Controls      CBI Time and temperature zone control
  Boiler Interlock      Yes
  Compensator      200002
  Delayed Start Stat      No
  Ctrl SAP Code      2110
  Flue Type      Balanced
  Fan Assisted Flue      Yes
  Pumped      Pump in heated space
  Heat Pump Age      2013 or later
  Heat Emitter      Radiators
  Flow Temperature      Normal (> 45°C)
  Combi boiler type      Standard Combi
  Combi keep hot type      None
Main Heating 2      None
Heating Systems Interaction      Each system heats separate parts of dwelling
Smoke Control Area      Unknown
Community Heating      None
Secondary Heating      None
Water Heating
  Type      MainHeating1
  WHS      HWP From main heating 1
  Low Water Usage      Yes
  SAP Code      901
  Showers in Property      Non-electric only
  Hot Water Cylinder      None
Flue Gas Heat Recovery System      None
Waste Water Heat Recovery      none
PV Unit
  Type      One Dwelling
PVUnit 1      Cells Peak = 1, Orientation = South West, Elevation = 30°, Overshading = None Or Little, , Connected to Dwelling = Yes
Wind Turbine      None
Terrain Type:      Urban
Small Scale Hydro      None
Special Features      None

```

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

DWELLING AS DESIGNED

Detached House, total floor area 126 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) 16.17 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 12.76 kg/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 52.8 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE) 48.5 kWh/m²OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Floor	0.16 (max. 0.25)	0.16 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.38 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals:	5.00 (design value)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
 Data from database
 Ideal Logic Combi ES 35
 Combi boiler
 Efficiency: 88.9% SEDBUK2009
 Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation

Hot water storage: No cylinder

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls:

No cylinder

Boiler interlock

Yes

OK

7 Low energy lights

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

Minimum: 75% OK

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (South East England): Not significant OK

Based on:

Overshading: Average

Windows facing North: 9.51 m², No overhang

Windows facing East: 1.26 m², No overhang

Windows facing South: 12.11 m², No overhang

Windows facing West: 1.26 m², No overhang

Air change rate: 4.00 ach

Blinds/curtains: None

10 Key features

Roof U-value: 0.11 W/m²K

Door U-value: 1.10 W/m²K

Thermal bridging y-value: 0.023 W/m²K

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	62.7900 (1b)	x 2.3100 (2b)	= 145.0449 (1b) - (3b)
First floor	62.7900 (1c)	x 2.6900 (2c)	= 168.9051 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	125.5800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 313.9500 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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) = 0.1274 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3774 (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) =	0.3208 (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	0.4090	0.4010	0.3930	0.3529	0.3449	0.3048	0.3048	0.2967	0.3208	0.3449	0.3609	0.3769 (22b)
Effective ac	0.5836	0.5804	0.5772	0.5623	0.5595	0.5464	0.5464	0.5440	0.5515	0.5595	0.5651	0.5710 (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					
Opening Type 1			2.1200	1.1000	2.3320		(26)					
Opening Type 2 (Uw = 1.40)			24.1400	1.3258	32.0038		(27)					
Heat Loss Floor 1			62.7900	0.1600	10.0464		(28a)					
External Wall 1	165.8500	26.2600	139.5900	0.2500	34.8975		(29a)					
External Roof 1	62.7900		62.7900	0.1100	6.9069		(30)					
Total net area of external elements Aum(A, m2)			291.4300				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.1866		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.5963 (36)					
Total fabric heat loss						(33) + (36) =	92.7829 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 60.4679	Feb 60.1314	Mar 59.8015	Apr 58.2522	May 57.9624	Jun 56.6130	Jul 56.6130	Aug 56.3631	Sep 57.1327	Oct 57.9624	Nov 58.5488	Dec 59.1618 (38)
Heat transfer coeff	153.2508	152.9143	152.5844	151.0351	150.7452	149.3958	149.3958	149.1459	149.9156	150.7452	151.3316	151.9447 (39)
Average = Sum(39)m / 12 =												151.0337 (39)
HLP	Jan 1.2203	Feb 1.2177	Mar 1.2150	Apr 1.2027	May 1.2004	Jun 1.1896	Jul 1.1896	Aug 1.1877	Sep 1.1938	Oct 1.2004	Nov 1.2051	Dec 1.2099 (40)
HLP (average)												1.2027 (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												2.8825 (42)
Average daily hot water use (litres/day)												102.6602 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.9262	108.8198	104.7134	100.6070	96.5006	92.3941	92.3941	96.5006	100.6070	104.7134	108.8198	112.9262 (44)
Energy conte	167.4663	146.4671	151.1409	131.7683	126.4348	109.1036	101.1006	116.0144	117.3999	136.8183	149.3479	162.1821 (45)
Energy content (annual)												Total = Sum(45)m = 1615.2441 (45)
Distribution loss (46)m = 0.15 x (45)m	25.1199	21.9701	22.6711	19.7652	18.9652	16.3655	15.1651	17.4022	17.6100	20.5227	22.4022	24.3273 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	26.6948	24.0367	26.4401	25.3611	25.9857	24.8781	25.5396	25.8288	25.1369	26.2167	25.6353	26.6124 (61)
Total heat required for water heating calculated for each month	194.1611	170.5037	177.5810	157.1294	152.4205	133.9817	126.6401	141.8432	142.5369	163.0350	174.9832	188.7945 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)
Output from w/h	194.1611	170.5037	177.5810	157.1294	152.4205	133.9817	126.6401	141.8432	142.5369	163.0350	174.9832	188.7945 (64)
Total per year (kWh/year) = Sum(64)m =												1923.6104 (64)

Heat gains from water heating, kWh/month

62.3562 54.7095 56.8644 50.1532 48.5360 42.4965 40.0008 45.0320 45.3197 52.0463 56.0670 60.5787 (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	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.3646	23.4168	19.0438	14.4174	10.7772	9.0986	9.8313	12.7791	17.1521	21.7785	25.4187	27.0974 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	292.3104	295.3436	287.6999	271.4273	250.8860	231.5802	218.6827	215.6494	223.2931	239.5657	260.1070	279.4128 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127 (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)	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013 (71)
Water heating gains (Table 5)	83.8121	81.4129	76.4306	69.6573	65.2366	59.0229	53.7645	60.5269	62.9440	69.9547	77.8708	81.4229 (72)
Total internal gains	471.7251	469.4113	452.4123	424.7400	396.1378	368.9396	351.5165	358.1934	372.6273	400.5369	432.6346	457.1711 (73)

6. Solar gains

[Jan]	Area m2				Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W	
North	9.5100				10.6334		0.6300		0.7000		0.7700		30.9047 (74)	
East	1.2600				19.6403		0.6300		0.7000		0.7700		7.5629 (76)	
South	12.1100				46.7521		0.6300		0.7000		0.7700		173.0282 (78)	
West	1.2600				19.6403		0.6300		0.7000		0.7700		7.5629 (80)	
Solar gains	219.0587	372.0253	510.0577	640.2445	729.3848	730.7624	701.6717	633.3183	554.4133	411.0611	262.0824	187.7147	(83)	
Total gains	690.7838	841.4366	962.4700	1064.9844	1125.5226	1099.7020	1053.1882	991.5117	927.0405	811.5980	694.7170	644.8858	(84)	

7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, nil,m (see Table 9a)												21.0000 (85)
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	56.9056	57.0309	57.1542	57.7404	57.8515	58.3740	58.3740	58.4718	58.1716	57.8515	57.6273	57.3948
util living area	4.7937	4.8021	4.8103	4.8494	4.8568	4.8916	4.8916	4.8981	4.8781	4.8568	4.8418	4.8263
	0.9986	0.9962	0.9896	0.9682	0.9062	0.7675	0.5992	0.6523	0.8719	0.9799	0.9969	0.9990 (86)
MIT	19.6196	19.8005	20.0687	20.4101	20.7170	20.9167	20.9805	20.9708	20.8323	20.4275	19.9553	19.5882 (87)
Th 2	19.9038	19.9059	19.9080	19.9178	19.9197	19.9283	19.9283	19.9299	19.9250	19.9197	19.9160	19.9121 (88)
util rest of house	0.9982	0.9949	0.9857	0.9554	0.8665	0.6755	0.4657	0.5195	0.8042	0.9694	0.9955	0.9987 (89)
MIT 2	18.0633	18.3289	18.7203	19.2163	19.6334	19.8705	19.9209	19.9175	19.7861	19.2488	18.5627	18.0231 (90)
Living area fraction									fLA = Living area / (4) =			0.1234 (91)
MIT	18.2554	18.5105	18.8868	19.3637	19.7671	19.9996	20.0517	20.0475	19.9153	19.3942	18.7346	18.2163 (92)
Temperature adjustment												0.0000
adjusted MIT	18.2554	18.5105	18.8868	19.3637	19.7671	19.9996	20.0517	20.0475	19.9153	19.3942	18.7346	18.2163 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9970	0.9923	0.9805	0.9466	0.8597	0.6824	0.4819	0.5352	0.8034	0.9621	0.9933	0.9978 (94)
Useful gains	688.7051	834.9252	943.7135	1008.1104	967.5862	750.4011	507.5491	530.6451	744.7962	780.8223	690.0364	643.4759 (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	2138.6740	2081.2396	1890.0287	1580.3787	1216.0790	806.6799	515.6724	544.0109	871.7968	1325.6904	1760.6805	2129.7022 (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	1078.7769	837.5233	704.0585	412.0332	184.8786	0.0000	0.0000	0.0000	0.0000	405.3819	770.8637	1105.7523 (98)
Space heating												5499.2685 (98)
Space heating per m2										(98) / (4) =		43.7910 (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 %)												92.8000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												5925.9359 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1078.7769	837.5233	704.0585	412.0332	184.8786	0.0000	0.0000	0.0000	0.0000	405.3819	770.8637	1105.7523 (98)
Space heating efficiency (main heating system 1)	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000 (210)
Space heating fuel (main heating system)	1162.4751	902.5035	758.6837	444.0013	199.2226	0.0000	0.0000	0.0000	0.0000	436.8339	830.6721	1191.5435 (211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)

Water heating													
Water heating requirement	194.1611	170.5037	177.5810	157.1294	152.4205	133.9817	126.6401	141.8432	142.5369	163.0350	174.9832	188.7945 (64)	
Efficiency of water heater												87.3000 (216)	
(217)m	89.4095	89.3671	89.2850	89.0956	88.6528	87.3000	87.3000	87.3000	87.3000	89.0684	89.3268	89.4265 (217)	
Fuel for water heating, kWh/month	217.1594	190.7902	198.8924	176.3604	171.9298	153.4727	145.0631	162.4779	163.2725	183.0447	195.8911	211.1169 (219)	
Water heating fuel used												2169.4712 (219)	
Annual totals kWh/year													
Space heating fuel - main system												5925.9359 (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)												465.6073 (232)	
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.00 * 1029 * 1.00) =										-823.3494		-823.3494 (233)	
Total delivered energy for all uses												7812.6650 (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	5925.9359	0.2160	1280.0021 (261)	
Space heating - secondary	0.0000	0.0000	0.0000 (263)	
Water heating (other fuel)	2169.4712	0.2160	468.6058 (264)	
Space and water heating			1748.6079 (265)	
Pumps and fans	75.0000	0.5190	38.9250 (267)	
Energy for lighting	465.6073	0.5190	241.6502 (268)	
Energy saving/generation technologies				
PV Unit	-823.3494	0.5190	-427.3183 (269)	
Total CO2, kg/year			1601.8648 (272)	
Dwelling Carbon Dioxide Emission Rate (DER)			12.7600 (273)	

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

DER		12.7600 ZC1
Total Floor Area	TFA	125.5800
Assumed number of occupants	N	2.8825
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		13.7934 ZC2
CO2 emissions from cooking, equation (L16)		1.4985 ZC3
Total CO2 emissions		28.0518 ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000 ZC7
Net CO2 emissions		28.0518 ZC8

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	62.7900 (1b)	x 2.3100 (2b)	= 145.0449 (1b) - (3b)
First floor	62.7900 (1c)	x 2.6900 (2c)	= 168.9051 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)... (1n)	125.5800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)... (3n) =	313.9500 (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) =	0.1274 (8)
Pressure test							Yes	
Measured/design q50							5.0000	
Infiltration rate								0.3774 (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) =	0.3208 (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 inflit rate												
	0.4090	0.4010	0.3930	0.3529	0.3449	0.3048	0.3048	0.2967	0.3208	0.3449	0.3609	0.3769 (22b)
Effective ac	0.5836	0.5804	0.5772	0.5623	0.5595	0.5464	0.5464	0.5440	0.5515	0.5595	0.5651	0.5710 (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			2.1200	1.0000	2.1200		(26)					
TER Opening Type (Uw = 1.40)			24.1400	1.3258	32.0038		(27)					
Heat Loss Floor 1			62.7900	0.1300	8.1627		(28)					
External Wall 1	165.8500	26.2600	139.5900	0.1800	25.1262		(29a)					
External Roof 1	62.7900		62.7900	0.1300	8.1627		(30)					
Total net area of external elements Aum(A, m2)			291.4300				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	75.5754		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.2782 (36)					
Total fabric heat loss						(33) + (36) =	86.8536 (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	60.4679	60.1314	59.8015	58.2522	57.9624	56.6130	56.6130	56.3631	57.1327	57.9624	58.5488	59.1618 (38)
Heat transfer coeff	147.3215	146.9850	146.6551	145.1058	144.8159	143.4665	143.4665	143.2167	143.9863	144.8159	145.4023	146.0154 (39)
Average = Sum(39)m / 12 =												145.1044 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1731	1.1704	1.1678	1.1555	1.1532	1.1424	1.1424	1.1404	1.1466	1.1532	1.1578	1.1627 (40)
HLP (average)												1.1555 (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												2.8825 (42)
Average daily hot water use (litres/day)												102.6602 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.9262	108.8198	104.7134	100.6070	96.5006	92.3941	92.3941	96.5006	100.6070	104.7134	108.8198	112.9262 (44)
Energy content (annual)	167.4663	146.4671	151.1409	131.7683	126.4348	109.1036	101.1006	116.0144	117.3999	136.8183	149.3479	162.1821 (45)
Distribution loss (46)m = 0.15 x (45)m	25.1199	21.9701	22.6711	19.7652	18.9652	16.3655	15.1651	17.4022	17.6100	20.5227	22.4022	24.3273 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	50.9589	46.0274	50.9589	49.3151	49.1756	45.5642	47.0830	49.1756	49.3151	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	218.4252	192.4945	202.0998	181.0834	175.6104	154.6679	148.1836	165.1900	166.7150	187.7772	198.6630	213.1410 (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	218.4252	192.4945	202.0998	181.0834	175.6104	154.6679	148.1836	165.1900	166.7150	187.7772	198.6630	213.1410 (64)
	Total per year (kWh/year) = Sum(64)m =										2204.0509 (64)	

Heat gains from water heating, kWh/month
68.4223 60.2071 62.9941 56.1417 54.3335 47.6680 45.3867 50.8687 51.3642 58.2318 61.9869 66.6653 (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	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.3646	23.4168	19.0438	14.4174	10.7772	9.0986	9.8313	12.7791	17.1521	21.7785	25.4187	27.0974 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	292.3104	295.3436	287.6999	271.4273	250.8860	231.5802	218.6827	215.6494	223.2931	239.5657	260.1070	279.4128 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127 (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)	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013 (71)
Water heating gains (Table 5)	91.9654	89.5940	84.6695	77.9746	73.0289	66.2056	61.0036	68.3719	71.3392	78.2686	86.0930	89.6039 (72)
Total internal gains	479.8784	477.5924	460.6512	433.0573	403.9301	376.1223	358.7556	366.0384	381.0224	408.8508	440.8567	465.3521 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W
North	9.5100	10.6334	0.6300	0.7000	0.7700	30.9047 (74)
East	1.2600	19.6403	0.6300	0.7000	0.7700	7.5629 (76)
South	12.1100	46.7521	0.6300	0.7000	0.7700	173.0282 (78)
West	1.2600	19.6403	0.6300	0.7000	0.7700	7.5629 (80)
Solar gains	219.0587	372.0253	510.0577	640.2445	729.3848	730.7624 701.6717 633.3183 554.4133 411.0611 262.0824 187.7147 (83)
Total gains	698.9370	849.6177	970.7089	1073.3018	1133.3149	1106.8847 1060.4273 999.3567 935.4357 819.9119 702.9391 653.0668 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	59.1959	59.3315	59.4649	60.0998	60.2201	60.7865	60.7865	60.8926	60.5671	60.2201	59.9773	59.7254
util living area	4.9464	4.9554	4.9643	5.0067	5.0147	5.0524	5.0524	5.0595	5.0378	5.0147	4.9985	4.9817
	0.9986	0.9960	0.9888	0.9651	0.8967	0.7483	0.5770	0.6296	0.8584	0.9778	0.9967	0.9990 (86)
MIT	19.6876	19.8673	20.1303	20.4621	20.7529	20.9327	20.9855	20.9778	20.8575	20.4736	20.0139	19.6565 (87)
Th 2	19.9416	19.9437	19.9458	19.9558	19.9576	19.9663	19.9663	19.9679	19.9630	19.9576	19.9539	19.9499 (88)
util rest of house	0.9981	0.9946	0.9847	0.9514	0.8553	0.6575	0.4507	0.5028	0.7888	0.9666	0.9953	0.9986 (89)
MIT 2	18.1890	18.4528	18.8365	19.3177	19.7097	19.9201	19.9609	19.9586	19.8465	19.3417	18.6748	18.1495 (90)
Living area fraction									fLA = Living area / (4) =			0.1234 (91)
MIT	18.3740	18.6274	18.9962	19.4590	19.8384	20.0451	20.0873	20.0844	19.9713	19.4814	18.8401	18.3355 (92)
Temperature adjustment												0.0000
adjusted MIT	18.3740	18.6274	18.9962	19.4590	19.8384	20.0451	20.0873	20.0844	19.9713	19.4814	18.8401	18.3355 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9969	0.9920	0.9795	0.9429	0.8496	0.6651	0.4661	0.5179	0.7895	0.9594	0.9930	0.9978 (94)
Useful gains	696.7959	842.8113	950.7876	1011.9783	962.8948	736.2153	494.3111	517.6152	738.5032	786.6051	698.0127	651.6194 (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	2073.3983	2017.7242	1832.6355	1532.1668	1178.5756	781.1914	500.3141	527.6644	845.3801	1286.1725	1707.0405	2063.9970 (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	1024.1923	789.5415	656.0948	374.5357	160.4665	0.0000	0.0000	0.0000	0.0000	371.6781	726.5000	1050.8090 (98)
Space heating												5153.8180 (98)
Space heating per m2										(98) / (4) =		41.0401 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												93.4000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												5518.0064 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1024.1923	789.5415	656.0948	374.5357	160.4665	0.0000	0.0000	0.0000	0.0000	371.6781	726.5000	1050.8090 (98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000 (210)
Space heating fuel (main heating system)	1096.5656	845.3335	702.4570	401.0019	171.8057	0.0000	0.0000	0.0000	0.0000	397.9423	777.8373	1125.0632 (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	218.4252	192.4945	202.0998	181.0834	175.6104	154.6679	148.1836	165.1900	166.7150	187.7772	198.6630	213.1410 (64)	
Efficiency of water heater												80.3000 (216)	
(217)m	88.4446	88.2249	87.7994	86.8402	84.8250	80.3000	80.3000	80.3000	80.3000	86.7382	88.0226	88.5224 (217)	
Fuel for water heating, kWh/month	246.9628	218.1862	230.1836	208.5249	207.0266	192.6125	184.5375	205.7160	207.6152	216.4873	225.6953	240.7763 (219)	
Water heating fuel used												2584.3243 (219)	
Annual totals kWh/year													
Space heating fuel - main system												5518.0064 (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)												465.6073 (232)	
Total delivered energy for all uses												8642.9381 (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	5518.0064	0.2160	1191.8894 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2584.3243	0.2160	558.2141 (264)
Space and water heating			1750.1034 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	465.6073	0.5190	241.6502 (268)
Total CO2, kg/m2/year			2030.6786 (272)
Emissions per m2 for space and water heating			13.9362 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			1.9243 (272b)
Emissions per m2 for pumps and fans			0.3100 (272c)
Target Carbon Dioxide Emission Rate (TER) = (13.9362 * 1.00) + 1.9243 + 0.3100, rounded to 2 d.p.			16.1700 (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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	62.7900 (1b)	x 2.3100 (2b)	= 145.0449 (1b) - (3b)
First floor	62.7900 (1c)	x 2.6900 (2c)	= 168.9051 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	125.5800		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 313.9500 (5)
Dwelling volume			

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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) = 0.1274 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3774 (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) =	0.3208 (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	0.4090	0.4010	0.3930	0.3529	0.3449	0.3048	0.3048	0.2967	0.3208	0.3449	0.3609	0.3769 (22b)
Effective ac	0.5836	0.5804	0.5772	0.5623	0.5595	0.5464	0.5464	0.5440	0.5515	0.5595	0.5651	0.5710 (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					
Opening Type 1			2.1200	1.1000	2.3320		(26)					
