Sustainability Statement & Energy Report

Client:
TAG Architects
14 Belsize Crescent
Hampstead
London
Greater London
NW3 5QU

Project:
5 Kemplay Road
London
Greater London
NW3 1TA

Document Ref: K:\Clients\TAG Architects\Kemplay Road_Right of Light work\Sustainability Statement\ MES Sustainability Statement - TAG Architects - Kemplay Road

Date: 02/09/2013

Author:
M. C. W. Crowther
Sustainability Consultant

MES Energy Services
Newark Beacon,
Beacon Hill Office Park,
Cafferata Way,
Newark
Nottinghamshire NG24 2TN.

Tel: 01636 653 055 Fax: 01636 653 010
Email: info@mesenergyservices.co.uk
www.mesenergyservices.co.uk

About *MES Energy Services*

MES Energy Services **is an established consultancy practice specialising in providing sustainable building solutions throughout the UK.**

We offer a full range of services for both residential and commercial buildings from small individual properties through to highly complex mixed used developments.

We are an industry leader in delivering a professional, accredited and certified service to a wide range of clients including architects, developers, builders, housing associations & the public sector.

Employing highly qualified staff, our team comes from a variety of backgrounds within the construction industry with combined knowledge of building design, engineering, assessment, construction, development, research and surveying.

We are renowned for our creative thinking and always provide a high quality, honest and diligent service. We achieve long-term relationships with our clients with nearly all of our business coming from existing clients or recommendation.

MES Energy Services maintains its position at the forefront of changes in building regulations as well as technological advances. Our clients, large or small are therefore assured of a cost effective, cohesive and fully integrated professional service.

About the Author

Matthew Crowther is a Sustainability Consultant within MES Energy Services and has several years experience in sustainable construction and is a fully qualified On Construction SAP energy assessor.

Contents

Section 1: Introduction

The purpose of this Sustainability Statement is to provide an overview of how sustainability will be promoted both during and after construction and to establish the predicted energy requirements for the proposed development. It illustrates how energy efficiency measures, in conjunction with renewable generation, can be used to reduce the predicted energy consumption and associated carbon dioxide emissions.

The report is produced in support of the planning application to fulfil the requirements of London Borough of Camden in accordance with the following development plan documents:

Camden Planning Guidance (CPG3),
Camden Core Strategy 2010-2025 CS13. Tackling climate change through promoting higher environmental standards,
Energy Planning GLA Guidance on preparing energy assessments.
DP22 - Promoting sustainable design and construction

Included in the report are details of how the development will address the following:

- The energy hierarchy
- Renewable technologies
- Code for Sustainable Homes

The following areas are investigated:

1. Environmental Rating - Achieve at least Code for Sustainable Homes Level 4 rating for dwellings.

2. Energy Assessment - Design the scheme for minimum energy use and CO2 emissions

3. Water consumption - Use water conservation devices and recycling techniques

4. Materials - Specify environmentally-friendly construction materials

5. Flood risk management - Prevent water pollution and overburdening of drainage systems

6. Recycling - Provide internal/ external recycling facilities

7. Health – Achieve Lifetime Homes criteria

8. Management- Reduce adverse impact of construction process on quality of site and its surroundings

9. Secure by design - Adopt best practice in the secure design of the development

10. Ecology – Maintain or improve site biodiversity

11. Quality – Building for life

12. Public Transport & **Cycling and Walking** - Facilitate the use of public transport and ensure development design encourages cycling and walking

13. Light pollution - Mitigate light pollution

14. Site contamination - Investigate potential contamination of site.

Issues 1 to 12 are assessed in the Code for Sustainable Homes and Camden Development Policy DP22 require that new build homes achieve Code for Sustainable Homes Level 4.

Section 2: Description of the development

Location

The site is located at 5 Kemplay Road, London. The proposal is to construct a new dwelling. The area is predominantly residential with existing three and four storey dwellings directly adjacent to the site and Hampstead Ponds less than half a mile to the North East.

Figure 2.1: Site Location Plan

Orientation

The proposed development is orientated so that its frontage faces Kemplay Road to the North. This is a new building; however the choice of orientation is limited due to site constraints. The design allows for the house to benefit from sunlight in both living areas and bedrooms.

Figure 2.2: Proposed plans

Figure 2.3: Proposed Elevations

Section 3: Energy

3.1 The Energy Hierarchy

The energy hierarchy is generally accepted as the most effective way of reducing building carbon emissions. This is highlighted and recognised in the 2011 edition of the London Plan in the Mayor's energy hierarchy;

1. Be lean: use less energy
2. Be clean: supply energy efficiently
3. Be green: use renewable energy

Development proposals should:

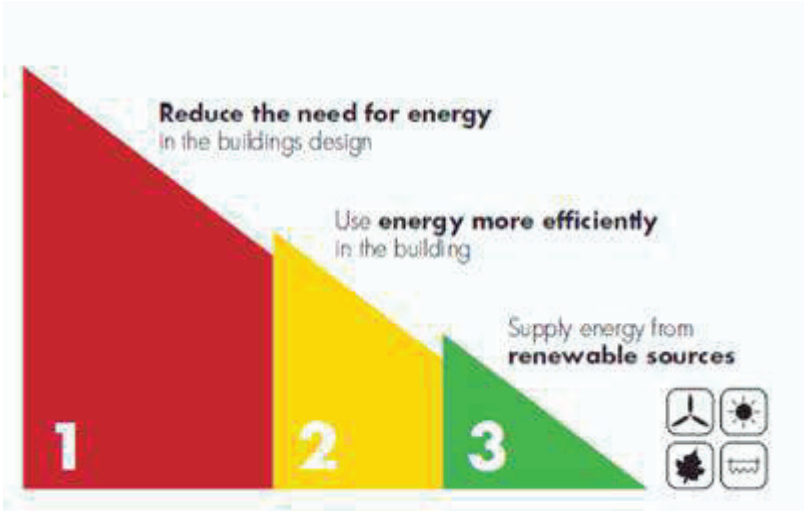


Figure 3.1: The Energy Hierarchy

- ***Reducing energy demand***

The first step in the process of reducing the overall energy used and CO_2 produced by the building is to minimise the energy required to heat it. A well insulated building envelope and passive design will reduce the energy requirement for heating and ventilating the building.

- ***Energy efficient systems and appliances***

The second step is to specify services and controls, lighting and appliances that are energy efficient and which result in further reduction in energy requirements.

- ***Making use of Low or zero-carbon (LZC) technologies***

When the energy demand has been reduced by implementing the processes of improving the fabric and energy efficiency, then LZC technologies can be employed to reduce the environmental impact of the remaining energy consumption.