Opening Type 2 (Uw = 1.40)			24.1400	1.3258	32.0038		(27)					
Heat Loss Floor 1			62.7900	0.1600	10.0464		(28a)					
External Wall 1	165.8500	26.2600	139.5900	0.2500	34.8975		(29a)					
External Roof 1	62.7900		62.7900	0.1100	6.9069		(30)					
Total net area of external elements Aum(A, m2)			291.4300				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.1866		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.5963 (36)					
Total fabric heat loss						(33) + (36) =	92.7829 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 60.4679	Feb 60.1314	Mar 59.8015	Apr 58.2522	May 57.9624	Jun 56.6130	Jul 56.6130	Aug 56.3631	Sep 57.1327	Oct 57.9624	Nov 58.5488	Dec 59.1618 (38)
Heat transfer coeff	153.2508	152.9143	152.5844	151.0351	150.7452	149.3958	149.3958	149.1459	149.9156	150.7452	151.3316	151.9447 (39)
Average = Sum(39)m / 12 =												151.0337 (39)
HLP	Jan 1.2203	Feb 1.2177	Mar 1.2150	Apr 1.2027	May 1.2004	Jun 1.1896	Jul 1.1896	Aug 1.1877	Sep 1.1938	Oct 1.2004	Nov 1.2051	Dec 1.2099 (40)
HLP (average)												1.2027 (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												2.8825 (42)
Average daily hot water use (litres/day)												102.6602 (43)
Daily hot water use	Jan 112.9262	Feb 108.8198	Mar 104.7134	Apr 100.6070	May 96.5006	Jun 92.3941	Jul 92.3941	Aug 96.5006	Sep 100.6070	Oct 104.7134	Nov 108.8198	Dec 112.9262 (44)
Energy conte	167.4663	146.4671	151.1409	131.7683	126.4348	109.1036	101.1006	116.0144	117.3999	136.8183	149.3479	162.1821 (45)
Energy content (annual)										Total = Sum(45)m =		1615.2441 (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	35.5866	31.1243	32.1174	28.0008	26.8674	23.1845	21.4839	24.6531	24.9475	29.0739	31.7364	34.4637 (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	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.3646	23.4168	19.0438	14.4174	10.7772	9.0986	9.8313	12.7791	17.1521	21.7785	25.4187	27.0974	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	292.3104	295.3436	287.6999	271.4273	250.8860	231.5802	218.6827	215.6494	223.2931	239.5657	260.1070	279.4128	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	(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)	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	(71)
Water heating gains (Table 5)	47.8314	46.3158	43.1686	38.8899	36.1121	32.2007	28.8762	33.1358	34.6493	39.0778	44.0784	46.3222	(72)
Total internal gains	432.7444	431.3143	416.1503	390.9726	364.0133	339.1174	323.6281	327.8023	341.3325	366.6601	395.8421	419.0704	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					9.5100	10.6334	0.6300	0.7000	0.7700		30.9047 (74)	
East					1.2600	19.6403	0.6300	0.7000	0.7700		7.5629 (76)	
South					12.1100	46.7521	0.6300	0.7000	0.7700		173.0282 (78)	
West					1.2600	19.6403	0.6300	0.7000	0.7700		7.5629 (80)	
Solar gains	219.0587	372.0253	510.0577	640.2445	729.3848	730.7624	701.6717	633.3183	554.4133	411.0611	262.0824	187.7147 (83)
Total gains	651.8031	803.3396	926.2080	1031.2171	1093.3981	1069.8798	1025.2999	961.1207	895.7458	777.7211	657.9245	606.7851 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000	(85)
Utilisation factor for gains for living area, nil, m (see Table 9a)														
tau	56.9056	57.0309	57.1542	57.7404	57.8515	58.3740	58.3740	58.4718	58.1716	57.8515	57.6273	57.3948		
alpha	4.7937	4.8021	4.8103	4.8494	4.8568	4.8916	4.8916	4.8981	4.8781	4.8568	4.8418	4.8263		
util living area	0.9989	0.9969	0.9911	0.9718	0.9142	0.7805	0.6129	0.6684	0.8836	0.9830	0.9975	0.9993	(86)	
MIT	19.5910	19.7729	20.0432	20.3886	20.7018	20.9101	20.9785	20.9676	20.8198	20.4047	19.9284	19.5601	(87)	
Th 2	19.9038	19.9059	19.9080	19.9178	19.9197	19.9283	19.9283	19.9299	19.9250	19.9197	19.9160	19.9121	(88)	
util rest of house	0.9986	0.9958	0.9878	0.9602	0.8767	0.6897	0.4776	0.5344	0.8192	0.9739	0.9965	0.9990	(89)	
MIT 2	18.6186	18.8017	19.0721	19.4187	19.7118	19.8851	19.9227	19.9203	19.8215	19.4399	18.9653	18.5944	(90)	
Living area fraction									fLA = Living area / (4) =			0.1234	(91)	
MIT	18.7387	18.9216	19.1920	19.5384	19.8340	20.0116	20.0530	20.0496	19.9447	19.5590	19.0842	18.7136	(92)	
Temperature adjustment												0.0000		
adjusted MIT	18.7387	18.9216	19.1920	19.5384	19.8340	20.0116	20.0530	20.0496	19.9447	19.5590	19.0842	18.7136	(93)	

8. Space heating requirement

Utilisation	0.9980	0.9944	0.9848	0.9549	0.8731	0.6976	0.4943	0.5506	0.8206	0.9697	0.9953	0.9986	(94)	
Useful gains	650.4897	798.8197	912.1054	984.7441	954.6018	746.3793	506.8044	529.2218	735.0483	754.1839	654.8237	605.9167	(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	2212.7353	2144.0988	1936.5952	1606.7696	1226.1614	808.4728	515.8659	544.3230	876.2106	1350.5224	1813.5910	2205.2595	(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	1162.3107	904.0276	762.2204	447.8584	202.0403	0.0000	0.0000	0.0000	0.0000	443.6759	834.3124	1189.9111	(98)	
Space heating												5946.3567	(98)	
Space heating per m2												(98) / (4) =	47.3511	(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	1404.3207	1105.5291	1133.5091	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8191	0.8930	0.8655	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1150.2335	987.2404	981.0089	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1367.5554	1312.8106	1240.0190	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	156.4717	242.2243	192.7035	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												591.3995	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	39.1179	60.5561	48.1759	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												147.8499	(107)
Space cooling per m2												1.1773	(108)
Energy for space heating												47.3511	(99)
Energy for space cooling												1.1773	(108)
Total												48.5285	(109)
Dwelling Fabric Energy Efficiency (DFEE)												48.5	(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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	62.7900 (1b)	x 2.3100 (2b)	= 145.0449 (1b) - (3b)
First floor	62.7900 (1c)	x 2.6900 (2c)	= 168.9051 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	125.5800		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 313.9500 (5)
Dwelling volume			

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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) = 0.1274 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3774 (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) =	0.3208 (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	0.4090	0.4010	0.3930	0.3529	0.3449	0.3048	0.3048	0.2967	0.3208	0.3449	0.3609	0.3769 (22b)
Effective ac	0.5836	0.5804	0.5772	0.5623	0.5595	0.5464	0.5464	0.5440	0.5515	0.5595	0.5651	0.5710 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1200	1.0000	2.1200		(26)
TER Opening Type (Uw = 1.40)			24.1400	1.3258	32.0038		(27)
Heat Loss Floor 1			62.7900	0.1300	8.1627		(28a)
External Wall 1	165.8500	26.2600	139.5900	0.1800	25.1262		(29a)
External Roof 1	62.7900		62.7900	0.1300	8.1627		(30)
Total net area of external elements Aum(A, m ²)			291.4300				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 75.5754		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.2782 (36)
Total fabric heat loss						(33) + (36) =	86.8536 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	60.4679	60.1314	59.8015	58.2522	57.9624	56.6130	56.6130
Heat transfer coeff	147.3215	146.9850	146.6551	145.1058	144.8159	143.4665	143.4665
Average = Sum(39)m / 12 =							
HLP	1.1731	1.1704	1.1678	1.1555	1.1532	1.1424	1.1424
HLP (average)							
Days in month	31	28	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8825 (42)
Average daily hot water use (litres/day)												102.6602 (43)
Daily hot water use	112.9262	108.8198	104.7134	100.6070	96.5006	92.3941	92.3941	96.5006	100.6070	104.7134	108.8198	112.9262 (44)
Energy conte	167.4663	146.4671	151.1409	131.7683	126.4348	109.1036	101.1006	116.0144	117.3999	136.8183	149.3479	162.1821 (45)
Energy content (annual)												Total = Sum(45)m = 1615.2441 (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	35.5866	31.1243	32.1174	28.0008	26.8674	23.1845	21.4839	24.6531	24.9475	29.0739	31.7364	34.4637 (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	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	144.1267	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.3646	23.4168	19.0438	14.4174	10.7772	9.0986	9.8313	12.7791	17.1521	21.7785	25.4187	27.0974	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	292.3104	295.3436	287.6999	271.4273	250.8860	231.5802	218.6827	215.6494	223.2931	239.5657	260.1070	279.4128	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	37.4127	(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)	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	(71)
Water heating gains (Table 5)	47.8314	46.3158	43.1686	38.8899	36.1121	32.2007	28.8762	33.1358	34.6493	39.0778	44.0784	46.3222	(72)
Total internal gains	432.7444	431.3143	416.1503	390.9726	364.0133	339.1174	323.6281	327.8023	341.3325	366.6601	395.8421	419.0704	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					9.5100	10.6334	0.6300	0.7000	0.7700		30.9047 (74)	
East					1.2600	19.6403	0.6300	0.7000	0.7700		7.5629 (76)	
South					12.1100	46.7521	0.6300	0.7000	0.7700		173.0282 (78)	
West					1.2600	19.6403	0.6300	0.7000	0.7700		7.5629 (80)	
Solar gains	219.0587	372.0253	510.0577	640.2445	729.3848	730.7624	701.6717	633.3183	554.4133	411.0611	262.0824	187.7147 (83)
Total gains	651.8031	803.3396	926.2080	1031.2171	1093.3981	1069.8798	1025.2999	961.1207	895.7458	777.7211	657.9245	606.7851 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000	(85)
Utilisation factor for gains for living area, nil, m (see Table 9a)														
tau	59.1959	59.3315	59.4649	60.0998	60.2201	60.7865	60.7865	60.8926	60.5671	60.2201	59.9773	59.9773	59.7254	
alpha	4.9464	4.9554	4.9643	5.0067	5.0147	5.0524	5.0524	5.0595	5.0378	5.0147	4.9985	4.9985	4.9817	
util living area	0.9990	0.9969	0.9908	0.9700	0.9074	0.7651	0.5941	0.6499	0.8744	0.9821	0.9975	0.9993	(86)	
MIT	19.6527	19.8335	20.0989	20.4356	20.7349	20.9254	20.9835	20.9744	20.8427	20.4452	19.9808	19.6221	(87)	
Th 2	19.9416	19.9437	19.9458	19.9558	19.9576	19.9663	19.9663	19.9679	19.9630	19.9576	19.9539	19.9499	(88)	
util rest of house	0.9986	0.9958	0.9874	0.9580	0.8687	0.6753	0.4654	0.5212	0.8087	0.9727	0.9965	0.9990	(89)	
MIT 2	18.7102	18.8922	19.1576	19.4953	19.7738	19.9308	19.9620	19.9604	19.8733	19.5102	19.0477	18.6863	(90)	
Living area fraction														
MIT	18.8265	19.0084	19.2738	19.6113	19.8924	20.0536	20.0881	20.0856	19.9930	19.6256	19.1629	18.8018	(92)	
Temperature adjustment														
adjusted MIT	18.8265	19.0084	19.2738	19.6113	19.8924	20.0536	20.0881	20.0856	19.9930	19.6256	19.1629	18.8018	(93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9944	0.9845	0.9528	0.8658	0.6837	0.4813	0.5369	0.8110	0.9686	0.9953	0.9986	(94)
Useful gains	650.5358	798.8447	911.8060	982.5868	946.6925	731.4877	493.5010	516.0556	726.4323	753.3337	654.8583	605.9553	(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	2140.0709	2073.7213	1873.3455	1554.2752	1186.3940	782.4066	500.4247	527.8392	848.5075	1307.0523	1753.9740	2132.0938	(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	1108.2141	856.7170	715.3854	411.6156	178.3380	0.0000	0.0000	0.0000	0.0000	411.9667	791.3633	1135.4470	(98)
Space heating												5609.0471	(98)
Space heating per m2												(98) / (4) =	44.6651 (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	1348.5855	1061.6524	1088.4465	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8406	0.9095	0.8843	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1133.5563	965.6212	962.4948	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1367.5554	1312.8106	1240.0190	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	168.4793	258.3090	206.4780	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												633.2663 (104)
Cooled fraction												1.0000 (105)
fC = cooled area / (4) =												
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	42.1198	64.5772	51.6195	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												158.3166 (107)
Space cooling per m2												1.2607 (108)
Energy for space heating												44.6651 (99)
Energy for space cooling												1.2607 (108)
Total												45.9258 (109)
Target Fabric Energy Efficiency (TFEE)												52.8 (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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	62.7900 (1b)	x 2.3100 (2b)	= 145.0449 (1b) - (3b)
First floor	62.7900 (1c)	x 2.6900 (2c)	= 168.9051 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	125.5800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 313.9500 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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) = 0.1274 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3774 (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) =		0.3208 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.0000	4.6000	4.4000	4.2000	4.4000	4.0000	4.1000	3.9000	4.0000	4.4000	4.3000	4.6000 (22)
Wind factor	1.2500	1.1500	1.1000	1.0500	1.1000	1.0000	1.0250	0.9750	1.0000	1.1000	1.0750	1.1500 (22a)
Adj infilt rate	0.4010	0.3689	0.3529	0.3368	0.3529	0.3208	0.3288	0.3128	0.3208	0.3529	0.3449	0.3689 (22b)
Effective ac	0.5804	0.5680	0.5623	0.5567	0.5623	0.5515	0.5541	0.5489	0.5515	0.5623	0.5595	0.5680 (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					
Opening Type 1			2.1200	1.1000	2.3320		(26)					
Opening Type 2 (Uw = 1.40)			24.1400	1.3258	32.0038		(27)					
Heat Loss Floor 1			62.7900	0.1600	10.0464		(28a)					
External Wall 1	165.8500	26.2600	139.5900	0.2500	34.8975		(29a)					
External Roof 1	62.7900		62.7900	0.1100	6.9069		(30)					
Total net area of external elements Aum(A, m2)			291.4300				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.1866		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.5963 (36)					
Total fabric heat loss						(33) + (36) =	92.7829 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 60.1314	Feb 58.8520	Mar 58.2522	Apr 57.6791	May 58.2522	Jun 57.1327	Jul 57.4026	Aug 56.8695	Sep 57.1327	Oct 58.2522	Nov 57.9624	Dec 58.8520 (38)
Heat transfer coeff	152.9143	151.6348	151.0351	150.4620	151.0351	149.9156	150.1855	149.6524	149.9156	151.0351	150.7452	151.6348 (39)
Average = Sum(39)m / 12 =												150.8471 (39)
HLP	Jan 1.2177	Feb 1.2075	Mar 1.2027	Apr 1.1981	May 1.2027	Jun 1.1938	Jul 1.1959	Aug 1.1917	Sep 1.1938	Oct 1.2027	Nov 1.2004	Dec 1.2075 (40)
HLP (average)												1.2012 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Average occupancy												2.8825 (42)
Average daily hot water use (litres/day)												102.6602 (43)
Daily hot water use	112.9262	108.8198	104.7134	100.6070	96.5006	92.3941	92.3941	96.5006	100.6070	104.7134	108.8198	112.9262 (44)
Energy conte	167.4663	146.4671	151.1409	131.7683	126.4348	109.1036	101.1006	116.0144	117.3999	136.8183	149.3479	162.1821 (45)
Energy content (annual)										Total = Sum(45)m =		1615.2441 (45)
Distribution loss (46)m = 0.15 x (45)m	25.1199	21.9701	22.6711	19.7652	18.9652	16.3655	15.1651	17.4022	17.6100	20.5227	22.4022	24.3273 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	26.6948	24.0367	26.4401	25.3611	25.9857	24.8781	25.5396	25.8288	25.1369	26.2167	25.6353	26.6124 (61)
Total heat required for water heating calculated for each month	194.1611	170.5037	177.5810	157.1294	152.4205	133.9817	126.6401	141.8432	142.5369	163.0350	174.9832	188.7945 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)
Output from w/h	194.1611	170.5037	177.5810	157.1294	152.4205	133.9817	126.6401	141.8432	142.5369	163.0350	174.9832	188.7945 (64)
Total per year (kWh/year) = Sum(64)m =												1923.6104 (64)

RHI water heating demand 1924 (64)
 Heat gains from water heating, kWh/month
 62.3562 54.7095 56.8644 50.1532 48.5360 42.4965 40.0008 45.0320 45.3197 52.0463 56.0670 60.5787 (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	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.9115	58.5420	47.6096	36.0435	26.9430	22.7464	24.5783	31.9478	42.8802	54.4463	63.5468	67.7434 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	436.2841	440.8114	429.4028	405.1153	374.4568	345.6420	326.3920	321.8648	333.2733	357.5608	388.2194	417.0341 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777 (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)	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013 (71)
Water heating gains (Table 5)	83.8121	81.4129	76.4306	69.6573	65.2366	59.0229	53.7645	60.5269	62.9440	69.9547	77.8708	81.4229 (72)
Total internal gains	701.8362	696.5947	669.2714	626.6445	582.4647	543.2397	520.5632	530.1678	554.9260	597.7901	645.4655	682.0288 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g Specific data or Table 6c	FF Specific data or Table 6c	Access factor Table 6d	Gains W		
North				9.5100	14.6401	0.6300		0.7000	0.7700	42.5496 (74)		
East				1.2600	27.3735	0.6300		0.7000	0.7700	10.5408 (76)		
South				12.1100	61.3950	0.6300		0.7000	0.7700	227.2212 (78)		
West				1.2600	27.3735	0.6300		0.7000	0.7700	10.5408 (80)		
Solar gains	290.8523	412.4026	562.0328	738.1033	818.3041	885.1027	842.4905	760.5310	655.2372	484.8410	333.5636	241.8339 (83)
Total gains	992.6885	1108.9973	1231.3042	1364.7478	1400.7688	1428.3424	1363.0537	1290.6988	1210.1631	1082.6311	979.0291	923.8628 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	57.0309	57.5121	57.7404	57.9604	57.7404	58.1716	58.0671	58.2739	58.1716	57.7404	57.8515	57.5121
alpha	4.8021	4.8341	4.8494	4.8640	4.8494	4.8781	4.8711	4.8849	4.8781	4.8494	4.8568	4.8341
util living area	0.9908	0.9847	0.9647	0.9039	0.7743	0.5508	0.3940	0.3917	0.6625	0.9018	0.9783	0.9928 (86)
MIT	19.9869	20.1024	20.3584	20.6653	20.8860	20.9831	20.9973	20.9976	20.9608	20.7387	20.3357	19.9730 (87)
Th 2	19.9059	19.9140	19.9178	19.9215	19.9178	19.9250	19.9233	19.9267	19.9250	19.9178	19.9197	19.9140 (88)
util rest of house	0.9876	0.9795	0.9526	0.8715	0.7047	0.4486	0.2776	0.2694	0.5561	0.8582	0.9691	0.9901 (89)
MIT 2	18.5997	18.7716	19.1391	19.5594	19.8224	19.9167	19.9227	19.9262	19.9029	19.6612	19.1138	18.5857 (90)
Living area fraction	fLA = Living area / (4) =											0.1234 (91)
MIT	18.7709	18.9358	19.2896	19.6959	19.9537	20.0483	20.0553	20.0584	20.0335	19.7942	19.2646	18.7569 (92)
Temperature adjustment												0.0000
adjusted MIT	18.7709	18.9358	19.2896	19.6959	19.9537	20.0483	20.0553	20.0584	20.0335	19.7942	19.2646	18.7569 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9827	0.9730	0.9433	0.8635	0.7072	0.4608	0.2921	0.2846	0.5676	0.8521	0.9615	0.9860 (94)
Useful gains	975.5606	1079.0325	1161.5392	1178.4189	990.6413	658.1226	398.0801	367.3378	686.9174	922.4663	941.3426	910.9523 (95)
Ext temp.	5.6000	5.8000	7.4000	9.8000	12.8000	15.6000	17.4000	17.6000	15.3000	12.2000	8.7000	5.8000 (96)
Heat loss rate W	2014.0186	1991.8474	1795.7494	1488.9571	1080.4564	666.8767	398.7892	367.9101	709.6186	1146.9833	1592.5646	1964.7157 (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	772.6127	613.4116	471.8524	223.5875	66.8224	0.0000	0.0000	0.0000	0.0000	167.0407	468.8799	784.0000 (98)
Space heating												3568.2072 (98)
RHI space heating demand												3568 (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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	62.7900 (1b)	x 2.3100 (2b)	= 145.0449 (1b) - (3b)
First floor	62.7900 (1c)	x 2.6900 (2c)	= 168.9051 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	125.5800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 313.9500 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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) = 0.1274 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3774 (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) =		0.3208 (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	0.4090	0.4010	0.3930	0.3529	0.3449	0.3048	0.3048	0.2967	0.3208	0.3449	0.3609	0.3769 (22b)
Effective ac	0.5836	0.5804	0.5772	0.5623	0.5595	0.5464	0.5464	0.5440	0.5515	0.5595	0.5651	0.5710 (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					
Opening Type 1			2.1200	1.1000	2.3320		(26)					
Opening Type 2 (Uw = 1.40)			24.1400	1.3258	32.0038		(27)					
Heat Loss Floor 1			62.7900	0.1600	10.0464		(28a)					
External Wall 1	165.8500	26.2600	139.5900	0.2500	34.8975		(29a)					
External Roof 1	62.7900		62.7900	0.1100	6.9069		(30)					
Total net area of external elements Aum(A, m2)			291.4300				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.1866		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.5963 (36)					
Total fabric heat loss						(33) + (36) =	92.7829 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 60.4679	Feb 60.1314	Mar 59.8015	Apr 58.2522	May 57.9624	Jun 56.6130	Jul 56.6130	Aug 56.3631	Sep 57.1327	Oct 57.9624	Nov 58.5488	Dec 59.1618 (38)