3.2 Calculating Baseline Energy Demand

Summary of section 3.2 *(Baseline)*	
Total estimated baseline site emissions (tonnes CO_2 per year)	7.23 (A)

Energy used in a building is divided between that which is regulated (Heating, Cooling, Hot water, Ventilation & Lighting) and that which is said to be associated with the building in use (Equipment and Appliances).

The first step is to calculate a Building Regulations Part L 2010 compliant specification in order to establish baseline emissions for the development. The government approved SAP2009 methodology has been used to establish baseline energy requirements to comply with the 2010 edition of Part L. A summary of the specification used in this calculation is shown in table 3.A, below.

Element	Specification
Walls	0.30W/m²K
Basement Wall	0.30W/m²K
Roof	0.18W/m²K
Ground Floor	0.20W/m²K
Basement Floor	0.18W/m²K
Openings	1.60W/m²K (for windows and roof lights) / 1.80W/m²K (for solid doors)
Air Permeability	5.10m³/m²/hr
Ventilation	Intermittent extract fans
Thermal Bridging	Accredited Construction Details
Lighting	75% low energy lamps
Heating (1) Space LGF & GF + DHW	89% Efficient Gas Combi Boiler
Heating Space + Cooling FF & TF	250% Efficient air to air heat pump
Secondary Heating	HETAS approved wood log only fire

Table 3.A: Sample model baseline specification

Total Area (m^2)	Carbon Emissions (tonns CO_2 per year)										Total Site Emissions inc. Unregulated Emissions (tonnes CO_2 per year)
	Space Heating (1) *SAP (261)*	Space Heating (2) *SAP (262)*	Secondary Heating *SAP (263)*	Water Heating *SAP (264)*	Space Cooling *SAP (266)*	Pumps & Fans *SAP (267)*	Lighting *SAP (268)*	Appliances *SAP (ZC2) per m2*	Cooking *SAP (ZC3) per m2*	Additional Allowable Generation	
286	1.59	1.27	0.03	0.60	0.07	0.32	0.45	2.70	0.19	0.00	7.23
										Total:	**7.23**

Table 3.B: Estimated baseline carbon dioxide (CO_2) emissions. (tonnes CO_2 per year)

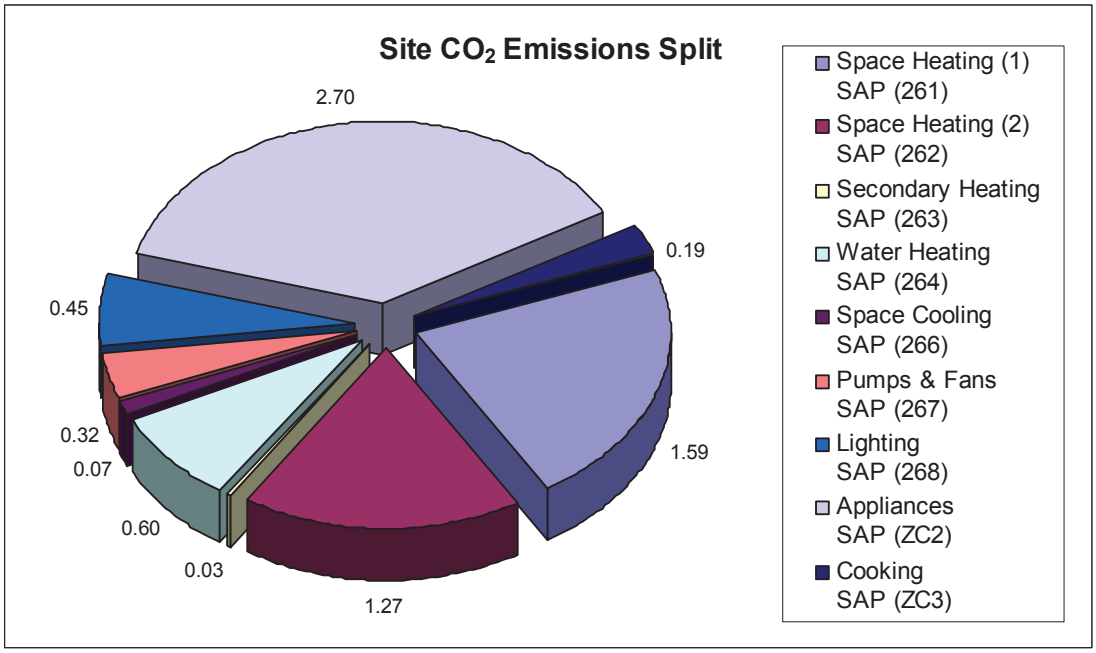


Figure 3.2: Estimated baseline carbon dioxide emissions (tonnes CO_2 per year) split.

Figure 3.2 shows how the CO2 emissions are spit between all the regulated and unregulated areas.

3.3 Energy Efficiency Measures (Be lean)

Summary of section 3.3 *(Be lean)*	
Improvement over estimated Building Regulations 2010 carbon dioxide CO_2 emissions (tonnes CO_2 per year)	0.21 (B)
% improvement over total baseline site emissions ((100 ÷ A) x B)	3 %

The first requirement, from the Mayor's energy hierarchy, is to reduce the energy consumption of a building using passive measures. However, as the new 2010 Part L is already very stringent in terms of its energy and CO_2 targets the reduction possible from further improvement to the building fabric and services is reduced.

Table 3.D show the effect of improving the buildings fabric as outlined in table 3.C. The increased fabric efficiency has reduced emissions as shown in the summary of section 3.3 above.

Table 3.C, shows a revised specification for the house that has an improved fabric specification in order to further reduce heat loss and therefore, CO_2 emissions.

Element	Specification
Walls	0.25W/m²K
Basement Wall	0.22W/m²K
Roof	0.16W/m²K
Ground Floor	0.20W/m²K
Basement Floor	0.18W/m²K
Openings	1.50W/m²K (for windows and roof lights) / 1.20W/m²K (for solid doors)
Air Permeability	5.10m³/m²/hr
Ventilation	Intermittent extract fans
Thermal Bridging	Accredited Construction Details
Lighting	75% low energy lamps
Heating (1) Space LGF & GF + DHW	89% Efficient Gas Combi Boiler
Heating Space + Cooling FF & TF	250% Efficient air to air heat pump
Secondary Heating	HETAS approved wood log only fire

Table 3.C: Sample model improved fabric specification

Total Area (m^2)	Carbon Emissions (tonns CO_2 per year)										Total Site Emissions inc. Unregulated Emissions (tonnes CO_2 per year)
	Space Heating (1) *SAP (261)*	Space Heating (2) *SAP (262)*	Secondary Heating *SAP (263)*	Water Heating *SAP (264)*	Space Cooling *SAP (266)*	Pumps & Fans *SAP (267)*	Lighting *SAP (268)*	Appliances *SAP (ZC2) per m2*	Cooking *SAP (ZC3) per m2*	Additional Allowable Generation	
286	1.47	1.18	0.03	0.60	0.07	0.32	0.45	2.70	0.19	0.00	7.02
										Total:	**7.02**

Table 3.D: Improved fabric carbon dioxide (CO_2) emissions. (tonnes CO_2 per yr)

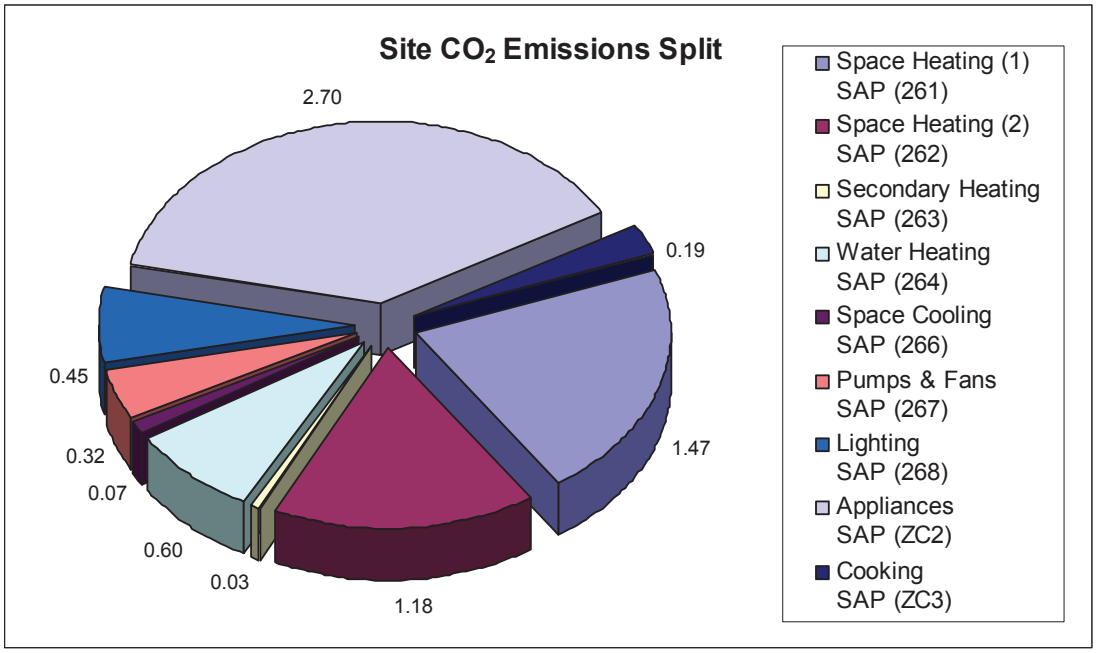


Figure 3.3: Estimated baseline carbon dioxide emissions (tonnes CO_2 per year) split.

Figure 3.3 demonstrates how the improvements detailed in table 3.C reduce the space heating and cooling CO_2 emissions by reducing improving the fabric of the building.

3.4 Supplying Energy Efficiently (Be clean)

Summary of section 3.4 *(Be lean + Be clean)*	
Improvement over estimated Building Regulations 2010 carbon dioxide CO_2 emissions (tonnes CO_2 per year)	**0.40 (C)**
% improvement over total baseline site emissions ((100 ÷ A) x C)	**6 %**

It is a requirement to consider the application of both CHP technology and/or a district heating scheme on all new developments unless it is not possible on the site.

In this case, CHP is not considered suitable as discussed in section 3.5 and no facility for linking the existing building into either an existing or future district heating or decentralised heating system exists.

Table 3.F show the effect of improving the buildings services as outlined in table 3.E. This combined with the improvements to the fabric of the building has resulted in the reduction in emissions shown in the summary table above.

Table 3.E below shows the specification with the mechanical services improvements that are feasible for the apartments.

Element	Specification
Walls	0.25W/m²K
Basement Wall	0.22W/m²K
Roof	0.16W/m²K
Ground Floor	0.20W/m²K
Basement Floor	0.18W/m²K
Openings	1.50W/m²K (for windows and roof lights) / 1.20W/m²K (for solid doors)
Air Permeability	5.10m³/m²/hr
Ventilation	Intermittent extract fans
Thermal Bridging	Accredited Construction Details
Lighting	100% low energy lamps
Heating (1) Space LGF & GF + DHW	89% Efficient Gas Combi Boiler with a delayed start stat and enhanced load/weather compensation
Heating Space + Cooling FF & TF	250% Efficient air to air heat pump
Secondary Heating	HETAS approved wood log only fire

Table 3.E: Sample model baseline specification

Total Area (m^2)	Carbon Emissions (tonns CO_2 per year)										Total Site Emissions inc. Unregulated Emissions (tonnes CO_2 per year)
	Space Heating (1) *SAP (261)*	Space Heating (2) *SAP (262)*	Secondary Heating *SAP (263)*	Water Heating *SAP (264)*	Space Cooling *SAP (266)*	Pumps & Fans *SAP (267)*	Lighting *SAP (268)*	Appliances *SAP (ZC2) per m2*	Cooking *SAP (ZC3) per m2*	Additional Allowable Generation	
286	1.40	1.16	0.03	0.60	0.07	0.32	0.36	2.70	0.19	0.00	6.82
										Total:	**6.82**

Table 3.F: Improved services carbon dioxide (CO_2) emissions. (tonnes CO_2 per yr)