Heat transfer coeff	153.2508	152.9143	152.5844	151.0351	150.7452	149.3958	149.3958	149.1459	149.9156	150.7452	151.3316	151.9447 (39)
Average = Sum(39)m / 12 =												151.0337 (39)
HLP	Jan 1.2203	Feb 1.2177	Mar 1.2150	Apr 1.2027	May 1.2004	Jun 1.1896	Jul 1.1896	Aug 1.1877	Sep 1.1938	Oct 1.2004	Nov 1.2051	Dec 1.2099 (40)
HLP (average)												1.2027 (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												2.8825 (42)
Average daily hot water use (litres/day)												102.6602 (43)
Daily hot water use	Jan 112.9262	Feb 108.8198	Mar 104.7134	Apr 100.6070	May 96.5006	Jun 92.3941	Jul 92.3941	Aug 96.5006	Sep 100.6070	Oct 104.7134	Nov 108.8198	Dec 112.9262 (44)
Energy conte	167.4663	146.4671	151.1409	131.7683	126.4348	109.1036	101.1006	116.0144	117.3999	136.8183	149.3479	162.1821 (45)
Energy content (annual)												Total = Sum(45)m = 1615.2441 (45)
Distribution loss (46)m = 0.15 x (45)m	25.1199	21.9701	22.6711	19.7652	18.9652	16.3655	15.1651	17.4022	17.6100	20.5227	22.4022	24.3273 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	26.6948	24.0367	26.4401	25.3611	25.9857	24.8781	25.5396	25.8288	25.1369	26.2167	25.6353	26.6124 (61)
Total heat required for water heating calculated for each month	194.1611	170.5037	177.5810	157.1294	152.4205	133.9817	126.6401	141.8432	142.5369	163.0350	174.9832	188.7945 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)
Output from w/h	194.1611	170.5037	177.5810	157.1294	152.4205	133.9817	126.6401	141.8432	142.5369	163.0350	174.9832	188.7945 (64)
Total per year (kWh/year) = Sum(64)m =												1923.6104 (64)

Heat gains from water heating, kWh/month
62.3562 54.7095 56.8644 50.1532 48.5360 42.4965 40.0008 45.0320 45.3197 52.0463 56.0670 60.5787 (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	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.9115	58.5420	47.6096	36.0435	26.9430	22.7464	24.5783	31.9478	42.8802	54.4463	63.5468	67.7434 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	436.2841	440.8114	429.4028	405.1153	374.4568	345.6420	326.3920	321.8648	333.2733	357.5608	388.2194	417.0341 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777 (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)	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013 (71)
Water heating gains (Table 5)	83.8121	81.4129	76.4306	69.6573	65.2366	59.0229	53.7645	60.5269	62.9440	69.9547	77.8708	81.4229 (72)
Total internal gains	701.8362	696.5947	669.2714	626.6445	582.4647	543.2397	520.5632	530.1678	554.9260	597.7901	645.4655	682.0288 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W
North					9.5100	10.6334	0.6300	0.7000			0.7700	30.9047 (74)
East					1.2600	19.6403	0.6300	0.7000			0.7700	7.5629 (76)
South					12.1100	46.7521	0.6300	0.7000			0.7700	173.0282 (78)
West					1.2600	19.6403	0.6300	0.7000			0.7700	7.5629 (80)
Solar gains	219.0587	372.0253	510.0577	640.2445	729.3848	730.7624	701.6717	633.3183	554.4133	411.0611	262.0824	187.7147 (83)
Total gains	920.8949	1068.6200	1179.3291	1266.8890	1311.8495	1274.0021	1222.2350	1163.4861	1109.3392	1008.8512	907.5479	869.7435 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	56.9056	57.0309	57.1542	57.7404	57.8515	58.3740	58.3740	58.4718	58.1716	57.8515	57.6273	57.3948
util living area	4.7937	4.8021	4.8103	4.8494	4.8568	4.8916	4.8916	4.8981	4.8781	4.8568	4.8418	4.8263
	0.9952	0.9896	0.9768	0.9412	0.8556	0.6941	0.5255	0.5706	0.7996	0.9547	0.9902	0.9963 (86)
MIT	19.7870	19.9625	20.2161	20.5295	20.7928	20.9467	20.9889	20.9835	20.8907	20.5519	20.1079	19.7526 (87)
Th 2	19.9038	19.9059	19.9080	19.9178	19.9197	19.9283	19.9283	19.9299	19.9250	19.9197	19.9160	19.9121 (88)
util rest of house	0.9936	0.9862	0.9688	0.9202	0.8048	0.5998	0.4038	0.4473	0.7181	0.9341	0.9864	0.9951 (89)
MIT 2	18.3072	18.5634	18.9301	19.3772	19.7207	19.8936	19.9243	19.9234	19.8417	19.4176	18.7835	18.2631 (90)
Living area fraction									fLA = Living area / (4) =			0.1234 (91)
MIT	18.4898	18.7361	19.0889	19.5195	19.8530	20.0236	20.0557	20.0542	19.9712	19.5576	18.9469	18.4469 (92)
Temperature adjustment												0.0000
adjusted MIT	18.4898	18.7361	19.0889	19.5195	19.8530	20.0236	20.0557	20.0542	19.9712	19.5576	18.9469	18.4469 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9906	0.9810	0.9608	0.9105	0.8011	0.6088	0.4188	0.4623	0.7221	0.9250	0.9814	0.9926 (94)
Useful gains	912.2021	1048.3332	1133.0427	1153.5632	1050.9674	775.6153	511.8405	537.8730	801.0750	933.2168	890.6411	863.3299 (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	2174.6047	2115.7379	1920.8631	1603.9119	1229.0273	810.2558	516.2705	545.0136	880.1844	1350.3218	1792.8165	2164.7475 (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	939.2275	717.2960	586.1384	324.2511	132.4766	0.0000	0.0000	0.0000	0.0000	310.3261	649.5663	968.2546 (98)
Space heating												4627.5367 (98)
Space heating per m2										(98) / (4) =		36.8493 (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 %)												92.8000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												4986.5697 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	939.2275	717.2960	586.1384	324.2511	132.4766	0.0000	0.0000	0.0000	0.0000	310.3261	649.5663	968.2546 (98)
Space heating efficiency (main heating system 1)	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000 (210)
Space heating fuel (main heating system)	1012.0986	772.9483	631.6147	349.4085	142.7550	0.0000	0.0000	0.0000	0.0000	334.4031	699.9637	1043.3778 (211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)

Water heating													
Water heating requirement	194.1611	170.5037	177.5810	157.1294	152.4205	133.9817	126.6401	141.8432	142.5369	163.0350	174.9832	188.7945 (64)	
Efficiency of water heater												87.3000 (216)	
(217)m	89.3616	89.3088	89.2060	88.9684	88.4450	87.3000	87.3000	87.3000	87.3000	88.9229	89.2576	89.3823 (217)	
Fuel for water heating, kWh/month	217.2757	190.9148											
Water heating fuel used			199.0685	176.6126	172.3338	153.4727	145.0631	162.4779	163.2725	183.3442	196.0430	211.2213 (219)	
Annual totals kWh/year												2171.1001 (219)	
Space heating fuel - main system												4986.5697 (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)												465.6073 (232)	
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.00 * 1029 * 1.00) =										-823.3494		-823.3494 (233)	
Total delivered energy for all uses												6874.9277 (238)	

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4986.5697	3.4800	173.5326 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2171.1001	3.4800	75.5543 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	465.6073	13.1900	61.4136 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-823.3494	13.1900	-108.5998 (252)
Total energy cost			331.7932 (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] =	0.8169 (257)
SAP value		88.6037
SAP rating (Section 12)		89 (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	4986.5697	0.2160	1077.0991 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2171.1001	0.2160	468.9576 (264)
Space and water heating			1546.0567 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	465.6073	0.5190	241.6502 (268)
Energy saving/generation technologies			
PV Unit	-823.3494	0.5190	-427.3183 (269)
Total kg/year			1399.3136 (272)
CO2 emissions per m2			11.1400 (273)
EI value			89.0076
EI rating			89 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.8980 = 3.875$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.8980 = 0.2405$, stars = 4
Water heating energy efficiency	$3.48 / 0.8850 = 3.932$, stars = 4
Water heating environmental impact	$0.216 / 0.8850 = 0.2441$, 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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	62.7900 (1b)	x 2.3100 (2b)	= 145.0449 (1b) - (3b)
First floor	62.7900 (1c)	x 2.6900 (2c)	= 168.9051 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	125.5800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 313.9500 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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) = 0.1274 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3774 (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) =		0.3208 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.0000	4.6000	4.4000	4.2000	4.4000	4.0000	4.1000	3.9000	4.0000	4.4000	4.3000	4.6000 (22)
Wind factor	1.2500	1.1500	1.1000	1.0500	1.1000	1.0000	1.0250	0.9750	1.0000	1.1000	1.0750	1.1500 (22a)
Adj infilt rate	0.4010	0.3689	0.3529	0.3368	0.3529	0.3208	0.3288	0.3128	0.3208	0.3529	0.3449	0.3689 (22b)
Effective ac	0.5804	0.5680	0.5623	0.5567	0.5623	0.5515	0.5541	0.5489	0.5515	0.5623	0.5595	0.5680 (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					
Opening Type 1			2.1200	1.1000	2.3320		(26)					
Opening Type 2 (Uw = 1.40)			24.1400	1.3258	32.0038		(27)					
Heat Loss Floor 1			62.7900	0.1600	10.0464		(28a)					
External Wall 1	165.8500	26.2600	139.5900	0.2500	34.8975		(29a)					
External Roof 1	62.7900		62.7900	0.1100	6.9069		(30)					
Total net area of external elements Aum(A, m2)			291.4300				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.1866		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.5963 (36)					
Total fabric heat loss						(33) + (36) =	92.7829 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 60.1314	Feb 58.8520	Mar 58.2522	Apr 57.6791	May 58.2522	Jun 57.1327	Jul 57.4026	Aug 56.8695	Sep 57.1327	Oct 58.2522	Nov 57.9624	Dec 58.8520 (38)
Heat transfer coeff	152.9143	151.6348	151.0351	150.4620	151.0351	149.9156	150.1855	149.6524	149.9156	151.0351	150.7452	151.6348 (39)
Average = Sum(39)m / 12 =												150.8471 (39)
HLP	Jan 1.2177	Feb 1.2075	Mar 1.2027	Apr 1.1981	May 1.2027	Jun 1.1938	Jul 1.1959	Aug 1.1917	Sep 1.1938	Oct 1.2027	Nov 1.2004	Dec 1.2075 (40)
HLP (average)												1.2012 (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												2.8825 (42)
Average daily hot water use (litres/day)												102.6602 (43)
Daily hot water use	112.9262	108.8198	104.7134	100.6070	96.5006	92.3941	92.3941	96.5006	100.6070	104.7134	108.8198	112.9262 (44)
Energy conte	167.4663	146.4671	151.1409	131.7683	126.4348	109.1036	101.1006	116.0144	117.3999	136.8183	149.3479	162.1821 (45)
Energy content (annual)										Total = Sum(45)m =		1615.2441 (45)
Distribution loss (46)m = 0.15 x (45)m	25.1199	21.9701	22.6711	19.7652	18.9652	16.3655	15.1651	17.4022	17.6100	20.5227	22.4022	24.3273 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	26.6948	24.0367	26.4401	25.3611	25.9857	24.8781	25.5396	25.8288	25.1369	26.2167	25.6353	26.6124 (61)
Total heat required for water heating calculated for each month	194.1611	170.5037	177.5810	157.1294	152.4205	133.9817	126.6401	141.8432	142.5369	163.0350	174.9832	188.7945 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum(63)m =												0.0000 (63)
Output from w/h	194.1611	170.5037	177.5810	157.1294	152.4205	133.9817	126.6401	141.8432	142.5369	163.0350	174.9832	188.7945 (64)
Total per year (kWh/year) = Sum(64)m =												1923.6104 (64)

Heat gains from water heating, kWh/month
62.3562 54.7095 56.8644 50.1532 48.5360 42.4965 40.0008 45.0320 45.3197 52.0463 56.0670 60.5787 (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	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	65.9115	58.5420	47.6096	36.0435	26.9430	22.7464	24.5783	31.9478	42.8802	54.4463	63.5468	67.7434 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	436.2841	440.8114	429.4028	405.1153	374.4568	345.6420	326.3920	321.8648	333.2733	357.5608	388.2194	417.0341 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777 (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)	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013 (71)
Water heating gains (Table 5)	83.8121	81.4129	76.4306	69.6573	65.2366	59.0229	53.7645	60.5269	62.9440	69.9547	77.8708	81.4229 (72)
Total internal gains	701.8362	696.5947	669.2714	626.6445	582.4647	543.2397	520.5632	530.1678	554.9260	597.7901	645.4655	682.0288 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North					9.5100	14.6401	0.6300		0.7000		0.7700		42.5496 (74)
East					1.2600	27.3735	0.6300		0.7000		0.7700		10.5408 (76)
South					12.1100	61.3950	0.6300		0.7000		0.7700		227.2212 (78)
West					1.2600	27.3735	0.6300		0.7000		0.7700		10.5408 (80)
Solar gains	290.8523	412.4026	562.0328	738.1033	818.3041	885.1027	842.4905	760.5310	655.2372	484.8410	333.5636	241.8339 (83)	
Total gains	992.6885	1108.9973	1231.3042	1364.7478	1400.7688	1428.3424	1363.0537	1290.6988	1210.1631	1082.6311	979.0291	923.8628 (84)	

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	57.0309	57.5121	57.7404	57.9604	57.7404	58.1716	58.0671	58.2739	58.1716	57.7404	57.8515	57.5121
util living area	4.8021	4.8341	4.8494	4.8640	4.8494	4.8781	4.8711	4.8849	4.8781	4.8494	4.8568	4.8341
	0.9908	0.9847	0.9647	0.9039	0.7743	0.5508	0.3940	0.3917	0.6625	0.9018	0.9783	0.9928 (86)
MIT	19.9869	20.1024	20.3584	20.6653	20.8860	20.9831	20.9973	20.9976	20.9608	20.7387	20.3357	19.9730 (87)
Th 2	19.9059	19.9140	19.9178	19.9215	19.9178	19.9250	19.9233	19.9267	19.9250	19.9178	19.9197	19.9140 (88)
util rest of house	0.9876	0.9795	0.9526	0.8715	0.7047	0.4486	0.2776	0.2694	0.5561	0.8582	0.9691	0.9901 (89)
MIT 2	18.5997	18.7716	19.1391	19.5594	19.8224	19.9167	19.9227	19.9262	19.9029	19.6612	19.1138	18.5857 (90)
Living area fraction									fLA = Living area / (4) =			0.1234 (91)
MIT	18.7709	18.9358	19.2896	19.6959	19.9537	20.0483	20.0553	20.0584	20.0335	19.7942	19.2646	18.7569 (92)
Temperature adjustment												0.0000
adjusted MIT	18.7709	18.9358	19.2896	19.6959	19.9537	20.0483	20.0553	20.0584	20.0335	19.7942	19.2646	18.7569 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9827	0.9730	0.9433	0.8635	0.7072	0.4608	0.2921	0.2846	0.5676	0.8521	0.9615	0.9860 (94)
Ext temp.	975.5606	1079.0325	1161.5392	1178.4189	990.6413	658.1226	398.0801	367.3378	686.9174	922.4663	941.3426	910.9523 (95)
Heat loss rate W	5.6000	5.8000	7.4000	9.8000	12.8000	15.6000	17.4000	17.6000	15.3000	12.2000	8.7000	5.8000 (96)
Month fracti	2014.0186	1991.8474	1795.7494	1488.9571	1080.4564	666.8767	398.7892	367.9101	709.6186	1146.9833	1592.5646	1964.7157 (97)
Space heating kWh	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)
	772.6127	613.4116	471.8524	223.5875	66.8224	0.0000	0.0000	0.0000	0.0000	167.0407	468.8799	784.0000 (98)
Space heating												3568.2072 (98)
Space heating per m2										(98) / (4) =		28.4138 (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 %)												92.8000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3845.0509 (211)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	772.6127	613.4116	471.8524	223.5875	66.8224	0.0000	0.0000	0.0000	0.0000	167.0407	468.8799	784.0000 (98)
Space heating efficiency (main heating system 1)	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000 (210)
Space heating fuel (main heating system)	832.5568	661.0039	508.4616	240.9348	72.0069	0.0000	0.0000	0.0000	0.0000	180.0007	505.2585	844.8275 (211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)

Water heating													
Water heating requirement	194.1611	170.5037	177.5810	157.1294	152.4205	133.9817	126.6401	141.8432	142.5369	163.0350	174.9832	188.7945 (64)	
Efficiency of water heater												87.3000 (216)	
(217)m	89.2865	89.2441	89.1023	88.7511	88.0471	87.3000	87.3000	87.3000	87.3000	88.5475	89.1065	89.3037 (217)	
Fuel for water heating, kWh/month	217.4585	191.0532	199.3002	177.0451	173.1125	153.4727	145.0631	162.4779	163.2725	184.1215	196.3753	211.4073 (219)	
Water heating fuel used												2174.1599 (219)	
Annual totals kWh/year													
Space heating fuel - main system												3845.0509 (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)												465.6073 (232)	
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.00 * 1239 * 1.00) =												-991.0631	-991.0631 (233)
Total delivered energy for all uses												5568.7550 (238)	

10a. Fuel costs - using BEDF prices (398)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3845.0509	4.2800	164.5682 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2174.1599	4.2800	93.0540 (247)
Pumps and fans for heating	75.0000	15.4400	11.5800 (249)
Energy for lighting	465.6073	15.4400	71.8898 (250)
Additional standing charges			92.0000 (251)
Energy saving/generation technologies			
PV Unit	-991.0631	15.4400	-153.0202 (252)
Total energy cost			280.0718 (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	3845.0509	0.2160	830.5310 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2174.1599	0.2160	469.6185 (264)
Space and water heating			1300.1495 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	465.6073	0.5190	241.6502 (268)
Energy saving/generation technologies			
PV Unit	-991.0631	0.5190	-514.3618 (269)
Total kg/year			1066.3630 (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	3845.0509	1.2200	4690.9621 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2174.1599	1.2200	2652.4751 (264)
Space and water heating			7343.4372 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	465.6073	3.0700	1429.4145 (268)
Energy saving/generation technologies			
PV Unit	-991.0631	3.0700	-3042.5639 (269)
Primary energy kWh/year			5960.5378 (272)
Primary energy kWh/m2/year			47.4641 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 89
Current environmental impact rating: B 89

(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	+ 1.0	-£ 38	-205 kg (19.2%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£38	1.63 kg/m ²	B 90 B 91
Total Savings	£38	1.63 kg/m ²	
Potential energy efficiency rating:		B 90	
Potential environmental impact rating:			B 91

Fuel prices for cost data on this page from database revision number 398 TEST (28 Sep 2016)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, South East England):

	Current	Potential	Saving
Electricity	£83	£91	-£8
Mains gas	£350	£304	£46
Space heating	£268	£268	£0
Water heating	£93	£55	£38
Lighting	£72	£72	£0
Generated (PV)	-£153	-£153	£0
Total cost of fuels	£280	£242	£38
Total cost of uses	£280	£242	£38
Delivered energy	44 kWh/m ²	36 kWh/m ²	8 kWh/m ²
Carbon dioxide emissions	1.1 tonnes	0.9 tonnes	0.2 tonnes
CO2 emissions per m ²	8 kg/m ²	7 kg/m ²	2 kg/m ²
Primary energy	47 kWh/m ²	38 kWh/m ²	9 kWh/m ²

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	62.7900 (1b)	x 2.3100 (2b)	= 145.0449 (1b) - (3b)
First floor	62.7900 (1c)	x 2.6900 (2c)	= 168.9051 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	125.5800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 313.9500 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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) = 0.1274 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3774 (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) =	0.3208 (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	0.4090	0.4010	0.3930	0.3529	0.3449	0.3048	0.3048	0.2967	0.3208	0.3449	0.3609	0.3769 (22b)
Effective ac	0.5836	0.5804	0.5772	0.5623	0.5595	0.5464	0.5464	0.5440	0.5515	0.5595	0.5651	0.5710 (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					
Opening Type 1			2.1200	1.1000	2.3320		(26)					
Opening Type 2 (Uw = 1.40)			24.1400	1.3258	32.0038		(27)					
Heat Loss Floor 1			62.7900	0.1600	10.0464		(28a)					
External Wall 1	165.8500	26.2600	139.5900	0.2500	34.8975		(29a)					
External Roof 1	62.7900		62.7900	0.1100	6.9069		(30)					
Total net area of external elements Aum(A, m2)			291.4300				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.1866		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.5963 (36)					
Total fabric heat loss						(33) + (36) =	92.7829 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	60.4679	60.1314	59.8015	58.2522	57.9624	56.6130	56.6130	56.3631	57.1327	57.9624	58.5488	59.1618 (38)
Heat transfer coeff	153.2508	152.9143	152.5844	151.0351	150.7452	149.3958	149.3958	149.1459	149.9156	150.7452	151.3316	151.9447 (39)
Average = Sum(39)m / 12 =												151.0337 (39)
HLP	1.2203	1.2177	1.2150	1.2027	1.2004	1.1896	1.1896	1.1877	1.1938	1.2004	1.2051	1.2099 (40)
HLP (average)												1.2027 (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												2.8825 (42)
Average daily hot water use (litres/day)												102.6602 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.9262	108.8198	104.7134	100.6070	96.5006	92.3941	92.3941	96.5006	100.6070	104.7134	108.8198	112.9262 (44)
Energy conte	167.4663	146.4671	151.1409	131.7683	126.4348	109.1036	101.1006	116.0144	117.3999	136.8183	149.3479	162.1821 (45)
Energy content (annual)												Total = Sum(45)m = 1615.2441 (45)