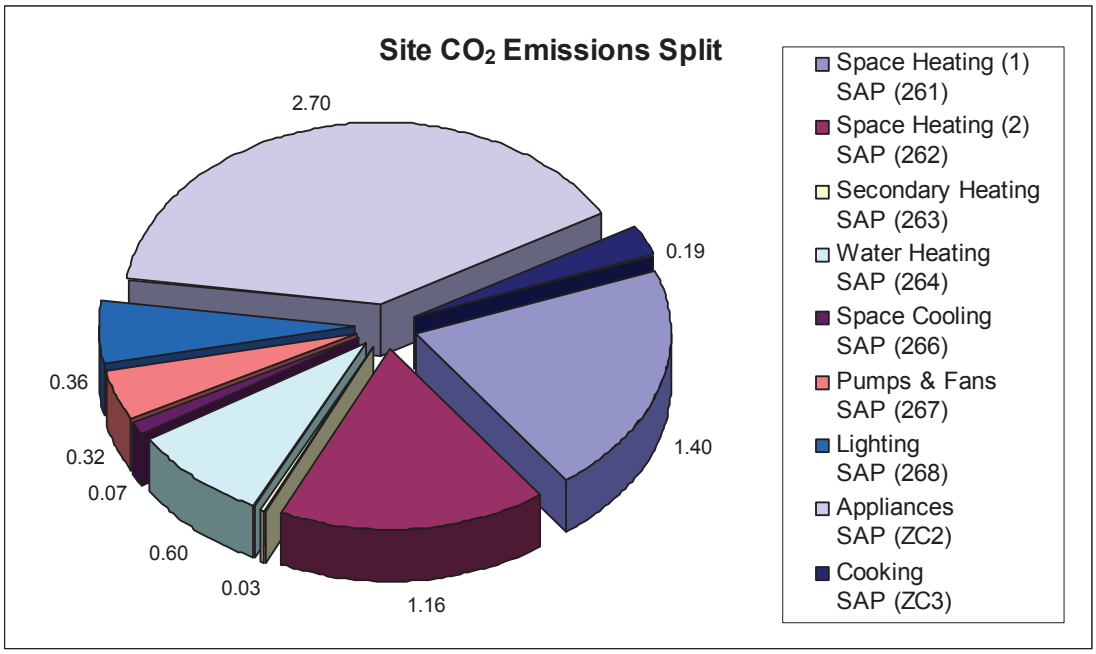


Figure 3.4: Estimated baseline carbon dioxide emissions (tonnes CO_2 per year) split.

Figure 3.4 demonstrates how the improvements detailed in table 3.E further reduce the space heating and cooling CO_2 emissions by incorporating more advanced heating controls and installing 100% low energy lighting.

3.5 CO_2 reduction through the use of renewable or low carbon technology (Be green)

Summary of section 3.5 *(Be lean + Be clean + Be green)*	
Improvement over estimated Building Regulations 2010 carbon dioxide CO_2 emissions (tonnes CO_2 per year)	1.77 (D)
Total Cumulative Savings % improvement over total baseline site emissions ((100 ÷ A) x D)	24 %
Proposed Renewable	**3kWp Photovoltaic Panel Array**
Site CO_2 after first 2 stages of the energy hierarchy (tonnes CO_2 per year)	**6.82 (E)**
Improvement over estimated site carbon dioxide CO_2 emissions (tonnes CO_2 per year)	**1.36 (F)**
Reduction in CO_2 emissions from on-site renewable energy. ((100 ÷ E) x F)	**20 %**

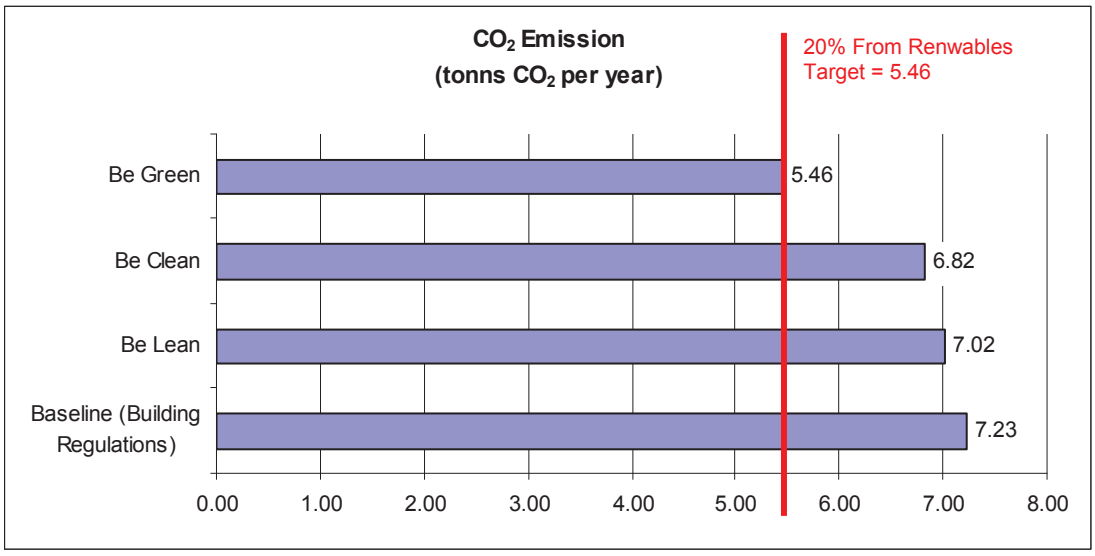


Figure 3.5: Site emissions at each stage of the energy hierarchy (tonnes CO_2 per year)

The proposal is to use the south elevation and install 3kWp of PV on the flat rood areas. Based on a preliminary SAP calculation a 3kWp PV array facing south at between 11 to 37 degrees will generate 2,575 kWh of electricity per year. This offsets a total of 1.36 tonnes CO_2 per year. Table 3.F shows the improvements outlined in sections 3.3 and 3.4 as well as the CO_2 saving from the additional allowable generation.

The summary table above shows how this site meets planning requirements to achieve a reduction of 20% in emissions through a renewable technology.

Total Area (m^2)	Carbon Emissions (tonns CO_2 per year)										Total Site Emissions inc. Unregulated Emissions (tonnes CO_2 per year)
	Space Heating (1) *SAP (261)*	**Space Heating (2)** *SAP (262)*	**Secondary Heating** *SAP (263)*	**Water Heating** *SAP (264)*	**Space Cooling** *SAP (266)*	**Pumps & Fans** *SAP (267)*	**Lighting** *SAP (268)*	**Appliances** *SAP (ZC2) per m2*	**Cooking** *SAP (ZC3) per m2*	**Additional Allowable Generation**	
286	1.40	1.16	0.03	0.60	0.07	0.32	0.36	2.70	0.19	-1.36	5.46
										Total:	**5.46**

Table 3.F: Improved services carbon dioxide (CO_2) emissions. (tonnes CO_2 per yr)

Based on a 250 watt PV panel the site will require 12 PV panels (3 kWp) that will cover approximately 20m^2 of the roof. This is assuming a south orientation with the panels elevated to at least 11 degrees from the horizontal. An array of this size should be feasible and could be mounted nearly horizontally on the flat roof areas of the house to minimise the visual impact of the renewable.

With current levels of feed in tariff, a system of this capacity would require an initial investment of around £4,860.00 to £6,830.00 and give a payback period of around 9 years (income and savings of approximately £520 per year).