Distribution loss (46)m = 0.15 x (45)m	25.1199	21.9701	22.6711	19.7652	18.9652	16.3655	15.1651	17.4022	17.6100	20.5227	22.4022	24.3273 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	26.6948	24.0367	26.4401	25.3611	25.9857	24.8781	25.5396	25.8288	25.1369	26.2167	25.6353	26.6124 (61)
Total heat required for water heating calculated for each month	194.1611	170.5037	177.5810	157.1294	152.4205	133.9817	126.6401	141.8432	142.5369	163.0350	174.9832	188.7945 (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													1.1228 (H8)
Utilisation factor													0.5896 (H9)
Collector performance factor													0.8793 (H10)
Dedicated solar storage volume													75.0000 (H11)
Effective solar volume													75.0000 (H13)
Daily hot water demand													102.6602 (H14)
Volume ratio Veff/V													0.7306 (H15)
Solar storage volume factor													0.9372 (H16)
Solar input													-881.1967 (H17)
Solar input	-25.5529	-42.6405	-72.6217	-97.3274	-120.2398	-118.2149	-116.6526	-101.9200	-79.8238	-54.5102	-30.3095	-21.3835 (63)	
Solar input	(sum of months) = Sum(63)m =												-881.1967 (63)
Output from w/h													
	168.6081	127.8632	104.9593	59.8020	32.1807	15.7668	9.9875	39.9232	62.7131	108.5248	144.6737	167.4111 (64)	
	Total per year (kWh/year) = Sum(64)m =												1042.4137 (64)
Heat gains from water heating, kWh/month													
	62.3562	54.7095	56.8644	50.1532	48.5360	42.4965	40.0008	45.0320	45.3197	52.0463	56.0670	60.5787 (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	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	65.9115	58.5420	47.6096	36.0435	26.9430	22.7464	24.5783	31.9478	42.8802	54.4463	63.5468	67.7434 (67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	436.2841	440.8114	429.4028	405.1153	374.4568	345.6420	326.3920	321.8648	333.2733	357.5608	388.2194	417.0341 (68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777 (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)													
	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013 (71)	
Water heating gains (Table 5)													
	83.8121	81.4129	76.4306	69.6573	65.2366	59.0229	53.7645	60.5269	62.9440	69.9547	77.8708	81.4229 (72)	
Total internal gains													
	701.8362	696.5947	669.2714	626.6445	582.4647	543.2397	520.5632	530.1678	554.9260	597.7901	645.4655	682.0288 (73)	

6. Solar gains

[Jan]													
			Area		Solar flux		g		FF		Access		Gains
			m2		Table 6a		or Table 6b		or Table 6c		factor		W
					W/m2						Table 6d		
North			9.5100		10.6334		0.6300		0.7000		0.7700		30.9047 (74)
East			1.2600		19.6403		0.6300		0.7000		0.7700		7.5629 (76)
South			12.1100		46.7521		0.6300		0.7000		0.7700		173.0282 (78)
West			1.2600		19.6403		0.6300		0.7000		0.7700		7.5629 (80)
Solar gains	219.0587	372.0253	510.0577	640.2445	729.3848	730.7624	701.6717	633.3183	554.4133	411.0611	262.0824	187.7147 (83)	
Total gains	920.8949	1068.6200	1179.3291	1266.8890	1311.8495	1274.0021	1222.2350	1163.4861	1109.3392	1008.8512	907.5479	869.7435 (84)	

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.9056	57.0309	57.1542	57.7404	57.8515	58.3740	58.3740	58.4718	58.1716	57.8515	57.6273	57.3948	
alpha	4.7937	4.8021	4.8103	4.8494	4.8568	4.8916	4.8916	4.8981	4.8781	4.8568	4.8418	4.8263	
util living area													
	0.9952	0.9896	0.9768	0.9412	0.8556	0.6941	0.5255	0.5706	0.7996	0.9547	0.9902	0.9963 (86)	
MIT	19.7870	19.9625	20.2161	20.5295	20.7928	20.9467	20.9889	20.9835	20.8907	20.5519	20.1079	19.7526 (87)	
Th 2	19.9038	19.9059	19.9080	19.9178	19.9197	19.9283	19.9283	19.9299	19.9250	19.9197	19.9160	19.9121 (88)	
util rest of house													
	0.9936	0.9862	0.9688	0.9202	0.8048	0.5998	0.4038	0.4473	0.7181	0.9341	0.9864	0.9951 (89)	
MIT 2	18.3072	18.5634	18.9301	19.3772	19.7207	19.8936	19.9243	19.9234	19.8417	19.4176	18.7835	18.2631 (90)	
Living area fraction													
	18.4898	18.7361	19.0889	19.5195	19.8530	20.0236	20.0557	20.0542	19.9712	19.5576	18.9469	18.4469 (91)	
Temperature adjustment													
	18.4898	18.7361	19.0889	19.5195	19.8530	20.0236	20.0557	20.0542	19.9712	19.5576	18.9469	18.4469 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9906	0.9810	0.9608	0.9105	0.8011	0.6088	0.4188	0.4623	0.7221	0.9250	0.9814	0.9926 (94)	
Useful gains	912.2021	1048.3332	1133.0427	1153.5632	1050.9674	775.6153	511.8405	537.8730	801.0750	933.2168	890.6411	863.3299 (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													
	2174.6047	2115.7379	1920.8631	1603.9119	1229.0273	810.2558	516.2705	545.0136	880.1844	1350.3218	1792.8165	2164.7475 (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													
	939.2275	717.2960	586.1384	324.2511	132.4766	0.0000	0.0000	0.0000	0.0000	310.3261	649.5663	968.2546 (98)	
Space heating													
													4627.5367 (98)
Space heating per m2													
													(98) / (4) =
													36.8493 (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 %)												92.8000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												4986.5697 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	939.2275	717.2960	586.1384	324.2511	132.4766	0.0000	0.0000	0.0000	0.0000	310.3261	649.5663	968.2546 (98)
Space heating efficiency (main heating system 1)	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000 (210)
Space heating fuel (main heating system)	1012.0986	772.9483	631.6147	349.4085	142.7550	0.0000	0.0000	0.0000	0.0000	334.4031	699.9637	1043.3778 (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 requirement	168.6081	127.8632	104.9593	59.8020	32.1807	15.7668	9.9875	39.9232	62.7131	108.5248	144.6737	167.4111 (64)
Efficiency of water heater (217)m	89.4103	89.4126	89.4111	89.4013	89.3002	87.3000	87.3000	87.3000	87.3000	89.1386	89.3340	87.3000 (216)
Fuel for water heating, kWh/month	188.5780	143.0035	117.3896	66.8916	36.0366	18.0605	11.4404	45.7311	71.8363	121.7484	161.9470	89.4225 (217)
Water heating fuel used												187.2136 (219)
Annual totals kWh/year												1169.8765 (219)
Space heating fuel - main system												4986.5697 (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)
pump for solar water heating												50.0000 (230g)
Total electricity for the above, kWh/year												125.0000 (231)
Electricity for lighting (calculated in Appendix L)												465.6073 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.00 * 1029 * 1.00) =										-823.3494		-823.3494 (233)
Total delivered energy for all uses												5923.7042 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4986.5697	3.4800	173.5326 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1169.8765	3.4800	40.7117 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Pump for solar water heating	50.0000	13.1900	6.5950 (249)
Energy for lighting	465.6073	13.1900	61.4136 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-823.3494	13.1900	-108.5998 (252)
Total energy cost			303.5457 (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] = 0.7474 (257)
SAP value	89.5740
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	4986.5697	0.2160	1077.0991 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1169.8765	0.2160	252.6933 (264)
Space and water heating			1329.7924 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	465.6073	0.5190	241.6502 (268)
Energy saving/generation technologies			
PV Unit	-823.3494	0.5190	-427.3183 (269)
Total kg/year			1208.9993 (272)
CO2 emissions per m2			9.6300 (273)
EI value			90.5026
EI rating			91 (274)
EI band			B

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	62.7900 (1b)	x 2.3100 (2b)	= 145.0449 (1b) - (3b)
First floor	62.7900 (1c)	x 2.6900 (2c)	= 168.9051 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	125.5800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 313.9500 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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) = 0.1274 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3774 (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) =		0.3208 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.0000	4.6000	4.4000	4.2000	4.4000	4.0000	4.1000	3.9000	4.0000	4.4000	4.3000	4.6000 (22)
Wind factor	1.2500	1.1500	1.1000	1.0500	1.1000	1.0000	1.0250	0.9750	1.0000	1.1000	1.0750	1.1500 (22a)
Adj infilt rate	0.4010	0.3689	0.3529	0.3368	0.3529	0.3208	0.3288	0.3128	0.3208	0.3529	0.3449	0.3689 (22b)
Effective ac	0.5804	0.5680	0.5623	0.5567	0.5623	0.5515	0.5541	0.5489	0.5515	0.5623	0.5595	0.5680 (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					
Opening Type 1			2.1200	1.1000	2.3320		(26)					
Opening Type 2 (Uw = 1.40)			24.1400	1.3258	32.0038		(27)					
Heat Loss Floor 1			62.7900	0.1600	10.0464		(28a)					
External Wall 1	165.8500	26.2600	139.5900	0.2500	34.8975		(29a)					
External Roof 1	62.7900		62.7900	0.1100	6.9069		(30)					
Total net area of external elements Aum(A, m2)			291.4300				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	86.1866		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							6.5963 (36)					
Total fabric heat loss						(33) + (36) =	92.7829 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	60.1314	58.8520	58.2522	57.6791	58.2522	57.1327	57.4026	56.8695	57.1327	58.2522	57.9624	58.8520 (38)
Heat transfer coeff	152.9143	151.6348	151.0351	150.4620	151.0351	149.9156	150.1855	149.6524	149.9156	151.0351	150.7452	151.6348 (39)
Average = Sum(39)m / 12 =												150.8471 (39)
HLP	1.2177	1.2075	1.2027	1.1981	1.2027	1.1938	1.1959	1.1917	1.1938	1.2027	1.2004	1.2075 (40)
HLP (average)												1.2012 (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												2.8825 (42)
Average daily hot water use (litres/day)												102.6602 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.9262	108.8198	104.7134	100.6070	96.5006	92.3941	92.3941	96.5006	100.6070	104.7134	108.8198	112.9262 (44)
Energy conte	167.4663	146.4671	151.1409	131.7683	126.4348	109.1036	101.1006	116.0144	117.3999	136.8183	149.3479	162.1821 (45)
Energy content (annual)										Total = Sum(45)m =		1615.2441 (45)
Distribution loss (46)m = 0.15 x (45)m	25.1199	21.9701	22.6711	19.7652	18.9652	16.3655	15.1651	17.4022	17.6100	20.5227	22.4022	24.3273 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	26.6948	24.0367	26.4401	25.3611	25.9857	24.8781	25.5396	25.8288	25.1369	26.2167	25.6353	26.6124 (61)
Total heat required for water heating calculated for each month	194.1611	170.5037	177.5810	157.1294	152.4205	133.9817	126.6401	141.8432	142.5369	163.0350	174.9832	188.7945 (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													1293.6477 (H5)
Overshading factor													0.8000 (H6)
Solar energy available													2173.3282 (H7)
Adjustment factor for showers													1.0000 (H7a)
Solar-to-load ratio													1.3455 (H8)
Utilisation factor													0.5244 (H9)
Collector performance factor													0.8793 (H10)
Dedicated solar storage volume													75.0000 (H11)
Effective solar volume													75.0000 (H13)
Daily hot water demand													102.6602 (H14)
Volume ratio Veff/V													0.7306 (H15)
Solar storage volume factor													0.9372 (H16)
Solar input													-939.2333 (H17)
Solar input	-31.0466	-43.2820	-73.0375	-101.5381	-121.1149	-128.1282	-125.5125	-110.3741	-85.8520	-58.8374	-35.3142		-25.1958 (63)
								Solar input	(sum of months) =	Sum(63)m =			-939.2333 (63)
Output from w/h													
	163.1145	127.2217	104.5436	55.5912	31.3056	5.8535	1.1276	31.4691	56.6848	104.1976	139.6690	163.5987 (64)	
								Total per year (kWh/year) =	Sum(64)m =				984.3771 (64)
Heat gains from water heating, kWh/month													
	62.3562	54.7095	56.8644	50.1532	48.5360	42.4965	40.0008	45.0320	45.3197	52.0463	56.0670	60.5787 (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	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	172.9520	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	65.9115	58.5420	47.6096	36.0435	26.9430	22.7464	24.5783	31.9478	42.8802	54.4463	63.5468	67.7434 (67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	436.2841	440.8114	429.4028	405.1153	374.4568	345.6420	326.3920	321.8648	333.2733	357.5608	388.2194	417.0341 (68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777	55.1777 (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)													
	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013	-115.3013 (71)	
Water heating gains (Table 5)													
	83.8121	81.4129	76.4306	69.6573	65.2366	59.0229	53.7645	60.5269	62.9440	69.9547	77.8708	81.4229 (72)	
Total internal gains													
	701.8362	696.5947	669.2714	626.6445	582.4647	543.2397	520.5632	530.1678	554.9260	597.7901	645.4655	682.0288 (73)	

6. Solar gains

[Jan]													
			Area		Solar flux		g		FF		Access		Gains
			m2		Table 6a		or Table 6b		Specific data		factor		W
					W/m2				or Table 6c		Table 6d		
North			9.5100		14.6401		0.6300		0.7000		0.7700		42.5496 (74)
East			1.2600		27.3735		0.6300		0.7000		0.7700		10.5408 (76)
South			12.1100		61.3950		0.6300		0.7000		0.7700		227.2212 (78)
West			1.2600		27.3735		0.6300		0.7000		0.7700		10.5408 (80)
Solar gains	290.8523	412.4026	562.0328	738.1033	818.3041	885.1027	842.4905	760.5310	655.2372	484.8410	333.5636	241.8339 (83)	
Total gains	992.6885	1108.9973	1231.3042	1364.7478	1400.7688	1428.3424	1363.0537	1290.6988	1210.1631	1082.6311	979.0291	923.8628 (84)	

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.0309	57.5121	57.7404	57.9604	57.7404	58.1716	58.0671	58.2739	58.1716	57.7404	57.8515	57.5121	
alpha	4.8021	4.8341	4.8494	4.8640	4.8494	4.8781	4.8711	4.8849	4.8781	4.8494	4.8568	4.8341	
util living area													
	0.9908	0.9847	0.9647	0.9039	0.7743	0.5508	0.3940	0.3917	0.6625	0.9018	0.9783	0.9928 (86)	
MIT	19.9869	20.1024	20.3584	20.6653	20.8860	20.9831	20.9973	20.9976	20.9608	20.7387	20.3357	19.9730 (87)	
Th 2	19.9059	19.9140	19.9178	19.9215	19.9178	19.9250	19.9233	19.9267	19.9250	19.9178	19.9197	19.9140 (88)	
util rest of house													
	0.9876	0.9795	0.9526	0.8715	0.7047	0.4486	0.2776	0.2694	0.5561	0.8582	0.9691	0.9901 (89)	
MIT 2	18.5997	18.7716	19.1391	19.5594	19.8224	19.9167	19.9227	19.9262	19.9029	19.6612	19.1138	18.5857 (90)	
Living area fraction									fLA =	Living area / (4) =		0.1234 (91)	
MIT	18.7709	18.9358	19.2896	19.6959	19.9537	20.0483	20.0553	20.0584	20.0335	19.7942	19.2646	18.7569 (92)	
Temperature adjustment												0.0000	
adjusted MIT	18.7709	18.9358	19.2896	19.6959	19.9537	20.0483	20.0553	20.0584	20.0335	19.7942	19.2646	18.7569 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9827	0.9730	0.9433	0.8635	0.7072	0.4608	0.2921	0.2846	0.5676	0.8521	0.9615	0.9860 (94)	
Useful gains	975.5606	1079.0325	1161.5392	1178.4189	990.6413	658.1226	398.0801	367.3378	686.9174	922.4663	941.3426	910.9523 (95)	
Ext temp.	5.6000	5.8000	7.4000	9.8000	12.8000	15.6000	17.4000	17.6000	15.3000	12.2000	8.7000	5.8000 (96)	
Heat loss rate W													
	2014.0186	1991.8474	1795.7494	1488.9571	1080.4564	666.8767	398.7892	367.9101	709.6186	1146.9833	1592.5646	1964.7157 (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													
	772.6127	613.4116	471.8524	223.5875	66.8224	0.0000	0.0000	0.0000	0.0000	167.0407	468.8799	784.0000 (98)	
Space heating												3568.2072 (98)	
Space heating per m2												(98) / (4) =	28.4138 (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 %)												92.8000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3845.0509 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	772.6127	613.4116	471.8524	223.5875	66.8224	0.0000	0.0000	0.0000	0.0000	167.0407	468.8799	784.0000 (98)
Space heating efficiency (main heating system 1)	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000 (210)
Space heating fuel (main heating system)	832.5568	661.0039	508.4616	240.9348	72.0069	0.0000	0.0000	0.0000	0.0000	180.0007	505.2585	844.8275 (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 requirement	163.1145	127.2217	104.5436	55.5912	31.3056	5.8535	1.1276	31.4691	56.6848	104.1976	139.6690	163.5987 (64)
Efficiency of water heater (217)m	89.3540	89.3604	89.3360	89.2908	88.9870	87.3000	87.3000	87.3000	87.3000	88.8229	89.2136	87.3000 (216)
Fuel for water heating, kWh/month	182.5488	142.3692	117.0229	62.2586	35.1800	6.7051	1.2916	36.0471	64.9311	117.3094	156.5557	183.0819 (219)
Water heating fuel used												1105.3014 (219)
Annual totals kWh/year												
Space heating fuel - main system												3845.0509 (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)
pump for solar water heating												50.0000 (230g)
Total electricity for the above, kWh/year												125.0000 (231)
Electricity for lighting (calculated in Appendix L)												465.6073 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.00 * 1239 * 1.00) =										-991.0631		-991.0631 (233)
Total delivered energy for all uses												4549.8965 (238)

10a. Fuel costs - using BEDF prices (398)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3845.0509	4.2800	164.5682 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1105.3014	4.2800	47.3069 (247)
Pumps and fans for heating	75.0000	15.4400	11.5800 (249)
Pump for solar water heating	50.0000	15.4400	7.7200 (249)
Energy for lighting	465.6073	15.4400	71.8898 (250)
Additional standing charges			92.0000 (251)
Energy saving/generation technologies			
PV Unit	-991.0631	15.4400	-153.0202 (252)
Total energy cost			242.0447 (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	3845.0509	0.2160	830.5310 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1105.3014	0.2160	238.7451 (264)
Space and water heating			1069.2761 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	465.6073	0.5190	241.6502 (268)
Energy saving/generation technologies			
PV Unit	-991.0631	0.5190	-514.3618 (269)
Total kg/year			861.4395 (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	3845.0509	1.2200	4690.9621 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1105.3014	1.2200	1348.4677 (264)
Space and water heating			6039.4298 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	465.6073	3.0700	1429.4145 (268)
Energy saving/generation technologies			
PV Unit	-991.0631	3.0700	-3042.5639 (269)
Primary energy kWh/year			4810.0305 (272)
Primary energy kWh/m2/year			38.3025 (273)

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

Overheating Calculation Input Data

Dwelling type Detached House

Number of storeys	2
Cross ventilation possible	Yes
SAP Region	South East England
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	250.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	414.41 (P1)
Transmission heat loss coefficient	92.78 (37)
Summer heat loss coefficient	507.20 (P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	Specific data FF or Table 6c	Shading	Gains W
North	9.5100	86.6589	0.6300	0.7000	0.9000	294.3860
East	1.2600	124.7972	0.6300	0.7000	0.9000	56.1693
South	12.1100	118.3991	0.6300	0.7000	0.9000	512.1722
West	1.2600	124.7972	0.6300	0.7000	0.9000	56.1693

total: 918.8968

Solar gains	Jun 969	Jul 919	Aug 833	(P3)
Internal gains	540	518	527	
Total summer gains	1510	1436	1360	(P5)

Summer gain/loss ratio	2.98	2.83	2.68	(P6)
Summer external temperature	15.40	17.40	17.50	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	18.63	20.48	20.43	(P7)

Likelihood of high internal temperature	Not significant	Not significant	Not significant
---	-----------------	-----------------	-----------------

Assessment of likelihood of high internal temperature: Not significant


```

33.      External roof, R1 Head of roof window, , No, 0, 0, 0, 0.00,
34.      External roof, R2 Sill of roof window, , No, 0, 0, 0, 0.00,
35.      External roof, R3 Jamb of roof window, , No, 0, 0, 0, 0.00,
36.      External roof, R4 Ridge (vaulted ceiling), , No, 0, 0, 0, 0.00,
37.      External roof, R5 Ridge (inverted), , No, 0, 0, 0, 0.00,
38.      External roof, R6 Flat ceiling, , No, 0, 0, 0, 0.00,
39.      External roof, R7 Flat ceiling (inverted), , No, 0, 0, 0, 0.00,
40.      External roof, R8 Roof to wall (rafter), , No, 0, 0, 0, 0.00,
41.      External roof, R9 Roof to wall (flat ceiling), , No, 0, 0, 0, 0.00,
Pressure Test:      True
Designed q50:      5.88
AsBuilt q50:      15
Property Tested:      False
Mechanical Ventilation      None
Chimneys MHS:      0
Chimneys SHS:      0
Chimneys Other:      0
Chimneys Total:      0
Open Flues MHS:      0
Open Flues SHS:      0
Open Flues Other:      0
Open Flues Total:      0
Intermittent Fans:      3
Passive Vents:      0
Flueless Gas Fires:      0
Cooling System      None
Light Fittings:      19
LEL Fittings:      19
Percentage of LEL Fittings:      100
External Lights Fitted:      No
External LELs Fitted:      No
Electricity Tariff:      Standard
Main Heating 1
Description
Percentage      100
Sedbuk ID      17045
Fuel Type      Mains gas
MHS      Mains gas BGW Post 98 Combi condens. with auto ign.
SAP Code      104
Boiler Efficiency Type      Split Efficiencies
Efficiency Winter      89.8
Efficiency Summer      87.3
Controls by PCDF      0
MHS Controls      CBI Time and temperature zone control
Boiler Interlock      Yes
Compensator      200002
Delayed Start Stat      No
Ctrl SAP Code      2110
Flue Type      Balanced
Fan Assisted Flue      Yes
Pumped      Pump in heated space
Heat Pump Age      2013 or later
Heat Emitter      Radiators
Flow Temperature      Normal (> 45°C)
Combi boiler type      Standard Combi
Combi keep hot type      None
Main Heating 2      None
Heating Systems Interaction      Each system heats separate parts of dwelling
Smoke Control Area      Unknown
Community Heating      None
Secondary Heating      None
Water Heating
Type      MainHeating1
WHS      HWP From main heating 1
Low Water Usage      Yes
SAP Code      901
Showers in Property      Non-electric only
Hot Water Cylinder      None
Flue Gas Heat Recovery System      None
Waste Water Heat Recovery      none
PV Unit
Type      One Dwelling
PVUnit 1      Cells Peak = 0.75, Orientation = South West, Elevation = 30°, Overshading = None Or Little, , Connected to Dwelling = Yes
Wind Turbine      None
Terrain Type:      Urban
Small Scale Hydro      None
Special Features      None

```

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

DWELLING AS DESIGNED

Semi-Detached House, total floor area 94 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) 17.51 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.09 kg/m²OK

1b TPFE and DFEE

Target Fabric Energy Efficiency (TFEE)51.2 kWh/m²
Dwelling Fabric Energy Efficiency (DFEE)48.1 kWh/m²OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.16 (max. 0.25)	0.16 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.37 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability		
Air permeability at 50 pascals:	5.88 (design value)	
Maximum	10.0	OK

4 Heating efficiency		
Main heating system:	Boiler system with radiators or underfloor - Mains gas	
Data from database		
Ideal Logic Combi ES 35		
Combi boiler		
Efficiency: 88.9% SEDBUK2009		
Minimum: 88.0%	OK	
Secondary heating system:	None	

5 Cylinder insulation		
Hot water storage	No cylinder	

6 Controls		
Space heating controls:	Time and temperature zone control	OK
Hot water controls:	No cylinder	
Boiler interlock	Yes	OK

7 Low energy lights		
Percentage of fixed lights with low-energy fittings:100%		
Minimum	75%	OK

8 Mechanical ventilation		
Not applicable		

9 Summertime temperature		
Overheating risk (South East England):	Not significant	OK
Based on:		
Overshading:	Average	
Windows facing North:	7.65 m ² , No overhang	
Windows facing South:	6.75 m ² , No overhang	
Windows facing West:	1.32 m ² , No overhang	
Air change rate:	4.00 ach	
Blinds/curtains:	None	

10 Key features		
Party wall U-value	0.00 W/m ² K	
Roof U-value	0.11 W/m ² K	
Door U-value	1.10 W/m ² K	
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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7600 (1b)	x 2.3100 (2b)	= 108.0156 (1b) - (3b)
First floor	46.7600 (1c)	x 2.6900 (2c)	= 125.7844 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.8000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1283 (8)
Pressure test					Yes
Measured/design q50					5.8800
Infiltration rate					0.4223 (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) =		0.3590 (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	0.4577	0.4487	0.4397	0.3949	0.3859	0.3410	0.3410	0.3320	0.3590	0.3859	0.4038	0.4218 (22b)
Effective ac	0.6047	0.6007	0.5967	0.5780	0.5745	0.5581	0.5581	0.5551	0.5644	0.5745	0.5815	0.5890 (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
Opening Type 1			2.1200	1.1000	2.3320		(26)
Opening Type 2 (Uw = 1.40)			15.7200	1.3258	20.8409		(27)
Opening Type 3			1.9700	1.4000	2.7580		(26a)
Heat Loss Floor 1			46.7600	0.1600	7.4816		(28a)
External Wall 1	97.1500	19.8100	77.3400	0.2500	19.3350		(29a)
External Roof 1	46.7600		46.7600	0.1100	5.1436		(30)
Total net area of external elements Aum(A, m2)			190.6700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.8911		(33)
Party Wall 1			43.6700	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							
Total fabric heat loss							
						(33) + (36) =	65.9207 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	Jan 46.6579	Feb 46.3441	Mar 46.0365	Apr 44.5918	May 44.3215	Jun 43.0633	Jul 43.0633
Heat transfer coeff	42.8303	43.5479	44.3215	44.8684	45.4400 (38)		
Average = Sum(39)m / 12 =	112.5786	112.2648	111.9572	110.5126	110.2423	108.9840	108.9840
	108.7510	109.4687	110.2423	110.7891	111.3607 (39)	110.5113 (39)	
HLP	Jan 1.2038	Feb 1.2004	Mar 1.1971	Apr 1.1817	May 1.1788	Jun 1.1654	Jul 1.1654
HLP (average)	1.1629	1.1705	1.1788	1.1847	1.1908 (40)	1.1817 (40)	
Days in month	31	28	31	30	31	30	31
							31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6709 (42)
Average daily hot water use (litres/day)												97.6339 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	107.3973	103.4919	99.5866	95.6812	91.7759	87.8705	87.8705	91.7759	95.6812	99.5866	103.4919	107.3973 (44)
Energy content (annual)	159.2671	139.2960	143.7410	125.3169	120.2446	103.7619	96.1507	110.3343	111.6520	130.1197	142.0358	154.2417 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8901	20.8944	21.5612	18.7975	18.0367	15.5643	14.4226	16.5501	16.7478	19.5180	21.3054	23.1363 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	26.5669	23.9248	26.3154	25.1760	25.8039	24.7278	25.4004	25.6620	24.9720	26.1038	25.5213	26.4885 (61)
Total heat required for water heating calculated for each month	185.8340	163.2208	170.0565	150.4929	146.0485	128.4898	121.5510	135.9963	136.6241	156.2235	167.5571	180.7302 (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)
Output from w/h								Solar input (sum of months) = Sum(63)m =				0.0000 (63)

185.8340	163.2208	170.0565	150.4929	146.0485	128.4898	121.5510	135.9963	136.6241	156.2235	167.5571	180.7302 (64)
Total per year (kWh/year) = Sum(64)m =											1842.8246 (64)
Heat gains from water heating, kWh/month											
59.5980	52.2971	54.3727	47.9619	46.4323	40.6828	38.3202	43.1017	43.3673	49.7907	53.6072	57.9075 (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	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	22.6109	20.0828	16.3325	12.3647	9.2428	7.8031	8.4316	10.9597	14.7100	18.6778	21.7997	23.2394 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	245.4067	247.9532	241.5360	227.8745	210.6293	194.4212	183.5932	181.0466	187.4639	201.1254	218.3706	234.5787 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545 (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)												
	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361 (71)
Water heating gains (Table 5)												
	80.1049	77.8231	73.0817	66.6137	62.4090	56.5039	51.5056	57.9323	60.2324	66.9230	74.4545	77.8326 (72)
Total internal gains												
	414.1860	411.9227	397.0136	372.9164	348.3445	324.7917	309.5939	316.0021	328.4698	352.7897	380.6883	401.7142 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North				7.6500	10.6334	0.6300		0.7000	0.7700		24.8602 (74)	
South				6.7500	46.7521	0.6300		0.7000	0.7700		96.4443 (78)	
West				1.3200	19.6403	0.6300		0.7000	0.7700		7.9231 (80)	
Solar gains	129.2276	220.9592	307.4560	394.3004	457.2696	461.7516	441.8688	393.0931	336.9284	245.3094	154.8668	110.5770 (83)
Total gains	543.4136	632.8819	704.4696	767.2169	805.6141	786.5433	751.4627	709.0953	665.3982	598.0991	535.5551	512.2912 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	57.6881	57.8493	58.0083	58.7666	58.9107	59.5908	59.5908	59.7185	59.3270	58.9107	58.6199	58.3190
alpha	4.8459	4.8566	4.8672	4.9178	4.9274	4.9727	4.9727	4.9812	4.9551	4.9274	4.9080	4.8879
util living area												
	0.9983	0.9960	0.9902	0.9712	0.9141	0.7789	0.6116	0.6638	0.8801	0.9802	0.9963	0.9987 (86)
MIT												
	19.6698	19.8287	20.0782	20.4088	20.7115	20.9150	20.9800	20.9704	20.8302	20.4403	19.9957	19.6451 (87)
Th 2												
	19.9170	19.9197	19.9223	19.9347	19.9370	19.9478	19.9478	19.9498	19.9436	19.9370	19.9323	19.9274 (88)
util rest of house												
	0.9977	0.9946	0.9865	0.9594	0.8769	0.6891	0.4786	0.5321	0.8153	0.9699	0.9948	0.9983 (89)
MIT 2												
	18.1458	18.3796	18.7443	19.2278	19.6420	19.8880	19.9401	19.9370	19.8012	19.2797	18.6331	18.1170 (90)
Living area fraction												
									fLA = Living area / (4) =			0.2042 (91)
MIT												
	18.4570	18.6755	19.0168	19.4690	19.8604	20.0977	20.1525	20.1480	20.0114	19.5167	18.9114	18.4291 (92)
Temperature adjustment												
												0.0000
adjusted MIT												
	18.4570	18.6755	19.0168	19.4690	19.8604	20.0977	20.1525	20.1480	20.0114	19.5167	18.9114	18.4291 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9964	0.9923	0.9822	0.9526	0.8737	0.7034	0.5058	0.5587	0.8203	0.9643	0.9926	0.9973 (94)
Useful gains	541.4620	627.9779	691.9246	730.8700	703.8312	553.2340	380.0943	396.1983	545.8076	576.7293	531.5909	510.8997 (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												
	1593.7788	1546.5059	1401.3418	1168.0032	899.6225	599.1636	387.1674	407.6039	647.1077	983.0020	1308.5690	1584.5579 (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												
	782.9237	617.2508	527.8063	314.7359	145.6687	0.0000	0.0000	0.0000	0.0000	302.2669	559.4242	798.8017 (98)
Space heating												
												4048.8783 (98)
Space heating per m ²												
										(98) / (4) =		43.2943 (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 %)												92.8000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												4363.0154 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement												
	782.9237	617.2508	527.8063	314.7359	145.6687	0.0000	0.0000	0.0000	0.0000	302.2669	559.4242	798.8017 (98)
Space heating efficiency (main heating system 1)												
	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000 (210)
Space heating fuel (main heating system)												
	843.6678	665.1410	568.7568	339.1551	156.9706	0.0000	0.0000	0.0000	0.0000	325.7186	602.8278	860.7777 (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	185.8340	163.2208	170.0565	150.4929	146.0485	128.4898	121.5510	135.9963	136.6241	156.2235	167.5571	180.7302 (64)
Efficiency of water heater												87.3000 (216)
(217)m	89.3094	89.2654	89.1777	88.9758	88.5307	87.3000	87.3000	87.3000	87.3000	88.9322	89.2112	89.3280 (217)
Fuel for water heating, kWh/month	208.0789	182.8489	190.6939	169.1392	164.9692	147.1819	139.2337	155.7804	156.4995	175.6658	187.8207	202.3220 (219)
Water heating fuel used												2080.2342 (219)
Annual totals kWh/year												
Space heating fuel - main system												4363.0154 (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)												399.3161 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.75 * 1029 * 1.00) =										-617.5120		-617.5120 (233)
Total delivered energy for all uses												6300.0537 (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	4363.0154	0.2160	942.4113 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2080.2342	0.2160	449.3306 (264)
Space and water heating			1391.7419 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	399.3161	0.5190	207.2451 (268)
Energy saving/generation technologies			
PV Unit	-617.5120	0.5190	-320.4887 (269)
Total CO2, kg/year			1317.4232 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.0900 (273)

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

DER		14.0900 ZC1
Total Floor Area	TFA	93.5200
Assumed number of occupants	N	2.6709
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		15.5499 ZC2
CO2 emissions from cooking, equation (L16)		1.9579 ZC3
Total CO2 emissions		31.5978 ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000 ZC5
Additional allowable electricity generation, kWh/m ² /year		0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000 ZC7
Net CO2 emissions		31.5978 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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7600 (1b)	x 2.3100 (2b)	= 108.0156 (1b) - (3b)
First floor	46.7600 (1c)	x 2.6900 (2c)	= 125.7844 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.8000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1283 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3783 (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) =	0.3216 (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	0.4100	0.4020	0.3939	0.3537	0.3457	0.3055	0.3055	0.2975	0.3216	0.3457	0.3618	0.3778 (22b)
Effective ac	0.5840	0.5808	0.5776	0.5626	0.5597	0.5467	0.5467	0.5442	0.5517	0.5597	0.5654	0.5714 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1200	1.0000	2.1200		(26)
TER Semi-glazed door			1.9700	1.2000	2.3640		(26a)
TER Opening Type (Uw = 1.40)			15.7200	1.3258	20.8409		(27)
Heat Loss Floor 1			46.7600	0.1300	6.0788		(28a)
External Wall 1	97.1500	19.8100	77.3400	0.1800	13.9212		(29a)
External Roof 1	46.7600		46.7600	0.1300	6.0788		(30)
Total net area of external elements Aum(A, m ²)			190.6700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.4037		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.9736 (36)
Total fabric heat loss						(33) + (36) =	61.3773 (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	45.0618	44.8099	44.5631	43.4038	43.1869	42.1771	42.1771	41.9902	42.5661	43.1869	43.6257	44.0844 (38)
Heat transfer coeff	106.4391	106.1872	105.9404	104.7811	104.5642	103.5545	103.5545	103.3675	103.9434	104.5642	105.0030	105.4617 (39)
Average = Sum(39)m / 12 =												104.7801 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1381	1.1354	1.1328	1.1204	1.1181	1.1073	1.1073	1.1053	1.1115	1.1181	1.1228	1.1277 (40)
HLP (average)												1.1204 (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												2.6709 (42)
Average daily hot water use (litres/day)												97.6339 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.3973	103.4919	99.5866	95.6812	91.7759	87.8705	87.8705	91.7759	95.6812	99.5866	103.4919	107.3973 (44)
Energy conte	159.2671	139.2960	143.7410	125.3169	120.2446	103.7619	96.1507	110.3343	111.6520	130.1197	142.0358	154.2417 (45)
Energy content (annual)												1536.1617 (45)
Distribution loss (46)m = 0.15 x (45)m												
	23.8901	20.8944	21.5612	18.7975	18.0367	15.5643	14.4226	16.5501	16.7478	19.5180	21.3054	23.1363 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	50.9589	46.0274	50.7482	47.1853	46.7680	43.3334	44.7779	46.7680	47.1853	50.7482	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	210.2260	185.3234	194.4893	172.5022	167.0125	147.0953	140.9285	157.1023	158.8373	180.8679	191.3509	205.2006 (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)
Output from w/h	210.2260	185.3234	194.4893	172.5022	167.0125	147.0953	140.9285	157.1023	158.8373	180.8679	191.3509	205.2006 (64)

Heat gains from water heating, kWh/month
65.6960 57.8228 60.4809 53.4642 51.6733 45.3342 43.1646 48.3781 48.9206 55.9519 59.5557 64.0251 (65)

Total per year (kWh/year) = Sum(64)m = 2110.9362 (64)

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	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.6109	20.0828	16.3325	12.3647	9.2428	7.8031	8.4316	10.9597	14.7100	18.6778	21.7997	23.2394 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.4067	247.9532	241.5360	227.8745	210.6293	194.4212	183.5932	181.0466	187.4639	201.1254	218.3706	234.5787 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545 (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)	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361 (71)
Water heating gains (Table 5)	88.3011	86.0458	81.2916	74.2558	69.4534	62.9641	58.0169	65.0244	67.9453	75.2041	82.7162	86.0552 (72)
Total internal gains	422.3823	420.1454	405.2236	380.5585	355.3889	331.2520	316.1051	323.0942	336.1827	361.0708	388.9501	409.9368 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g Specific data or Table 6c	FF Specific data or Table 6c	Access factor Table 6d	Gains W		
North				7.6500	10.6334	0.6300		0.7000	0.7700	24.8602 (74)		
South				6.7500	46.7521	0.6300		0.7000	0.7700	96.4443 (78)		
West				1.3200	19.6403	0.6300		0.7000	0.7700	7.9231 (80)		
Solar gains	129.2276	220.9592	307.4560	394.3004	457.2696	461.7516	441.8688	393.0931	336.9284	245.3094	154.8668	110.5770 (83)
Total gains	551.6098	641.1046	712.6796	774.8590	812.6585	793.0035	757.9740	716.1873	673.1111	606.3802	543.8168	520.5138 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	61.0156	61.1603	61.3028	61.9811	62.1096	62.7153	62.7153	62.8287	62.4806	62.1096	61.8501	61.5811
alpha	5.0677	5.0774	5.0869	5.1321	5.1406	5.1810	5.1810	5.1886	5.1654	5.1406	5.1233	5.1054
util living area	0.9982	0.9957	0.9891	0.9673	0.9022	0.7549	0.5832	0.6350	0.8632	0.9774	0.9960	0.9986 (86)
MIT	19.7652	19.9213	20.1626	20.4767	20.7583	20.9351	20.9862	20.9790	20.8623	20.5002	20.0736	19.7376 (87)
Th 2	19.9698	19.9720	19.9741	19.9842	19.9861	19.9949	19.9949	19.9965	19.9915	19.9861	19.9823	19.9783 (88)
util rest of house	0.9975	0.9942	0.9852	0.9545	0.8627	0.6662	0.4591	0.5106	0.7958	0.9661	0.9944	0.9982 (89)
MIT 2	18.3224	18.5517	18.9039	19.3604	19.7415	19.9499	19.9896	19.9875	19.8778	19.4008	18.7821	18.2881 (90)
Living area fraction	18.6171	18.8314	19.1610	19.5884	19.9492	20.1511	20.1932	20.1900	20.0789	19.6253	19.0459	18.5842 (92)
Temperature adjustment	18.6171	18.8314	19.1610	19.5884	19.9492	20.1511	20.1932	20.1900	20.0789	19.6253	19.0459	18.5842 (93)
adjusted MIT	18.6171	18.8314	19.1610	19.5884	19.9492	20.1511	20.1932	20.1900	20.0789	19.6253	19.0459	18.5842 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9963	0.9918	0.9808	0.9480	0.8610	0.6813	0.4846	0.5359	0.8026	0.9606	0.9921	0.9972 (94)
Useful gains	549.5639	635.8668	698.9997	734.5979	699.7303	540.2412	367.2810	383.8178	540.2459	582.4928	539.5350	519.0588 (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	1523.8944	1479.3411	1341.3091	1119.9409	862.5688	574.8387	372.0876	391.7649	621.4642	943.7242	1254.3526	1516.9780 (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	724.9019	566.8147	477.8782	277.4469	121.1519	0.0000	0.0000	0.0000	0.0000	268.7561	514.6686	742.4518 (98)
Space heating	724.9019	566.8147	477.8782	277.4469	121.1519	0.0000	0.0000	0.0000	0.0000	268.7561	514.6686	742.4518 (98)
Space heating per m ²										(98) / (4) =		39.5003 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												93.4000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3955.1074 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	724.9019	566.8147	477.8782	277.4469	121.1519	0.0000	0.0000	0.0000	0.0000	268.7561	514.6686	742.4518 (98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000 (210)
Space heating fuel (main heating system)	776.1263	606.8680	511.6469	297.0524	129.7130	0.0000	0.0000	0.0000	0.0000	287.7475	551.0371	794.9163 (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	210.2260	185.3234	194.4893	172.5022	167.0125	147.0953	140.9285	157.1023	158.8373	180.8679	191.3509	205.2006 (64)	
Efficiency of water heater												80.3000 (216)	
(217)m	87.9141	87.6826	87.2265	86.2413	84.2578	80.3000	80.3000	80.3000	80.3000	86.0464	87.4199	88.0032 (217)	
Fuel for water heating, kWh/month	239.1266	211.3571	222.9705	200.0226	198.2161	183.1822	175.5025	195.6442	197.8049	210.1982	218.8871	233.1740 (219)	
Water heating fuel used												2486.0859 (219)	
Annual totals kWh/year													
Space heating fuel - main system												3955.1074 (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)												399.3161 (232)	
Total delivered energy for all uses												6915.5094 (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	3955.1074	0.2160	854.3032 (261)	
Space heating - secondary	0.0000	0.0000	0.0000 (263)	
Water heating (other fuel)	2486.0859	0.2160	536.9945 (264)	
Space and water heating			1391.2977 (265)	
Pumps and fans	75.0000	0.5190	38.9250 (267)	
Energy for lighting	399.3161	0.5190	207.2451 (268)	
Total CO2, kg/m2/year			1637.4678 (272)	
Emissions per m2 for space and water heating			14.8770 (272a)	
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2161 (272b)	
Emissions per m2 for pumps and fans			0.4162 (272c)	
Target Carbon Dioxide Emission Rate (TER) = (14.8770 * 1.00) + 2.2161 + 0.4162, rounded to 2 d.p.			17.5100 (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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7600 (1b)	x 2.3100 (2b)	= 108.0156 (1b) - (3b)