Energy resources accepted as renewable or low carbon technologies are defined by the Department of Energy & Climate Change Low Carbon Buildings Program as:

- Solar photovoltaics
- Wind turbines
- Small hydro
- Solar thermal hot water
- Ground source heat pumps
- Air source heat pumps
- Bio-energy
- Renewable CHP
- Micro CHP (Combined heat and power)

Solar Photovoltaics

Solar panel electricity systems, also known as solar photovoltaics (PV), capture the sun's energy using photovoltaic cells. These cells do not need direct sunlight to work – they can still generate some electricity on a cloudy day. The cells convert the sunlight into electricity, which can be used to run household appliances and lighting.

This is the chosen renewable technology on the site.

Wind Turbines

Wind turbines harness the power of the wind and use it to generate electricity. Forty percent of all the wind energy in Europe blows over the UK, making it an ideal country for domestic turbines. Urban sites such as the location of this development are generally unsuitable for wind turbine installations due to the interrupted turbulent wind flows caused by surrounding buildings and large obstacles. There are also possible issues with noise and 'flicker' for the neighbouring buildings. The DTI wind resource database for the site location (Grid ref: 330 753 (TQ2678)) records average wind speeds as shown in Table 3.G below. The British Wind Energy Association (BWEA) generally recommends an average wind speed of at least 7m/s for viable system performance.

Average wind speeds for grid ref: TQ2678	
45m above ground level	5.8m/s
25m above ground level	5.3m/s
10m above ground level	4.6m/s

Table 3.G: Average wind speeds available on site.

The urban nature of the site and low average wind speeds mean that a wind turbine cannot be recommended as a viable option for this development. There are also general issues surrounding the use of

building mounted turbines with the potential for excessive noise & vibration within the building.

As this building is located in an urban location with no spare land in which to locate a large turbine, building mounting would be the only option and is therefore not proposed as a practical solution for this building.

Small Hydro

Hydroelectricity generation uses running water to generate electricity, whether it's a small stream or a larger river. All streams and rivers flow downhill. Before the water flows down the hill, it has potential energy because of its height. Hydro power systems convert this potential energy into kinetic energy in a turbine, which drives a generator to produce electricity. Small, or 'micro' hydro generation requires a reliable source of flowing water with a reasonably constant flow velocity. Systems of this nature are normally installed in locations with a natural moving water source such as a river, stream or spring where part of the flow can be diverted through a generator.

There is no such source of flowing water in this case and small hydro generation is not an option for this development.

Solar Water heating

Solar water heating systems use free heat from the sun to warm domestic hot water. Solar hot water heating can generate a large proportion of a dwelling's annual DHW requirement. The displaced fuel would be mains gas meaning that the CO_2 savings of this type of system would be relatively low due to the low carbon intensity of the displaced fuel.

Consequently, solar thermal is not considered to be a suitable system for this development and the roof space would be better used for PV as it offsets electricity meaning the CO_2 saving is considerably more than solar thermal.

Heat Pumps

Heat pumps use similar technology as refrigerators but reversed. A refrigerant liquid is used as a medium to extract heat from a source and convert it into useful heat energy. The heat source used can be generally one of three types; the ground, the air or a body of water. Both ground and water sourced heat pumps use a long circuitous pipe through which a refrigerant is pumped. In ground sourced heat pumps this can be either a coiled pipe or 'slinky' that is buried in a series of horizontal trenches or a loop inside a vertical bore hole to depths that can be up to 200m or deeper. Water sourced heat pumps generally use a similar system to the 'slinky' used for ground sourced systems but either floated on or submerged in a body of water (either a large pool or running water source). Air source heat pumps have a refrigerant coil mounted outside the building through which is passed air so that heat can be extracted. All three types of heat pump generally use the collected heat from the source to heat water. The heated water can then be used for space heating and DHW. Heat pumps require an input of energy to drive pumps, this is usually electricity and so they cannot be considered to be zero carbon unless the supplied electricity is from renewable sources; they do however have very good efficiencies; energy produced by heat pumps is typically in the region of 2.5 times that which is required to run them, giving efficiencies of 250%.

Because the 'fuel' for heat pumps is usually grid supplied electricity there is not necessarily any substantial reduction in carbon emissions when compared to an efficient gas condensing heating system where gas is available on site.

An air to air heat pump is being used for space heating and cooling on the top two floors of this house that helps meet Building Regulations however due to the main heating fuel is gas we are unable to demonstrate any CO_2 savings from this renewable technology.

Bio Energy

The Low Carbon Buildings Programme (LCBP) defines biomass as follows:

"Biomass is often called 'bioenergy' or 'biofuels'. These biofuels are produced from organic materials, either directly from plants or indirectly from industrial, commercial, domestic or agricultural products. Biofuels fall into two main categories:

- *Woody biomass includes forest products, untreated wood products, energy crops, short rotation coppice (SRC), e.g. willow.*
- *Non-woody biomass includes animal waste, industrial and biodegradable municipal products from food processing and high energy crops, e.g. rape, sugar cane, maize."*

For small-scale domestic (and small scale commercial) applications of biomass the fuel usually takes the form of wood pellets, wood chips and logs.

The LCBP goes on to state:

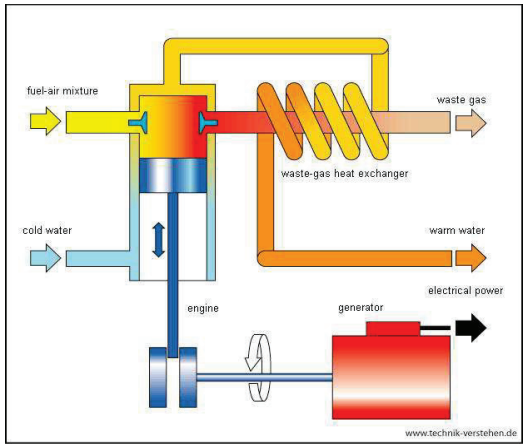
"There are two main ways of using biomass to heat a domestic property:

- *Stand-alone stoves providing space heating for a single room. These can be fuelled by logs or pellets but only pellets are suitable for automatic feed. Generally they are 5-11 kW in output, and some models can be fitted with a back boiler to provide water heating.*
- *Boilers connected to central heating and hot water systems. These are suitable for pellets, logs or chips, and are generally larger than 15 kW"*

(http://www.lowcarbonbuildings.org.uk/micro/biomass)

For this development, neither biomass boilers nor stand alone room heater are practical due to the physical nature (large duct runs creating heat losses and reducing CO_2 savings as well as minimal space for a large wood store and plant) and the location of the building making it difficult to maintain a local source of fuel and receive regular fuel deliveries to maintain heat and hot water year round.