First floor	46.7600 (1c)	x 2.6900 (2c)	= 125.7844 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.5200		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 233.8000 (5)
Dwelling volume			

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1283 (8)
Pressure test					Yes
Measured/design q50					5.8800
Infiltration rate					0.4223 (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) =		0.3590 (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	0.4577	0.4487	0.4397	0.3949	0.3859	0.3410	0.3410	0.3320	0.3590	0.3859	0.4038	0.4218 (22b)
Effective ac	0.6047	0.6007	0.5967	0.5780	0.5745	0.5581	0.5581	0.5551	0.5644	0.5745	0.5815	0.5890 (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					
Opening Type 1			2.1200	1.1000	2.3320		(26)					
Opening Type 2 (Uw = 1.40)			15.7200	1.3258	20.8409		(27)					
Opening Type 3			1.9700	1.4000	2.7580		(26a)					
Heat Loss Floor 1			46.7600	0.1600	7.4816		(28a)					
External Wall 1	97.1500	19.8100	77.3400	0.2500	19.3350		(29a)					
External Roof 1	46.7600		46.7600	0.1100	5.1436		(30)					
Total net area of external elements Aum(A, m2)			190.6700				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.8911		(33)					
Party Wall 1			43.6700	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)							8.0296 (36)					
Total fabric heat loss						(33) + (36) =	65.9207 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	46.6579	46.3441	46.0365	44.5918	44.3215	43.0633	43.0633	42.8303	43.5479	44.3215	44.8684	45.4400 (38)
	112.5786	112.2648	111.9572	110.5126	110.2423	108.9840	108.9840	108.7510	109.4687	110.2423	110.7891	111.3607 (39)
Average = Sum(39)m / 12 =												110.5113 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.2038	1.2004	1.1971	1.1817	1.1788	1.1654	1.1654	1.1629	1.1705	1.1788	1.1847	1.1908 (40)
Days in month												1.1817 (40)
	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6709 (42)
Average daily hot water use (litres/day)												97.6339 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	107.3973	103.4919	99.5866	95.6812	91.7759	87.8705	87.8705	91.7759	95.6812	99.5866	103.4919	107.3973 (44)
Energy content (annual)	159.2671	139.2960	143.7410	125.3169	120.2446	103.7619	96.1507	110.3343	111.6520	130.1197	142.0358	154.2417 (45)
Distribution loss (46)m = 0.15 x (45)m												1536.1617 (45)
Water 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 (46)
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	33.8443	29.6004	30.5450	26.6298	25.5520	22.0494	20.4320	23.4460	23.7261	27.6504	30.1826	32.7764 (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	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.6109	20.0828	16.3325	12.3647	9.2428	7.8031	8.4316	10.9597	14.7100	18.6778	21.7997	23.2394 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.4067	247.9532	241.5360	227.8745	210.6293	194.4212	183.5932	181.0466	187.4639	201.1254	218.3706	234.5787 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545 (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)	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361 (71)
Water heating gains (Table 5)	45.4896	44.0482	41.0551	36.9859	34.3440	30.6242	27.4624	31.5135	32.9529	37.1646	41.9203	44.0542 (72)
Total internal gains	376.5707	375.1478	361.9870	340.2886	317.2796	295.9120	282.5507	286.5833	298.1903	320.0312	345.1541	364.9358 (73)

6. Solar gains

[Jan]			Area m2		Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North			7.6500		10.6334		0.6300		0.7000		0.7700		24.8602 (74)
South			6.7500		46.7521		0.6300		0.7000		0.7700		96.4443 (78)
West			1.3200		19.6403		0.6300		0.7000		0.7700		7.9231 (80)
Solar gains	129.2276	220.9592	307.4560	394.3004	457.2696	461.7516	441.8688	393.0931	336.9284	245.3094	154.8668	110.5770	(83)
Total gains	505.7983	596.1070	669.4431	734.5890	774.5492	757.6636	724.4195	679.6764	635.1187	565.3406	500.0209	475.5128	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	57.6881	57.8493	58.0083	58.7666	58.9107	59.5908	59.5908	59.7185	59.3270	58.9107	58.6199	58.3190
alpha	4.8459	4.8566	4.8672	4.9178	4.9274	4.9727	4.9727	4.9812	4.9551	4.9274	4.9080	4.8879
util living area	0.9987	0.9969	0.9921	0.9756	0.9242	0.7963	0.6305	0.6858	0.8953	0.9842	0.9973	0.9991 (86)
MIT	19.6327	19.7928	20.0449	20.3804	20.6909	20.9057	20.9772	20.9658	20.8132	20.4105	19.9608	19.6086 (87)
Th 2	19.9170	19.9197	19.9223	19.9347	19.9370	19.9478	19.9478	19.9498	19.9436	19.9370	19.9323	19.9274 (88)
util rest of house	0.9983	0.9958	0.9891	0.9654	0.8900	0.7084	0.4953	0.5528	0.8351	0.9758	0.9962	0.9988 (89)
MIT 2	18.6707	18.8325	19.0853	19.4251	19.7185	19.9016	19.9417	19.9395	19.8342	19.4598	19.0106	18.6549 (90)
Living area fraction									fLA = Living area / (4) =			0.2042 (91)
MIT	18.8671	19.0286	19.2813	19.6202	19.9171	20.1067	20.1532	20.1491	20.0342	19.6540	19.2047	18.8497 (92)
Temperature adjustment												0.0000
adjusted MIT	18.8671	19.0286	19.2813	19.6202	19.9171	20.1067	20.1532	20.1491	20.0342	19.6540	19.2047	18.8497 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9977	0.9946	0.9867	0.9615	0.8892	0.7233	0.5232	0.5801	0.8413	0.9727	0.9950	0.9983 (94)
Useful gains	504.6268	592.8868	660.5085	706.3118	688.7319	548.0389	379.0452	394.2920	534.3381	549.9181	497.5392	474.6984 (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	1639.9489	1586.1436	1430.9585	1184.7220	905.8696	600.1435	387.2424	407.7178	649.6069	998.1280	1341.0672	1631.4033 (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	844.6797	667.4686	573.2148	344.4553	161.5504	0.0000	0.0000	0.0000	0.0000	333.4682	607.3401	860.5884 (98)
Space heating												4392.7656 (98)
Space heating per m2										(98) / (4) =		46.9714 (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	1024.4495	806.4815	826.5074	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8168	0.8915	0.8644	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	836.7262	718.9675	714.4533	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	987.1368	946.1454	895.7053	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	108.2957	169.0203	134.8515	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												412.1675 (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	27.0739	42.2551	33.7129	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												103.0419 (107)
Space cooling per m2												1.1018 (108)
Energy for space heating												46.9714 (99)
Energy for space cooling												1.1018 (108)
Total												48.0732 (109)
Dwelling Fabric Energy Efficiency (DFEE)												48.1 (109)

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7600 (1b)	x 2.3100 (2b)	= 108.0156 (1b) - (3b)
First floor	46.7600 (1c)	x 2.6900 (2c)	= 125.7844 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.5200		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 233.8000 (5)
Dwelling volume			

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1283 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3783 (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) =	0.3216 (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	0.4100	0.4020	0.3939	0.3537	0.3457	0.3055	0.3055	0.2975	0.3216	0.3457	0.3618	0.3778 (22b)
Effective ac	0.5840	0.5808	0.5776	0.5626	0.5597	0.5467	0.5467	0.5442	0.5517	0.5597	0.5654	0.5714 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1200	1.0000	2.1200		(26)
TER Semi-glazed door			1.9700	1.2000	2.3640		(26a)
TER Opening Type (Uw = 1.40)			15.7200	1.3258	20.8409		(27)
Heat Loss Floor 1			46.7600	0.1300	6.0788		(28a)
External Wall 1	97.1500	19.8100	77.3400	0.1800	13.9212		(29a)
External Roof 1	46.7600		46.7600	0.1300	6.0788		(30)
Total net area of external elements Aum(A, m ²)			190.6700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	51.4037		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.9736 (36)
Total fabric heat loss						(33) + (36) =	61.3773 (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	45.0618	44.8099	44.5631	43.4038	43.1869	42.1771	42.1771	41.9902	42.5661	43.1869	43.6257	44.0844 (38)
Heat transfer coeff	106.4391	106.1872	105.9404	104.7811	104.5642	103.5545	103.5545	103.3675	103.9434	104.5642	105.0030	105.4617 (39)
Average = Sum(39)m / 12 =												104.7801 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1381	1.1354	1.1328	1.1204	1.1181	1.1073	1.1073	1.1053	1.1115	1.1181	1.1228	1.1277 (40)
HLP (average)												1.1204 (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												2.6709 (42)
Average daily hot water use (litres/day)												97.6339 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.3973	103.4919	99.5866	95.6812	91.7759	87.8705	87.8705	91.7759	95.6812	99.5866	103.4919	107.3973 (44)
Energy conte	159.2671	139.2960	143.7410	125.3169	120.2446	103.7619	96.1507	110.3343	111.6520	130.1197	142.0358	154.2417 (45)
Energy content (annual)												1536.1617 (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	33.8443	29.6004	30.5450	26.6298	25.5520	22.0494	20.4320	23.4460	23.7261	27.6504	30.1826	32.7764 (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	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451	133.5451 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.6109	20.0828	16.3325	12.3647	9.2428	7.8031	8.4316	10.9597	14.7100	18.6778	21.7997	23.2394 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.4067	247.9532	241.5360	227.8745	210.6293	194.4212	183.5932	181.0466	187.4639	201.1254	218.3706	234.5787 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545	36.3545 (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)	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361 (71)
Water heating gains (Table 5)	45.4896	44.0482	41.0551	36.9859	34.3440	30.6242	27.4624	31.5135	32.9529	37.1646	41.9203	44.0542 (72)
Total internal gains	376.5707	375.1478	361.9870	340.2886	317.2796	295.9120	282.5507	286.5833	298.1903	320.0312	345.1541	364.9358 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W
North				7.6500	10.6334	0.6300	0.7000			0.7700			24.8602 (74)
South				6.7500	46.7521	0.6300	0.7000			0.7700			96.4443 (78)
West				1.3200	19.6403	0.6300	0.7000			0.7700			7.9231 (80)
Solar gains	129.2276	220.9592	307.4560	394.3004	457.2696	461.7516	441.8688	393.0931	336.9284	245.3094	154.8668	110.5770	(83)
Total gains	505.7983	596.1070	669.4431	734.5890	774.5492	757.6636	724.4195	679.6764	635.1187	565.3406	500.0209	475.5128	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	61.0156	61.1603	61.3028	61.9811	62.1096	62.7153	62.7153	62.8287	62.4806	62.1096	61.8501	61.5811
alpha	5.0677	5.0774	5.0869	5.1321	5.1406	5.1810	5.1810	5.1886	5.1654	5.1406	5.1233	5.1054
util living area	0.9988	0.9969	0.9917	0.9735	0.9161	0.7774	0.6066	0.6626	0.8842	0.9831	0.9973	0.9991 (86)
MIT	19.7195	19.8769	20.1213	20.4419	20.7344	20.9254	20.9836	20.9746	20.8426	20.4629	20.0302	19.6925 (87)
Th 2	19.9698	19.9720	19.9741	19.9842	19.9861	19.9949	19.9949	19.9965	19.9915	19.9861	19.9823	19.9783 (88)
util rest of house	0.9984	0.9958	0.9886	0.9627	0.8802	0.6902	0.4793	0.5359	0.8222	0.9742	0.9961	0.9988 (89)
MIT 2	18.7994	18.9582	19.2028	19.5256	19.7996	19.9588	19.9905	19.9889	19.9003	19.5511	19.1198	18.7793 (90)
Living area fraction									fLA = Living area / (4) =			0.2042 (91)
MIT	18.9873	19.1458	19.3904	19.7128	19.9905	20.1562	20.1933	20.1902	20.0927	19.7373	19.3057	18.9658 (92)
Temperature adjustment												0.0000
adjusted MIT	18.9873	19.1458	19.3904	19.7128	19.9905	20.1562	20.1933	20.1902	20.0927	19.7373	19.3057	18.9658 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9978	0.9946	0.9863	0.9591	0.8804	0.7057	0.5056	0.5619	0.8296	0.9713	0.9951	0.9984 (94)
Useful gains	504.6733	592.9022	660.2420	704.5288	681.9268	534.6803	366.2737	381.9380	526.8686	549.1433	497.5590	474.7384 (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	1563.3071	1512.7266	1365.6161	1132.9719	866.8898	575.3659	372.1047	391.7819	622.9021	955.4343	1281.6387	1557.2296 (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	787.6236	618.1220	524.7983	308.4790	137.6125	0.0000	0.0000	0.0000	0.0000	302.2805	564.5374	805.3735 (98)
Space heating												4048.8268 (98)
Space heating per m2											(98) / (4) =	43.2937 (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	973.4119	766.3030	785.5928	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8440	0.9124	0.8880	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	821.5836	699.2124	697.6364	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	987.1368	946.1454	895.7053	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	119.1983	183.7181	147.3633	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												450.2797 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	29.7996	45.9295	36.8408	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												112.5699 (107)
Space cooling per m2												1.2037 (108)
Energy for space heating												43.2937 (99)
Energy for space cooling												1.2037 (108)
Total												44.4974 (109)
Target Fabric Energy Efficiency (TFEE)												51.2 (109)

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7600 (1b)	x 2.3100 (2b)	= 108.0156 (1b) - (3b)
First floor	46.7600 (1c)	x 2.6900 (2c)	= 125.7844 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.5200		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 233.8000 (5)
Dwelling volume			

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1283 (8)
Pressure test					Yes
Measured/design q50					5.8800
Infiltration rate					0.4223 (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) =		0.3590 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.0000	4.6000	4.4000	4.2000	4.4000	4.0000	4.1000	3.9000	4.0000	4.4000	4.3000	4.6000 (22)
Wind factor	1.2500	1.1500	1.1000	1.0500	1.1000	1.0000	1.0250	0.9750	1.0000	1.1000	1.0750	1.1500 (22a)
Adj infilt rate	0.4487	0.4128	0.3949	0.3769	0.3949	0.3590	0.3679	0.3500	0.3590	0.3949	0.3859	0.4128 (22b)
Effective ac	0.6007	0.5852	0.5780	0.5710	0.5780	0.5644	0.5677	0.5612	0.5644	0.5780	0.5745	0.5852 (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					
Opening Type 1			2.1200	1.1000	2.3320		(26)					
Opening Type 2 (Uw = 1.40)			15.7200	1.3258	20.8409		(27)					
Opening Type 3			1.9700	1.4000	2.7580		(26a)					
Heat Loss Floor 1			46.7600	0.1600	7.4816		(28a)					
External Wall 1	97.1500	19.8100	77.3400	0.2500	19.3350		(29a)					
External Roof 1	46.7600		46.7600	0.1100	5.1436		(30)					
Total net area of external elements Aum(A, m2)			190.6700				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.8911		(33)					
Party Wall 1			43.6700	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)							8.0296 (36)					
Total fabric heat loss						(33) + (36) =	65.9207 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 46.3441	Feb 45.1511	Mar 44.5918	Apr 44.0575	May 44.5918	Jun 43.5479	Jul 43.7996	Aug 43.3025	Sep 43.5479	Oct 44.5918	Nov 44.3215	Dec 45.1511 (38)
Heat transfer coeff	112.2648	111.0718	110.5126	109.9782	110.5126	109.4687	109.7203	109.2232	109.4687	110.5126	110.2423	111.0718 (39)
Average = Sum(39)m / 12 =												110.3373 (39)
HLP	Jan 1.2004	Feb 1.1877	Mar 1.1817	Apr 1.1760	May 1.1817	Jun 1.1705	Jul 1.1732	Aug 1.1679	Sep 1.1705	Oct 1.1817	Nov 1.1788	Dec 1.1877 (40)
HLP (average)												1.1798 (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												2.6709 (42)
Average daily hot water use (litres/day)												97.6339 (43)
Daily hot water use	Jan 107.3973	Feb 103.4919	Mar 99.5866	Apr 95.6812	May 91.7759	Jun 87.8705	Jul 87.8705	Aug 91.7759	Sep 95.6812	Oct 99.5866	Nov 103.4919	Dec 107.3973 (44)
Energy conte	159.2671	139.2960	143.7410	125.3169	120.2446	103.7619	96.1507	110.3343	111.6520	130.1197	142.0358	154.2417 (45)
Energy content (annual)										Total = Sum(45)m =		1536.1617 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8901	20.8944	21.5612	18.7975	18.0367	15.5643	14.4226	16.5501	16.7478	19.5180	21.3054	23.1363 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	26.5669	23.9248	26.3154	25.1760	25.8039	24.7278	25.4004	25.6620	24.9720	26.1038	25.5213	26.4885 (61)
Total heat required for water heating calculated for each month	185.8340	163.2208	170.0565	150.4929	146.0485	128.4898	121.5510	135.9963	136.6241	156.2235	167.5571	180.7302 (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)
Output from w/h								Solar input (sum of months) = Sum(63)m =				0.0000 (63)

185.8340	163.2208	170.0565	150.4929	146.0485	128.4898	121.5510	135.9963	136.6241	156.2235	167.5571	180.7302 (64)
RHI water heating demand											1842.8246 (64)
Heat gains from water heating, kWh/month											1843 (64)
59.5980	52.2971	54.3727	47.9619	46.4323	40.6828	38.3202	43.1017	43.3673	49.7907	53.6072	57.9075 (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	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.5273	50.2071	40.8311	30.9118	23.1069	19.5078	21.0789	27.3992	36.7751	46.6944	54.4993	58.0984 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	366.2786	370.0795	360.5015	340.1112	314.3720	290.1809	274.0197	270.2188	279.7968	300.1871	325.9263	350.1174 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963 (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)	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361 (71)
Water heating gains (Table 5)	80.1049	77.8231	73.0817	66.6137	62.4090	56.5039	51.5056	57.9323	60.2324	66.9230	74.4545	77.8326 (72)
Total internal gains	613.0252	608.2240	584.5286	547.7510	510.0023	476.3069	456.7186	465.6647	486.9186	523.9190	564.9944	596.1628 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				7.6500	14.6401	0.6300		0.7000		0.7700		34.2276 (74)
South				6.7500	61.3950	0.6300		0.7000		0.7700		126.6509 (78)
West				1.3200	27.3735	0.6300		0.7000		0.7700		11.0427 (80)
Solar gains	171.9213	245.6853	340.3370	457.0323	515.5975	561.8224	533.0861	474.5870	400.2227	290.3906	197.5538	142.7023 (83)
Total gains	784.9465	853.9093	924.8657	1004.7833	1025.5998	1038.1293	989.8046	940.2517	887.1413	814.3096	762.5482	738.8651 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	57.8493	58.4707	58.7666	59.0521	58.7666	59.3270	59.1909	59.4603	59.3270	58.7666	58.9107	58.4707
alpha	4.8566	4.8980	4.9178	4.9368	4.9178	4.9551	4.9461	4.9640	4.9551	4.9178	4.9274	4.8980
util living area												
	0.9881	0.9821	0.9626	0.9039	0.7758	0.5538	0.3965	0.3926	0.6617	0.8955	0.9735	0.9901 (86)
MIT	20.0514	20.1526	20.3882	20.6766	20.8896	20.9838	20.9975	20.9978	20.9631	20.7571	20.3869	20.0458 (87)
Th 2	19.9197	19.9299	19.9347	19.9393	19.9347	19.9436	19.9415	19.9458	19.9436	19.9347	19.9370	19.9299 (88)
util rest of house												
	0.9840	0.9762	0.9498	0.8717	0.7070	0.4528	0.2813	0.2722	0.5569	0.8505	0.9627	0.9866 (89)
MIT 2	18.7024	18.8549	19.1936	19.5891	19.8419	19.9357	19.9409	19.9453	19.9227	19.6975	19.1986	18.7021 (90)
Living area fraction												
									FLA = Living area / (4) =			0.2042 (91)
MIT	18.9779	19.1200	19.4375	19.8112	20.0559	20.1497	20.1567	20.1603	20.1352	19.9139	19.4413	18.9765 (92)
Temperature adjustment												
												0.0000
adjusted MIT												
	18.9779	19.1200	19.4375	19.8112	20.0559	20.1497	20.1567	20.1603	20.1352	19.9139	19.4413	18.9765 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9791	0.9702	0.9423	0.8672	0.7155	0.4731	0.3050	0.2969	0.5771	0.8495	0.9561	0.9823 (94)
Useful gains	768.5425	828.4553	871.4836	871.3389	733.8666	491.1611	301.8691	279.1628	511.9840	691.7293	729.0383	725.7689 (95)
Ext temp.	5.6000	5.8000	7.4000	9.8000	12.8000	15.6000	17.4000	17.6000	15.3000	12.2000	8.7000	5.8000 (96)
Heat loss rate W												
	1501.8683	1479.4730	1330.2996	1101.0161	801.8699	498.0543	302.4662	279.6407	529.3041	852.4809	1184.1411	1463.5421 (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												
	545.5944	437.4839	341.3591	165.3676	50.5944	0.0000	0.0000	0.0000	0.0000	119.5991	327.6740	548.9033 (98)
Space heating												
												2536.5758 (98)
RHI space heating demand												
												2537 (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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7600 (1b)	x 2.3100 (2b)	= 108.0156 (1b) - (3b)
First floor	46.7600 (1c)	x 2.6900 (2c)	= 125.7844 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.5200		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 233.8000 (5)
Dwelling volume			

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1283 (8)
Pressure test					Yes
Measured/design q50					5.8800