Combined heat & power (CHP)



Combined heat and power uses an electricity generator, generally for this size of development a gas powered internal combustion engine, with heat recovery on the exhaust used to heat water for heating and domestic hot water supply. The proportions of heat and electricity produced are normally fixed and are in the region of 50:50. This requires a constant heat load throughout the year for the system to perform efficiently. This is not the case in domestic installations where the heating profile varies throughout the year making this technology unsuitable for this development.

Section 4: Sustainability Statement

Assessment under the Code for Sustainable Homes

This site aims to achieve the Code for Sustainable Homes Level 4 inline with Camden Development Policy DP22.

The Code for Sustainable Homes (CSH) provides an all-round measure of the sustainability of new homes. Nine categories are assessed and Credits are scored in each category. Some categories are mandatory however most are optional.

The CSH considers the wider sustainability issues associated with the site and its surroundings, the sustainable design & construction SPD supplementary document has been referenced and could be used to further enhance the sites sustainability measures.

Each category is weighted differently so that, for example, Credits gained in Category 1 (Energy & CO_2) are worth more overall percentage points than the Credits gained in Category 3 (Materials). The *Pre Assessment Estimator Tool* can be used to assist in predicting an overall score. A copy of the tool completed for this development is included in Appendix 1.

To achieve Code Level 4 a minimum of 25% reduction in emissions over Building Regulations 2010 must be achieved. It is highly recommend to aim for more than the minimum points at the Design Stage to allow for changes during construction.

CSH is a two stage assessment process; *Design Stage Assessment* and *Post Construction Stage Assessment*. Both stages require the collation of evidence (depending on where Credits are sought). However many of the Design Stage Assessment issues can be dealt with by a formal letter from the developer giving a specific undertaking.

The Post Construction Stage Assessment normally requires the collation of a significant amount of information to confirm the property complies with CSH requirement in its built form. It should also be remembered that changes in the specification of the development during construction can have an impact on the final Code points achieved.

Relationship between Total percentage points score and Code Level	
Total percentage points score (equal to or greater than)	**Code Levels**
36 Points	Level 1 (*)
48 Points	Level 2 (**)
57 Points	Level 3 (***)
68 Points	Level 4 (****)
84 Points	Level 5 (*****)
90 Points	Level 6 (******)

Total Credits available, Weighting Factors and Points			
Categories of Environmental Impact	**Total Credits in each Category**	**Weighting factor (% points contribution)**	**Approximate weighted value of each credit**
Category 1 – Energy and CO_2 Emissions	31	36.4%	1.17
Category 2 – Water	6	9.0%	1.50
Category 3 – Materials	24	7.2%	0.30
Category 4 – Surface Water Run-off	4	2.2%	0.55
Category 5 – Waste	8	6.4%	0.80
Category 6 – Pollution	4	2.8%	0.70
Category 7 – Health and Wellbeing	12	14.0%	1.17
Category 8 – Management	9	10.0%	1.11
Category 9 – Ecology	9	12.0%	1.33
Total	**–**	**100.0%**	**–**

A Code for Sustainable Homes pre-assessment has been completed by an accredited Code Assessor to determine how the specified Code Level could be achieved.

The purpose of the pre-assessment process is as a guide to achieving the desired Code Level for the development. CSH is a flexible process and it is often for the developer to decide in which areas they wish to gain points.

Developers will have different approaches to the way they wish to fulfil CSH requirements. For example some developers may want to meet Energy targets by installing LZC technologies (i.e. solar panels), however others may wish to gain points by increasing the insulation in the building fabric.

Some developers may want to meet the Water targets by installing smaller baths etc. whereas others will want more flexibility in the specification of showers, taps and baths and will therefore be prepared to install rain water harvesting collectors.

It should be remembered that certain areas are mandatory but most are optional (or tradable). Regard should also be given to the fact that some areas of CSH require reports by external consultants.

Category 1: *Energy & CO_2 emissions*

Category 1 of the Code for Sustainable Homes considers the energy efficiency and emissions from the property. The Code is structured so as to encourage energy efficiency through tradable Credits and mandatory standards for building emissions. Achieving Level 4 of the Code ensures that the development will be designed sustainably by reducing overall energy requirements and encouraging both energy efficiency and clean technologies:

- **Ene 1- *Dwelling Emission Rate (M)*:**
  To reach Code Level 4 the mandatory minimum requirement is to reduce AD L1A 2010 Target Emission Rate (TER) for carbon dioxide by at least 25%. We have carried out SAP calculations demonstrating that the house will achieve a 41% reduction in emissions and achieving 4.4 credits by reducing emissions by over 25% beyond the L1A TER.
  Code Credits: 4.4 **Technical Guide Page ref: 32**

- **Ene 2- *Fabric Energy Efficiency (M)*:**
  This is a measure of the heat losses from the building envelope and ventilation. After incorporating improvements detailed in section 3, and based on the preliminary SAP calculation, no credits will be achieved in this section.
  Code Credits: 0 **Technical Guide Page ref: 40**

- **Ene 3- *Energy Display Devices*:**
  Energy display devices encourage energy efficiency in the home and allow for better management of fuel use. We have therefore assumed the apartments will be fitted with devices that measure primary energy use and fuel consumption and will achieve two credits in this issue of the Code.
  Code Credits: 2 **Technical Guide Page ref: 46**

- **Ene 4- *Drying Space*:**
  This is an easy issue to gain the credit. We have therefore assumed the house will achieve the requirement by providing external drying facilities which reduce the need to use tumble dryers.
  Code Credits: 1 **Technical Guide Page ref: 50**

- **Ene 5- *Energy Labelled White Goods*:**
  The Code encourages the use of energy efficient white goods by awarding Credits for appliances with appropriate ratings under the EU energy Rating Scheme. We have assumed the apartments will achieve maximum credits by providing A+ rated

fridge & freezer, A rated washing machine & dishwasher and B rated tumble dryer.
Code Credits: 2 **Technical Guide Page ref: 54**

- **Ene 6- *External lighting*:**
  Fitting energy efficient lighting saves electricity and reduces emissions. Building regulations sets standards for internal lighting; requiring 75% of internal lighting is energy efficient. In addition the Code for Sustainable Homes encourages the use of energy efficient external lighting. Credits are scored by incorporating energy efficient, Code compliant, space and security light fittings etc. We have assumed the house will achieve the maximum requirements.
  Code Credits: 2 **Technical Guide Page ref: 58**

- **Ene 7- *LZC Technologies*:**
  The Code for Sustainable Homes does not insist on LZC technologies as it recognises that this can conflict with other aspects of the sustainability of the buildings design. However; the installation of LZCs are rewarded in the Code. Based on the preliminary SAP calculation the proposed LZC will achieve two credits in this area.
  Code Credits: 2 **Technical Guide Page ref: 63**

- **Ene 8- *Cycle Storage*:**
  The Code encourages the use of bicycles as an alternative to cars and other forms of public transport by rewarding the incorporation of suitable secure storage for a specified number of bicycles per dwelling. Because the home has no direct access to the rear garden it is assumed that there is insufficient space for cycle storage. We have therefore assumed the house will achieve no credits in this area.
  Code Credits: 0 **Technical Guide Page ref: 72**

- **Ene 9- *Home Office*:**
  The Code encourages working from home to reduce unnecessary journeys. By providing adequate space and provision for a home office area which it properly ventilated and has access to good levels of natural light it is possible to score one credit.
  Code Credits: 1 **Technical Guide Page ref: 77**

Category 2: *Water*

- **Wat 1- *Indoor Water Use (M)*:**
  Clean water is a precious resource and efforts to be efficient in its use and minimise waste are of ever growing in importance. Building regulations allow for a daily potable water consumption of 125 litres/person/day in new dwellings. To reach Code Level 4 the minimum requirement is to restrict average water usage to105 litres/person/day. We have assumed that this house will aim to restrict average water usage through high efficiency taps, low flow rate showers and small baths etc and achieve 4 credits.
  Code Credits: 3 **Technical Guide Page ref: 82**

- **Wat 2- *External Water Use*:**
  The Code encourages the utilisation of recycled water for use outside. This reduces the amount of valuable potable water required. We have assumed the available Credit will be gained by providing rainwater collection systems to provide irrigation water for any suitable outdoor space.
  Code Credits: 1 **Technical Guide Page ref: 87**

Category 3: *Materials*

- **Mat 1- *Environmental Impact of Materials (M)*:**
  The Code recognises the importance of choosing sustainable construction materials and sets minimum mandatory requirements in this Issue. The BRE Green Guide assesses the sustainability of a building element based on the materials used in its construction. Elements are rated from A+ to E (details are available at http://bre.co.uk/greenguide). Credits are gained by specifying constructions which are rated A+ to D in the Green Guide. As a minimum at least three of the five main building elements (roof, external walls, internal walls, upper and ground floors and windows) must fall into this category. The building will be specified to go beyond this minimum requirement and we have assumed a minimum of 12 out of the 15 available Credits will be achieved.
  Code Credits: 12 Technical Guide Page ref: 92

  The Code also promotes the use of responsibly sourced materials by ensuring that materials that are appropriately certified are used. The BES 6001:2008 "Framework for the Responsible Sourcing of Construction Products" is used to assess the suitability of products.
  The Code assesses basic building elements and finishing elements separately and we have assumed Credits will be gained as follows:

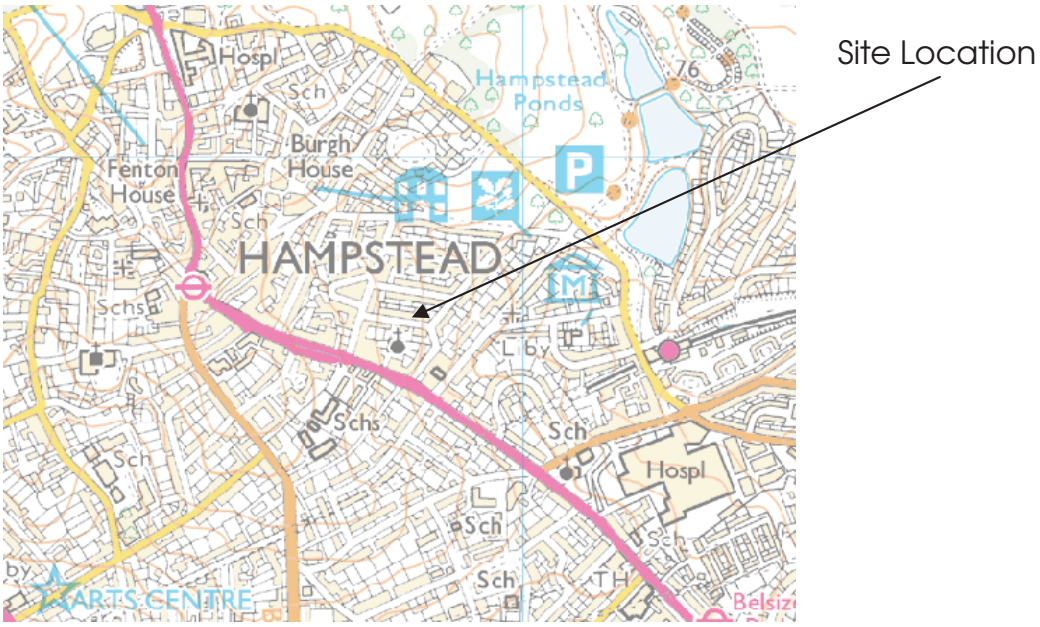
- **Mat 2- *Responsible Sourcing of Materials- Basic Building Elements*:**
  It is assumed that the design team will be targeting 4 credits here by specifying materials which are appropriately certified as legally and sustainably sourced.
  Code Credits: 4 Technical Guide Page ref: 97

- **Mat 3- *Responsible Sourcing of Materials- Finishing Elements* :**
  It is assumed that the design team will be targeting 2 credits here by specifying materials which are appropriately certified as legally and sustainably sourced.
  Code Credits: 2 Technical Guide Page ref: 113

Category 4: *Surface Water Run-Off*

- **Sur 1- *Management of Surface Water Runoff (M)*:**
  We have assumed that this development will meet the mandatory requirements in the Code by ensuring no increase in surface water run-off. There is an opportunity to achieve a tradable credit for the implementation of SUDs and a suitable SUD management/maintenance plan.
  Code Credits: 1 **Technical Guide Page ref: 124**

- **Sur 2- *Flood Risk*:**
  The code awards development in areas with a low risk of flooding or where mitigation measures are implemented in areas where a risk is identified. We have assumed two credits will be scored in this category as initial investigation seems to suggest the site is in Zone 1 for flooding. This will need to be confirmed by completing a flood risk assessment.
  Code Credits: 2 **Technical Guide Page ref: 143**



Category 5: *Waste*

- **Wst 1- *Storage of non-recyclable & recyclable household waste (M)*:**
  The Code has mandatory requirements in relation to dealing with household waste and recycling. We have assumed the development will gain the maximum Credits by adopting the local authority scheme. Initial investigation suggests that an appropriate post-collection sorting and recycling scheme is offered by Camden. Adequate internal storage will be provided (single 30L bin in a kitchen cupboard for example) along with a storage area provided for waste and recycling bins outside.
  Code Credits: 4 **Technical Guide Page ref: 150**