Infiltration rate					0.4223 (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) =		0.3590 (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	0.4577	0.4487	0.4397	0.3949	0.3859	0.3410	0.3410	0.3320	0.3590	0.3859	0.4038	0.4218 (22b)
Effective ac	0.6047	0.6007	0.5967	0.5780	0.5745	0.5581	0.5581	0.5551	0.5644	0.5745	0.5815	0.5890 (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					
Opening Type 1			2.1200	1.1000	2.3320		(26)					
Opening Type 2 (Uw = 1.40)			15.7200	1.3258	20.8409		(27)					
Opening Type 3			1.9700	1.4000	2.7580		(26a)					
Heat Loss Floor 1			46.7600	0.1600	7.4816		(28a)					
External Wall 1	97.1500	19.8100	77.3400	0.2500	19.3350		(29a)					
External Roof 1	46.7600		46.7600	0.1100	5.1436		(30)					
Total net area of external elements Aum(A, m2)			190.6700				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.8911		(33)					
Party Wall 1			43.6700	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)							8.0296 (36)					
Total fabric heat loss						(33) + (36) =	65.9207 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 46.6579	Feb 46.3441	Mar 46.0365	Apr 44.5918	May 44.3215	Jun 43.0633	Jul 43.0633	Aug 42.8303	Sep 43.5479	Oct 44.3215	Nov 44.8684	Dec 45.4400 (38)
Heat transfer coeff	112.5786	112.2648	111.9572	110.5126	110.2423	108.9840	108.9840	108.7510	109.4687	110.2423	110.7891	111.3607 (39)
Average = Sum(39)m / 12 =												110.5113 (39)
HLP	Jan 1.2038	Feb 1.2004	Mar 1.1971	Apr 1.1817	May 1.1788	Jun 1.1654	Jul 1.1654	Aug 1.1629	Sep 1.1705	Oct 1.1788	Nov 1.1847	Dec 1.1908 (40)
HLP (average)												1.1817 (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												2.6709 (42)
Average daily hot water use (litres/day)												97.6339 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	107.3973	103.4919	99.5866	95.6812	91.7759	87.8705	87.8705	91.7759	95.6812	99.5866	103.4919	107.3973 (44)
Energy content (annual)	159.2671	139.2960	143.7410	125.3169	120.2446	103.7619	96.1507	110.3343	111.6520	130.1197	142.0358	154.2417 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8901	20.8944	21.5612	18.7975	18.0367	15.5643	14.4226	16.5501	16.7478	19.5180	21.3054	23.1363 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	26.5669	23.9248	26.3154	25.1760	25.8039	24.7278	25.4004	25.6620	24.9720	26.1038	25.5213	26.4885 (61)
Total heat required for water heating calculated for each month	185.8340	163.2208	170.0565	150.4929	146.0485	128.4898	121.5510	135.9963	136.6241	156.2235	167.5571	180.7302 (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)
Output from w/h								Solar input (sum of months) = Sum(63)m =				0.0000 (63)

185.8340	163.2208	170.0565	150.4929	146.0485	128.4898	121.5510	135.9963	136.6241	156.2235	167.5571	180.7302 (64)
Heat gains from water heating, kWh/month											Total per year (kWh/year) = Sum(64)m = 1842.8246 (64)
59.5980	52.2971	54.3727	47.9619	46.4323	40.6828	38.3202	43.1017	43.3673	49.7907	53.6072	57.9075 (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	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.5273	50.2071	40.8311	30.9118	23.1069	19.5078	21.0789	27.3992	36.7751	46.6944	54.4993	58.0984 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	366.2786	370.0795	360.5015	340.1112	314.3720	290.1809	274.0197	270.2188	279.7968	300.1871	325.9263	350.1174 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963 (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)	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361 (71)
Water heating gains (Table 5)	80.1049	77.8231	73.0817	66.6137	62.4090	56.5039	51.5056	57.9323	60.2324	66.9230	74.4545	77.8326 (72)
Total internal gains	613.0252	608.2240	584.5286	547.7510	510.0023	476.3069	456.7186	465.6647	486.9186	523.9190	564.9944	596.1628 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				7.6500	10.6334	0.6300		0.7000		0.7700		24.8602 (74)
South				6.7500	46.7521	0.6300		0.7000		0.7700		96.4443 (78)
West				1.3200	19.6403	0.6300		0.7000		0.7700		7.9231 (80)

Solar gains	129.2276	220.9592	307.4560	394.3004	457.2696	461.7516	441.8688	393.0931	336.9284	245.3094	154.8668	110.5770 (83)
Total gains	742.2528	829.1832	891.9846	942.0514	967.2719	938.0585	898.5874	858.7578	823.8470	769.2283	719.8612	706.7398 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	57.6881	57.8493	58.0083	58.7666	58.9107	59.5908	59.5908	59.7185	59.3270	58.9107	58.6199	58.3190
util living area	4.8459	4.8566	4.8672	4.9178	4.9274	4.9727	4.9727	4.9812	4.9551	4.9274	4.9080	4.8879
	0.9933	0.9876	0.9748	0.9396	0.8545	0.6909	0.5224	0.5654	0.7940	0.9492	0.9871	0.9946 (86)
MIT	19.8635	20.0163	20.2494	20.5487	20.8015	20.9505	20.9899	20.9852	20.8988	20.5840	20.1723	19.8358 (87)
Th 2	19.9170	19.9197	19.9223	19.9347	19.9370	19.9478	19.9478	19.9498	19.9436	19.9370	19.9323	19.9274 (88)
util rest of house	0.9911	0.9836	0.9663	0.9183	0.8040	0.5979	0.4033	0.4449	0.7128	0.9268	0.9822	0.9929 (89)
MIT 2	18.4276	18.6507	18.9878	19.4165	19.7462	19.9156	19.9442	19.9440	19.8668	19.4741	18.8878	18.3948 (90)
Living area fraction									fLA = Living area / (4) =			0.2042 (91)
MIT	18.7209	18.9296	19.2455	19.6477	19.9617	20.1269	20.1578	20.1566	20.0776	19.7008	19.1501	18.6891 (92)
Temperature adjustment												0.0000
adjusted MIT	18.7209	18.9296	19.2455	19.6477	19.9617	20.1269	20.1578	20.1566	20.0776	19.7008	19.1501	18.6891 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9876	0.9785	0.9593	0.9113	0.8053	0.6148	0.4277	0.4695	0.7243	0.9205	0.9772	0.9900 (94)
Ext temp.	733.0779	811.3585	855.7097	858.5155	778.9828	576.7108	384.3438	403.1817	596.7428	708.0977	703.4296	699.6609 (95)
Heat loss rate W	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)
Month fracti	1623.4821	1575.0343	1426.9489	1187.7567	910.7939	602.3487	387.7402	408.5369	654.3550	1003.2875	1335.0208	1613.5198 (97)
Space heating kWh	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 per m2	662.4607	513.1901	425.0019	237.0537	98.0674	0.0000	0.0000	0.0000	0.0000	219.6212	454.7457	679.9111 (98)
										(98) / (4) =		3290.0519 (98)
												35.1802 (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)
Efficiency of main space heating system 1 (in %)												1.0000 (202)
Efficiency of secondary/supplementary heating system, %												92.8000 (206)
Space heating requirement												0.0000 (208)
												3545.3146 (211)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating efficiency (main heating system 1)	662.4607	513.1901	425.0019	237.0537	98.0674	0.0000	0.0000	0.0000	0.0000	219.6212	454.7457	679.9111 (98)
Space heating fuel (main heating system)	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000 (210)
Water heating requirement	713.8586	553.0066	457.9762	255.4458	105.6761	0.0000	0.0000	0.0000	0.0000	236.6608	490.0277	732.6628 (211)

	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	185.8340	163.2208	170.0565	150.4929	146.0485	128.4898	121.5510	135.9963	136.6241	156.2235	167.5571	180.7302 (64)
Efficiency of water heater												87.3000 (216)
(217)m	89.2402	89.1837	89.0711	88.8124	88.2874	87.3000	87.3000	87.3000	87.3000	88.7437	89.1129	89.2632 (217)
Fuel for water heating, kWh/month	208.2403	183.0164	190.9223	169.4504	165.4239	147.1819	139.2337	155.7804	156.4995	176.0390	188.0279	202.4689 (219)
Water heating fuel used												2082.2846 (219)
Annual totals kWh/year												
Space heating fuel - main system												3545.3146 (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)												399.3161 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.75 * 1029 * 1.00) =										-617.5120		-617.5120 (233)
Total delivered energy for all uses												5484.4032 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3545.3146	3.4800	123.3769 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2082.2846	3.4800	72.4635 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	399.3161	13.1900	52.6698 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-617.5120	13.1900	-81.4498 (252)
Total energy cost			296.9529 (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] =	0.9004 (257)
SAP value		87.4397
SAP rating (Section 12)		87 (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	3545.3146	0.2160	765.7879 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2082.2846	0.2160	449.7735 (264)
Space and water heating			1215.5614 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	399.3161	0.5190	207.2451 (268)
Energy saving/generation technologies			
PV Unit	-617.5120	0.5190	-320.4887 (269)
Total kg/year			1141.2427 (272)
CO2 emissions per m2			12.2000 (273)
EI value			88.9600
EI rating			89 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.8980 = 3.875$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.8980 = 0.2405$, stars = 4
Water heating energy efficiency	$3.48 / 0.8841 = 3.936$, stars = 4
Water heating environmental impact	$0.216 / 0.8841 = 0.2443$, 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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7600 (1b)	x 2.3100 (2b)	= 108.0156 (1b) - (3b)
First floor	46.7600 (1c)	x 2.6900 (2c)	= 125.7844 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.5200		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 233.8000 (5)
Dwelling volume			

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1283 (8)
Pressure test					Yes
Measured/design q50					5.8800
Infiltration rate					0.4223 (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) =	0.3590 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.0000	4.6000	4.4000	4.2000	4.4000	4.0000	4.1000	3.9000	4.0000	4.4000	4.3000	4.6000 (22)
Wind factor	1.2500	1.1500	1.1000	1.0500	1.1000	1.0000	1.0250	0.9750	1.0000	1.1000	1.0750	1.1500 (22a)
Adj infilt rate	0.4487	0.4128	0.3949	0.3769	0.3949	0.3590	0.3679	0.3500	0.3590	0.3949	0.3859	0.4128 (22b)
Effective ac	0.6007	0.5852	0.5780	0.5710	0.5780	0.5644	0.5677	0.5612	0.5644	0.5780	0.5745	0.5852 (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					
Opening Type 1			2.1200	1.1000	2.3320		(26)					
Opening Type 2 (Uw = 1.40)			15.7200	1.3258	20.8409		(27)					
Opening Type 3			1.9700	1.4000	2.7580		(26a)					
Heat Loss Floor 1			46.7600	0.1600	7.4816		(28a)					
External Wall 1	97.1500	19.8100	77.3400	0.2500	19.3350		(29a)					
External Roof 1	46.7600		46.7600	0.1100	5.1436		(30)					
Total net area of external elements Aum(A, m2)			190.6700				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.8911		(33)					
Party Wall 1			43.6700	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)							8.0296 (36)					
Total fabric heat loss						(33) + (36) =	65.9207 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 46.3441	Feb 45.1511	Mar 44.5918	Apr 44.0575	May 44.5918	Jun 43.5479	Jul 43.7996	Aug 43.3025	Sep 43.5479	Oct 44.5918	Nov 44.3215	Dec 45.1511 (38)
Heat transfer coeff	112.2648	111.0718	110.5126	109.9782	110.5126	109.4687	109.7203	109.2232	109.4687	110.5126	110.2423	111.0718 (39)
Average = Sum(39)m / 12 =												110.3373 (39)
HLP	Jan 1.2004	Feb 1.1877	Mar 1.1817	Apr 1.1760	May 1.1817	Jun 1.1705	Jul 1.1732	Aug 1.1679	Sep 1.1705	Oct 1.1817	Nov 1.1788	Dec 1.1877 (40)
HLP (average)												1.1798 (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												2.6709 (42)
Average daily hot water use (litres/day)												97.6339 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	107.3973	103.4919	99.5866	95.6812	91.7759	87.8705	87.8705	91.7759	95.6812	99.5866	103.4919	107.3973 (44)
Energy content (annual)	159.2671	139.2960	143.7410	125.3169	120.2446	103.7619	96.1507	110.3343	111.6520	130.1197	142.0358	154.2417 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8901	20.8944	21.5612	18.7975	18.0367	15.5643	14.4226	16.5501	16.7478	19.5180	21.3054	23.1363 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	26.5669	23.9248	26.3154	25.1760	25.8039	24.7278	25.4004	25.6620	24.9720	26.1038	25.5213	26.4885 (61)
Total heat required for water heating calculated for each month	185.8340	163.2208	170.0565	150.4929	146.0485	128.4898	121.5510	135.9963	136.6241	156.2235	167.5571	180.7302 (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)
Output from w/h									Solar input (sum of months) = Sum(63)m =			0.0000 (63)

185.8340	163.2208	170.0565	150.4929	146.0485	128.4898	121.5510	135.9963	136.6241	156.2235	167.5571	180.7302 (64)
Total per year (kWh/year) = Sum(64)m =											1842.8246 (64)
Heat gains from water heating, kWh/month											
59.5980	52.2971	54.3727	47.9619	46.4323	40.6828	38.3202	43.1017	43.3673	49.7907	53.6072	57.9075 (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	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.5273	50.2071	40.8311	30.9118	23.1069	19.5078	21.0789	27.3992	36.7751	46.6944	54.4993	58.0984 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	366.2786	370.0795	360.5015	340.1112	314.3720	290.1809	274.0197	270.2188	279.7968	300.1871	325.9263	350.1174 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963 (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)	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361 (71)
Water heating gains (Table 5)	80.1049	77.8231	73.0817	66.6137	62.4090	56.5039	51.5056	57.9323	60.2324	66.9230	74.4545	77.8326 (72)
Total internal gains	613.0252	608.2240	584.5286	547.7510	510.0023	476.3069	456.7186	465.6647	486.9186	523.9190	564.9944	596.1628 (73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	g or Table 6c	FF or Table 6c	Access factor Table 6d	Gains W
North	7.6500	14.6401		0.6300	0.7000	0.7700	34.2276 (74)
South	6.7500	61.3950		0.6300	0.7000	0.7700	126.6509 (78)
West	1.3200	27.3735		0.6300	0.7000	0.7700	11.0427 (80)

Solar gains	171.9213	245.6853	340.3370	457.0323	515.5975	561.8224	533.0861	474.5870	400.2227	290.3906	197.5538	142.7023 (83)
Total gains	784.9465	853.9093	924.8657	1004.7833	1025.5998	1038.1293	989.8046	940.2517	887.1413	814.3096	762.5482	738.8651 (84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	57.8493	58.4707	58.7666	59.0521	58.7666	59.3270	59.1909	59.4603	59.3270	58.7666	58.9107	58.4707
alpha	4.8566	4.8980	4.9178	4.9368	4.9178	4.9551	4.9461	4.9640	4.9551	4.9178	4.9274	4.8980
util living area	0.9881	0.9821	0.9626	0.9039	0.7758	0.5538	0.3965	0.3926	0.6617	0.8955	0.9735	0.9901 (86)
MIT	20.0514	20.1526	20.3882	20.6766	20.8896	20.9838	20.9975	20.9978	20.9631	20.7571	20.3869	20.0458 (87)
Th 2	19.9197	19.9299	19.9347	19.9393	19.9347	19.9436	19.9415	19.9458	19.9436	19.9347	19.9370	19.9299 (88)
util rest of house	0.9840	0.9762	0.9498	0.8717	0.7070	0.4528	0.2813	0.2722	0.5569	0.8505	0.9627	0.9866 (89)
MIT 2	18.7024	18.8549	19.1936	19.5891	19.8419	19.9357	19.9409	19.9453	19.9227	19.6975	19.1986	18.7021 (90)
Living area fraction									fLA = Living area / (4) =			0.2042 (91)
MIT	18.9779	19.1200	19.4375	19.8112	20.0559	20.1497	20.1567	20.1603	20.1352	19.9139	19.4413	18.9765 (92)
Temperature adjustment												0.0000
adjusted MIT	18.9779	19.1200	19.4375	19.8112	20.0559	20.1497	20.1567	20.1603	20.1352	19.9139	19.4413	18.9765 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9791	0.9702	0.9423	0.8672	0.7155	0.4731	0.3050	0.2969	0.5771	0.8495	0.9561	0.9823 (94)
Useful gains	768.5425	828.4553	871.4836	871.3389	733.8666	491.1611	301.8691	279.1628	511.9840	691.7293	729.0383	725.7689 (95)
Ext temp.	5.6000	5.8000	7.4000	9.8000	12.8000	15.6000	17.4000	17.6000	15.3000	12.2000	8.7000	5.8000 (96)
Heat loss rate W	1501.8683	1479.4730	1330.2996	1101.0161	801.8699	498.0543	302.4662	279.6407	529.3041	852.4809	1184.1411	1463.5421 (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	545.5944	437.4839	341.3591	165.3676	50.5944	0.0000	0.0000	0.0000	0.0000	119.5991	327.6740	548.9033 (98)
Space heating												2536.5758 (98)
Space heating per m ²										(98) / (4) =		27.1234 (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 %)												92.8000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												2733.3791 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	545.5944	437.4839	341.3591	165.3676	50.5944	0.0000	0.0000	0.0000	0.0000	119.5991	327.6740	548.9033 (98)
Space heating efficiency (main heating system 1)	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000 (210)
Space heating fuel (main heating system)	587.9250	471.4266	367.8438	178.1979	54.5199	0.0000	0.0000	0.0000	0.0000	128.8784	353.0970	591.4906 (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	185.8340	163.2208	170.0565	150.4929	146.0485	128.4898	121.5510	135.9963	136.6241	156.2235	167.5571	180.7302 (64)
Efficiency of water heater												87.3000 (216)
(217)m	89.1514	89.1067	88.9530	88.5912	87.9298	87.3000	87.3000	87.3000	87.3000	88.3667	88.9383	89.1675 (217)
Fuel for water heating, kWh/month	208.4478	183.1747	191.1757	169.8733	166.0966	147.1819	139.2337	155.7804	156.4995	176.7900	188.3970	202.6862 (219)
Water heating fuel used												2085.3368 (219)
Annual totals kWh/year												
Space heating fuel - main system												2733.3791 (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)												399.3161 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.75 * 1239 * 1.00) =									-743.2974			-743.2974 (233)
Total delivered energy for all uses												4549.7347 (238)

10a. Fuel costs - using BEDF prices (398)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2733.3791	4.2800	116.9886 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2085.3368	4.2800	89.2524 (247)
Pumps and fans for heating	75.0000	15.4400	11.5800 (249)
Energy for lighting	399.3161	15.4400	61.6544 (250)
Additional standing charges			92.0000 (251)
Energy saving/generation technologies			
PV Unit	-743.2974	15.4400	-114.7651 (252)
Total energy cost			256.7103 (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	2733.3791	0.2160	590.4099 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2085.3368	0.2160	450.4327 (264)
Space and water heating			1040.8426 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	399.3161	0.5190	207.2451 (268)
Energy saving/generation technologies			
PV Unit	-743.2974	0.5190	-385.7713 (269)
Total kg/year			901.2414 (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	2733.3791	1.2200	3334.7225 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2085.3368	1.2200	2544.1109 (264)
Space and water heating			5878.8334 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	399.3161	3.0700	1225.9005 (268)
Energy saving/generation technologies			
PV Unit	-743.2974	3.0700	-2281.9229 (269)
Primary energy kWh/year			5053.0610 (272)
Primary energy kWh/m2/year			54.0319 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 87
Current environmental impact rating: B 89

(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	+ 1.2	-£ 37	-200 kg (22.1%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£37	2.13 kg/m²	B 89
Total Savings	£37	2.13 kg/m²	B 91
Potential energy efficiency rating:			B 89
Potential environmental impact rating:			B 91

Fuel prices for cost data on this page from database revision number 398 TEST (28 Sep 2016)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, South East England):

	Current	Potential	Saving
Electricity	£73	£81	-£8
Mains gas	£298	£254	£45
Space heating	£221	£221	£0
Water heating	£89	£52	£37
Lighting	£62	£62	£0
Generated (PV)	-£115	-£115	£0
Total cost of fuels	£256	£220	£37
Total cost of uses	£257	£220	£37
Delivered energy	49 kWh/m²	38 kWh/m²	11 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.7 tonnes	0.2 tonnes
CO2 emissions per m²	10 kg/m²	8 kg/m²	2 kg/m²
Primary energy	54 kWh/m²	42 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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7600 (1b)	x 2.3100 (2b)	= 108.0156 (1b) - (3b)
First floor	46.7600 (1c)	x 2.6900 (2c)	= 125.7844 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.8000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1283 (8)
Pressure test					Yes
Measured/design q50					5.8800
Infiltration rate					0.4223 (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) =		0.3590 (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	0.4577	0.4487	0.4397	0.3949	0.3859	0.3410	0.3410	0.3320	0.3590	0.3859	0.4038	0.4218 (22b)
Effective ac	0.6047	0.6007	0.5967	0.5780	0.5745	0.5581	0.5581	0.5551	0.5644	0.5745	0.5815	0.5890 (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					
Opening Type 1			2.1200	1.1000	2.3320		(26)					
Opening Type 2 (Uw = 1.40)			15.7200	1.3258	20.8409		(27)					
Opening Type 3			1.9700	1.4000	2.7580		(26a)					
Heat Loss Floor 1			46.7600	0.1600	7.4816		(28a)					
External Wall 1	97.1500	19.8100	77.3400	0.2500	19.3350		(29a)					
External Roof 1	46.7600		46.7600	0.1100	5.1436		(30)					
Total net area of external elements Sum(A, m2)			190.6700				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.8911		(33)					
Party Wall 1			43.6700	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)							8.0296 (36)					
Total fabric heat loss						(33) + (36) =	65.9207 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 46.6579	Feb 46.3441	Mar 46.0365	Apr 44.5918	May 44.3215	Jun 43.0633	Jul 43.0633	Aug 42.8303	Sep 43.5479	Oct 44.3215	Nov 44.8684	Dec 45.4400 (38)
Heat transfer coeff	112.5786	112.2648	111.9572	110.5126	110.2423	108.9840	108.9840	108.7510	109.4687	110.2423	110.7891	111.3607 (39)
Average = Sum(39)m / 12 =												110.5113 (39)
HLP	Jan 1.2038	Feb 1.2004	Mar 1.1971	Apr 1.1817	May 1.1788	Jun 1.1654	Jul 1.1654	Aug 1.1629	Sep 1.1705	Oct 1.1788	Nov 1.1847	Dec 1.1908 (40)
HLP (average)												1.1817 (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												2.6709 (42)
Average daily hot water use (litres/day)												97.6339 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	107.3973	103.4919	99.5866	95.6812	91.7759	87.8705	87.8705	91.7759	95.6812	99.5866	103.4919	107.3973 (44)
Energy content (annual)	159.2671	139.2960	143.7410	125.3169	120.2446	103.7619	96.1507	110.3343	111.6520	130.1197	142.0358	154.2417 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8901	20.8944	21.5612	18.7975	18.0367	15.5643	14.4226	16.5501	16.7478	19.5180	21.3054	23.1363 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	26.5669	23.9248	26.3154	25.1760	25.8039	24.7278	25.4004	25.6620	24.9720	26.1038	25.5213	26.4885 (61)
Total heat required for water heating calculated for each month	185.8340	163.2208	170.0565	150.4929	146.0485	128.4898	121.5510	135.9963	136.6241	156.2235	167.5571	180.7302 (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													1.1806 (H8)
Utilisation factor													0.5713 (H9)
Collector performance factor													0.8793 (H10)
Dedicated solar storage volume													75.0000 (H11)
Effective solar volume													75.0000 (H13)
Daily hot water demand													97.6339 (H14)
Volume ratio Veff/V													0.7682 (H15)
Solar storage volume factor													0.9473 (H16)
Solar input													-863.0060 (H17)
Solar input	-25.0255	-41.7603	-71.1226	-95.3182	-117.7577	-115.7745	-114.2445	-99.8160	-78.1760	-53.3850	-29.6838	-20.9420	(63)
								Solar input (sum of months) = Sum(63)m =					-863.0060 (63)
Output from w/h													
	160.8086	121.4606	98.9339	55.1747	28.2908	12.7152	7.3065	36.1803	58.4481	102.8385	137.8733	159.7882	(64)
								Total per year (kWh/year) = Sum(64)m =					979.8186 (64)
Heat gains from water heating, kWh/month													
	59.5980	52.2971	54.3727	47.9619	46.4323	40.6828	38.3202	43.1017	43.3673	49.7907	53.6072	57.9075	(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	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.5273	50.2071	40.8311	30.9118	23.1069	19.5078	21.0789	27.3992	36.7751	46.6944	54.4993	58.0984	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	366.2786	370.0795	360.5015	340.1112	314.3720	290.1809	274.0197	270.2188	279.7968	300.1871	325.9263	350.1174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	(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)	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	(71)
Water heating gains (Table 5)	80.1049	77.8231	73.0817	66.6137	62.4090	56.5039	51.5056	57.9323	60.2324	66.9230	74.4545	77.8326	(72)
Total internal gains	613.0252	608.2240	584.5286	547.7510	510.0023	476.3069	456.7186	465.6647	486.9186	523.9190	564.9944	596.1628	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d		Gains W

North				7.6500	10.6334		0.6300		0.7000	0.7700		24.8602 (74)
South				6.7500	46.7521		0.6300		0.7000	0.7700		96.4443 (78)
West				1.3200	19.6403		0.6300		0.7000	0.7700		7.9231 (80)

Solar gains	129.2276	220.9592	307.4560	394.3004	457.2696	461.7516	441.8688	393.0931	336.9284	245.3094	154.8668	110.5770 (83)
Total gains	742.2528	829.1832	891.9846	942.0514	967.2719	938.0585	898.5874	858.7578	823.8470	769.2283	719.8612	706.7398 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.6881	57.8493	58.0083	58.7666	58.9107	59.5908	59.5908	59.7185	59.3270	58.9107	58.6199	58.3190	
alpha	4.8459	4.8566	4.8672	4.9178	4.9274	4.9727	4.9727	4.9812	4.9551	4.9274	4.9080	4.8879	
util living area	0.9933	0.9876	0.9748	0.9396	0.8545	0.6909	0.5224	0.5654	0.7940	0.9492	0.9871	0.9946	(86)
MIT	19.8635	20.0163	20.2494	20.5487	20.8015	20.9505	20.9899	20.9852	20.8988	20.5840	20.1723	19.8358	(87)
Th 2	19.9170	19.9197	19.9223	19.9347	19.9370	19.9478	19.9478	19.9498	19.9436	19.9370	19.9323	19.9274	(88)
util rest of house	0.9911	0.9836	0.9663	0.9183	0.8040	0.5979	0.4033	0.4449	0.7128	0.9268	0.9822	0.9929	(89)
MIT 2	18.4276	18.6507	18.9878	19.4165	19.7462	19.9156	19.9442	19.9440	19.8668	19.4741	18.8878	18.3948	(90)
Living area fraction									fLA = Living area / (4) =			0.2042	(91)
MIT	18.7209	18.9296	19.2455	19.6477	19.9617	20.1269	20.1578	20.1566	20.0776	19.7008	19.1501	18.6891	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7209	18.9296	19.2455	19.6477	19.9617	20.1269	20.1578	20.1566	20.0776	19.7008	19.1501	18.6891	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9876	0.9785	0.9593	0.9113	0.8053	0.6148	0.4277	0.4695	0.7243	0.9205	0.9772	0.9900	(94)
Useful gains	733.0779	811.3585	855.7097	858.5155	778.9828	576.7108	384.3438	403.1817	596.7428	708.0977	703.4296	699.6609	(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	1623.4821	1575.0343	1426.9489	1187.7567	910.7939	602.3487	387.7402	408.5369	654.3550	1003.2875	1335.0208	1613.5198	(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	662.4607	513.1901	425.0019	237.0537	98.0674	0.0000	0.0000	0.0000	0.0000	219.6212	454.7457	679.9111	(98)
Space heating												3290.0519	(98)
Space heating per m2											(98) / (4) =	35.1802	(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 %)												92.8000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3545.3146 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	662.4607	513.1901	425.0019	237.0537	98.0674	0.0000	0.0000	0.0000	0.0000	219.6212	454.7457	679.9111 (98)
Space heating efficiency (main heating system 1)	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000 (210)
Space heating fuel (main heating system)	713.8586	553.0066	457.9762	255.4458	105.6761	0.0000	0.0000	0.0000	0.0000	236.6608	490.0277	732.6628 (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 requirement	160.8086	121.4606	98.9339	55.1747	28.2908	12.7152	7.3065	36.1803	58.4481	102.8385	137.8733	159.7882 (64)
Efficiency of water heater (217)m	89.3005	89.3105	89.3170	89.3171	89.2279	87.3000	87.3000	87.3000	87.3000	88.9873	89.2057	89.3133 (217)
Fuel for water heating, kWh/month	180.0758	135.9980	110.7671	61.7739	31.7062	14.5650	8.3694	41.4436	66.9509	115.5654	154.5566	178.9075 (219)
Water heating fuel used												1100.6795 (219)
Annual totals kWh/year												
Space heating fuel - main system												3545.3146 (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)
pump for solar water heating												50.0000 (230g)
Total electricity for the above, kWh/year												125.0000 (231)
Electricity for lighting (calculated in Appendix L)												399.3161 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.75 * 1029 * 1.00) =										-617.5120		-617.5120 (233)
Total delivered energy for all uses												4552.7982 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3545.3146	3.4800	123.3769 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1100.6795	3.4800	38.3036 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Pump for solar water heating	50.0000	13.1900	6.5950 (249)
Energy for lighting	399.3161	13.1900	52.6698 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-617.5120	13.1900	-81.4498 (252)
Total energy cost			269.3881 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.8168 (257)
SAP value		88.6057
SAP rating (Section 12)		89 (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	3545.3146	0.2160	765.7879 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1100.6795	0.2160	237.7468 (264)
Space and water heating			1003.5347 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	399.3161	0.5190	207.2451 (268)
Energy saving/generation technologies			
PV Unit	-617.5120	0.5190	-320.4887 (269)
Total kg/year			955.1660 (272)
CO2 emissions per m2			10.2100 (273)
EI value			90.7600
EI rating			91 (274)
EI band			B

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7600 (1b)	x 2.3100 (2b)	= 108.0156 (1b) - (3b)
First floor	46.7600 (1c)	x 2.6900 (2c)	= 125.7844 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.5200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.8000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1283 (8)
Pressure test					Yes
Measured/design q50					5.8800
Infiltration rate					0.4223 (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) =		0.3590 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.0000	4.6000	4.4000	4.2000	4.4000	4.0000	4.1000	3.9000	4.0000	4.4000	4.3000	4.6000 (22)
Wind factor	1.2500	1.1500	1.1000	1.0500	1.1000	1.0000	1.0250	0.9750	1.0000	1.1000	1.0750	1.1500 (22a)
Adj infilt rate	0.4487	0.4128	0.3949	0.3769	0.3949	0.3590	0.3679	0.3500	0.3590	0.3949	0.3859	0.4128 (22b)
Effective ac	0.6007	0.5852	0.5780	0.5710	0.5780	0.5644	0.5677	0.5612	0.5644	0.5780	0.5745	0.5852 (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					
Opening Type 1			2.1200	1.1000	2.3320		(26)					
Opening Type 2 (Uw = 1.40)			15.7200	1.3258	20.8409		(27)					
Opening Type 3			1.9700	1.4000	2.7580		(26a)					
Heat Loss Floor 1			46.7600	0.1600	7.4816		(28a)					
External Wall 1	97.1500	19.8100	77.3400	0.2500	19.3350		(29a)					
External Roof 1	46.7600		46.7600	0.1100	5.1436		(30)					
Total net area of external elements Aum(A, m2)			190.6700				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.8911		(33)					
Party Wall 1			43.6700	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)								8.0296 (36)				
Total fabric heat loss						(33) + (36) =	65.9207 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 46.3441	Feb 45.1511	Mar 44.5918	Apr 44.0575	May 44.5918	Jun 43.5479	Jul 43.7996	Aug 43.3025	Sep 43.5479	Oct 44.5918	Nov 44.3215	Dec 45.1511 (38)
Heat transfer coeff	112.2648	111.0718	110.5126	109.9782	110.5126	109.4687	109.7203	109.2232	109.4687	110.5126	110.2423	111.0718 (39)
Average = Sum(39)m / 12 =												110.3373 (39)
HLP	Jan 1.2004	Feb 1.1877	Mar 1.1817	Apr 1.1760	May 1.1817	Jun 1.1705	Jul 1.1732	Aug 1.1679	Sep 1.1705	Oct 1.1817	Nov 1.1788	Dec 1.1877 (40)
HLP (average)												1.1798 (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												2.6709 (42)
Average daily hot water use (litres/day)												97.6339 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	107.3973	103.4919	99.5866	95.6812	91.7759	87.8705	87.8705	91.7759	95.6812	99.5866	103.4919	107.3973 (44)
Energy content (annual)	159.2671	139.2960	143.7410	125.3169	120.2446	103.7619	96.1507	110.3343	111.6520	130.1197	142.0358	154.2417 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8901	20.8944	21.5612	18.7975	18.0367	15.5643	14.4226	16.5501	16.7478	19.5180	21.3054	23.1363 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	26.5669	23.9248	26.3154	25.1760	25.8039	24.7278	25.4004	25.6620	24.9720	26.1038	25.5213	26.4885 (61)
Total heat required for water heating calculated for each month	185.8340	163.2208	170.0565	150.4929	146.0485	128.4898	121.5510	135.9963	136.6241	156.2235	167.5571	180.7302 (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												1293.6477 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2173.3282 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.4148 (H8)
Utilisation factor												0.5068 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												97.6339 (H14)
Volume ratio Veff/V												0.7682 (H15)
Solar storage volume factor												0.9473 (H16)
Solar input												-917.3917 (H17)
Solar input	-30.3246	-42.2755	-71.3390	-99.1769	-118.2984	-125.1486	-122.5937	-107.8074	-83.8556	-57.4692	-34.4930	-24.6099 (63)
												Solar input (sum of months) = Sum(63)m = -917.3917 (63)
Output from w/h												
	155.5094	120.9453	98.7174	51.3160	27.7500	3.3412	0.0000	28.1889	52.7685	98.7543	133.0641	156.1203 (64)
												Total per year (kWh/year) = Sum(64)m = 926.4756 (64)
Heat gains from water heating, kWh/month												
	59.5980	52.2971	54.3727	47.9619	46.4323	40.6828	38.3202	43.1017	43.3673	49.7907	53.6072	57.9075 (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	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	160.2541	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.5273	50.2071	40.8311	30.9118	23.1069	19.5078	21.0789	27.3992	36.7751	46.6944	54.4993	58.0984	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	366.2786	370.0795	360.5015	340.1112	314.3720	290.1809	274.0197	270.2188	279.7968	300.1871	325.9263	350.1174	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	53.6963	(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)	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	-106.8361	(71)
Water heating gains (Table 5)	80.1049	77.8231	73.0817	66.6137	62.4090	56.5039	51.5056	57.9323	60.2324	66.9230	74.4545	77.8326	(72)
Total internal gains	613.0252	608.2240	584.5286	547.7510	510.0023	476.3069	456.7186	465.6647	486.9186	523.9190	564.9944	596.1628	(73)

6. Solar gains

[Jan]		Area m2		Solar flux Table 6a W/m2		Specific data or Table 6b		Specific data or Table 6c		Access factor Table 6d		Gains W	
North		7.6500		14.6401		0.6300		0.7000		0.7700		34.2276	(74)
South		6.7500		61.3950		0.6300		0.7000		0.7700		126.6509	(78)
West		1.3200		27.3735		0.6300		0.7000		0.7700		11.0427	(80)
Solar gains	171.9213	245.6853	340.3370	457.0323	515.5975	561.8224	533.0861	474.5870	400.2227	290.3906	197.5538	142.7023	(83)
Total gains	784.9465	853.9093	924.8657	1004.7833	1025.5998	1038.1293	989.8046	940.2517	887.1413	814.3096	762.5482	738.8651	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.8493	58.4707	58.7666	59.0521	58.7666	59.3270	59.1909	59.4603	59.3270	58.7666	58.9107	58.4707	
alpha	4.8566	4.8980	4.9178	4.9368	4.9178	4.9551	4.9461	4.9640	4.9551	4.9178	4.9274	4.8980	
util living area	0.9881	0.9821	0.9626	0.9039	0.7758	0.5538	0.3965	0.3926	0.6617	0.8955	0.9735	0.9901	(86)
MIT	20.0514	20.1526	20.3882	20.6766	20.8896	20.9838	20.9975	20.9978	20.9631	20.7571	20.3869	20.0458	(87)
Th 2	19.9197	19.9299	19.9347	19.9393	19.9347	19.9436	19.9415	19.9458	19.9436	19.9347	19.9370	19.9299	(88)
util rest of house	0.9840	0.9762	0.9498	0.8717	0.7070	0.4528	0.2813	0.2722	0.5569	0.8505	0.9627	0.9866	(89)
MIT 2	18.7024	18.8549	19.1936	19.5891	19.8419	19.9357	19.9409	19.9453	19.9227	19.6975	19.1986	18.7021	(90)
Living area fraction									fLA = Living area / (4) =			0.2042	(91)
MIT	18.9779	19.1200	19.4375	19.8112	20.0559	20.1497	20.1567	20.1603	20.1352	19.9139	19.4413	18.9765	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9779	19.1200	19.4375	19.8112	20.0559	20.1497	20.1567	20.1603	20.1352	19.9139	19.4413	18.9765	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9791	0.9702	0.9423	0.8672	0.7155	0.4731	0.3050	0.2969	0.5771	0.8495	0.9561	0.9823	(94)
Useful gains	768.5425	828.4553	871.4836	871.3389	733.8666	491.1611	301.8691	279.1628	511.9840	691.7293	729.0383	725.7689	(95)
Ext temp.	5.6000	5.8000	7.4000	9.8000	12.8000	15.6000	17.4000	17.6000	15.3000	12.2000	8.7000	5.8000	(96)
Heat loss rate W	1501.8683	1479.4730	1330.2996	1101.0161	801.8699	498.0543	302.4662	279.6407	529.3041	852.4809	1184.1411	1463.5421	(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	545.5944	437.4839	341.3591	165.3676	50.5944	0.0000	0.0000	0.0000	0.0000	119.5991	327.6740	548.9033	(98)
Space heating												2536.5758	(98)
Space heating per m2											(98) / (4) =	27.1234	(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 %)													92.8000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2733.3791 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	545.5944	437.4839	341.3591	165.3676	50.5944	0.0000	0.0000	0.0000	0.0000	119.5991	327.6740	548.9033	(98)
Space heating efficiency (main heating system 1)	92.8000	92.8000	92.8000	92.8000	92.8000	0.0000	0.0000	0.0000	0.0000	92.8000	92.8000	92.8000	(210)
Space heating fuel (main heating system)	587.9250	471.4266	367.8438	178.1979	54.5199	0.0000	0.0000	0.0000	0.0000	128.8784	353.0970	591.4906	(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 requirement	155.5094	120.9453	98.7174	51.3160	27.7500	3.3412	0.0000	28.1889	52.7685	98.7543	133.0641	156.1203	(64)
Efficiency of water heater (217)m	89.2332	89.2465	89.2268	89.1951	88.8983	87.3000	87.3000	87.3000	87.3000	88.6518	89.0634	89.2341	(217)
Fuel for water heating, kWh/month	174.2731	135.5183	110.6365	57.5323	31.2155	3.8272	0.0000	32.2897	60.4450	111.3957	149.4038	174.9558	(219)
Water heating fuel used												1041.4930	(219)
Annual totals kWh/year													
Space heating fuel - main system												2733.3791	(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)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												399.3161	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.75 * 1239 * 1.00) =										-743.2974		-743.2974	(233)
Total delivered energy for all uses												3555.8909	(238)

10a. Fuel costs - using BEDF prices (398)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2733.3791	4.2600	116.9886 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1041.4930	4.2800	44.5759 (247)
Pumps and fans for heating	75.0000	15.4400	11.5800 (249)
Pump for solar water heating	50.0000	15.4400	7.7200 (249)
Energy for lighting	399.3161	15.4400	61.6544 (250)
Additional standing charges			92.0000 (251)
Energy saving/generation technologies			
PV Unit	-743.2974	15.4400	-114.7651 (252)
Total energy cost			219.7538 (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	2733.3791	0.2160	590.4099 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1041.4930	0.2160	224.9625 (264)
Space and water heating			815.3724 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	399.3161	0.5190	207.2451 (268)
Energy saving/generation technologies			
PV Unit	-743.2974	0.5190	-385.7713 (269)
Total kg/year			701.7211 (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	2733.3791	1.2200	3334.7225 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1041.4930	1.2200	1270.6215 (264)
Space and water heating			4605.3440 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	399.3161	3.0700	1225.9005 (268)
Energy saving/generation technologies			
PV Unit	-743.2974	3.0700	-2281.9229 (269)
Primary energy kWh/year			3933.0716 (272)
Primary energy kWh/m2/year			42.0559 (273)

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

Overheating Calculation Input Data

Dwelling type SemiDetached House
 Number of storeys 2
 Cross ventilation possible Yes
 SAP Region South East England
 Front of dwelling faces North
 Overshading Average or unknown
 Thermal mass parameter 250.0
 Night ventilation Yes
 Ventilation rate during hot weather (ach) 4.00 (Windows half open)

 Overheating Calculation

Summer ventilation heat loss coefficient 308.62 (P1)
 Transmission heat loss coefficient 65.92 (37)
 Summer heat loss coefficient 374.54 (P2)

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

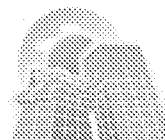
Solar shading Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	1.000	0.90	1.000	0.900 (P8)
South	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	7.6500	86.6589	0.6300	0.7000	0.9000	236.8089
South	6.7500	118.3991	0.6300	0.7000	0.9000	285.4800
West	1.3200	124.7972	0.6300	0.7000	0.9000	58.8440
total:						581.1329

	Jun	Jul	Aug	
Solar gains	615	581	519	(P3)
Internal gains	473	454	463	
Total summer gains	1088	1035	982	(P5)
Summer gain/loss ratio	2.91	2.76	2.62	(P6)
Summer external temperature	15.40	17.40	17.50	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	18.56	20.41	20.37	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	
Assessment of likelihood of high internal temperature: Not significant				

Southern Energy Consultants Ltd

Suite 36, Liberty House
The Enterprise Centre
Greenham Business Park
Newbury
Berkshire
RG19 6HS



Southern Energy
Consultants
Energy & Sustainability Solutions