- **Wst 2- *Construction Site Waste Management*:**
  A site waste management plan will need to be developed including targets for resource efficiency in accordance with best practice. We assume a site waste management plan will be implemented with benchmarks, commitments and procedures for minimising and diverting 85% of waste from landfill in line with Checklist WAS2a, b and c.
  Code Credits: 3 **Technical Guide Page ref: 162**

- **Wst 3- *Composting*:**
  It is assumed that this credit will be achieved through the provision of home composting facilities or use of the local authority collection scheme. If the latter is the case then a storage area for the bin will be provided. This must be accessible (Inline with checklist IDP).
  Code Credits: 1 **Technical Guide Page ref: 169**

Category 6: *Pollution*

- **Pol 1- *Global Warming Potential (GWP) of Insulants*:**
  The Code discourages the use of materials that are harmful to the environment by rewarding the use of insulations with low Global Warming Potential (GWP). We have assumed the credit will not be achieved.
  Code Credits: 0 **Technical Guide Page ref: 175**

- **Pol 2- *NO_X Emissions*:**
  It is assumed that credits will not be achieved here due to the combination of an air to air heat pump and gas boiler.
  Code Credits: 0 **Technical Guide Page ref: 182**

Category 7: *Health and Wellbeing*

- **Hea 1- *Daylighting*:**
  The house is designed with large areas of glazing to the main habitable areas. The Code rewards design that takes best advantage of natural light, both to provide a healthy, pleasant interior environment and also to reduce the reliance on artificial lighting. We have assumed two credits will be sought and achieved. This will need to be confirmed via daylighting calculations at Design Stage.
  Code Credits: 2 Technical Guide Page ref: 192

- **Hea 2- *Sound Insulation*:**
  Robust details for party walls and floors can be used to ensure sound transmission between the apartments is minimised. A maximum of 4 Credits are available in the Code for designing to minimise sound transmission between dwellings. We have assumed that at least 3 credits will be sought in this area.
  Credits: 3 Technical Guide Page ref: 199

- **Hea 3- *Private Space*:**
  This house has its own private outdoor space and should achieve full credits in this area. The code encourages the provision of private space.
  Code Credits: 1 Technical Guide Page ref: 204

- **Hea 4- *Lifetime Homes*:**
  The Lifetime Homes standard is a set of 16 design criteria that provide a model for building accessible and adaptable homes. The Code rewards designs which incorporate these issues so as to create dwellings that can adapt to the changing needs of the occupier. It is assumed that all Criteria of Lifetime Homes will be met and 4 Credits achieved. Details of requirements can be found at: www.lifetimehomes.org.uk
  Credits: 4 Technical Guide Page ref: 208

  The 20 principles of Building for Life will also be considered. Some of these are covered within the Code for Sustainable Homes and have already been addressed, others will be considered separately, but due to the nature and scale of the project many of the issues are outside the control of the development.

Category 8: *Management*

- **Man 1- *Home User Guide*:**
  A home user guide will be provided covering both operational issues and the site and surrounding area.
  Credits: 3 **Technical Guide Page ref: 213**

- **Man 2- *Considerate Constructors Scheme*:**
  It is assumed that the site will be registered with the Considerate Contractors Scheme and that a beyond best practice score of at least 35 achieved.
  Credits: 2 **Technical Guide Page ref: 219**

- **Man 3- *Construction Site Impacts*:**
  Efforts will be made to reduce the impact of site activities by taking measures to reduce emissions and water consumption during the build. Best practice will be followed in relation to air and water pollution and where possible site timber will be reclaimed, re-used or responsibly sourced. We have assumed all Code Credits will be sought in this Issue.
  Credits: 2 **Technical Guide Page ref: 224**

- **Man 4- *Security*:**
  The Code encourages consideration to security and a suitably qualified consultant will be appointed in order to gain Credits here. The development will incorporate the principals of Secure by Design and act on the recommendations of the ALO/CPDA, who will be appointed early in the design stage.
  Credits: 2 **Technical Guide Page ref: 231**

Category 9: *Ecology*

- **Eco 1- *Ecological Value of Site*:**
  This site is assumed to have low ecological value. A suitably qualified ecologist will need to confirm this however we are assuming one credit will be achieved in this section.
  Credits: 1 **Technical Guide Page ref: 234**

- **Eco 2- *Ecological Enhancement*:**
  A suitably qualified ecologist will need to provide recommendations for improving the ecology on the site. It is assumed that all key recommendations and 30% additional recommendations will be incorporated into the scheme achieving full credits in this section.
  Credits: 1 **Technical Guide Page ref: 240**

- **Eco 3- Protection of Ecological Features:**
  This site is assumed to have low ecological value. A suitably qualified ecologist will need to confirm this however we are assuming one credit will be achieved in this section.
  Credits: 1 **Technical Guide Page ref: 245**

- **Eco 4- *Change in Ecological Values of Site*:**
  As we have assumed that the site has low ecological value we have also assumed that the green roofs and planted areas will achieve full credits in this section through major enhancements. This will need to be confirmed by a suitably qualified ecologist.
  Credits: 4 **Technical Guide Page ref: 250**

- **Eco 5- *Building Footprint*:**
  From initial calculations the site should achieve one credit in this section with a housing ratio of 2.5:1.
  Credits: 1 **Technical Guide Page ref: 261**

This specification will achieve **68.69%** and **Level 4** in Code for Sustainable Homes. The detailed Pre Assessment tool printout is included in Appendix 1.

Public Transport & Cycling and Walking

The development is in an urban location with public transport hubs within easy walking distance. Bus routes on Rosslyn Hill are within 100m and Hampstead Underground Station is approximately 0.5km from the house. Within a 1km radius there are retail outlets, food shops, banks, doctors surgeries, pharmacies, primary schools and secondary schools. Pedestrian and cycle access to the local facilities are good.

Light pollution

The development will be designed using best practice principals and ILE Guidance in order to minimise light pollution

Site contamination

We are not aware of any issues regarding site contamination.

Section 5: Summary and Conclusions

This report shows that the proposed development at 5 Kemplay Road, London, Greater London NW3 1TA considers and addresses all of the issues raised by Camden as detailed in their policy documents.

The report is written using Camden Planning Guidance (CPG3) and Energy Planning GLA Guidance on preparing energy assessments (September 2011).

Summary of section 3 *(Be lean + Be clean + Be green)*	
Proposed Renewable	**3kWp PV Array**
Reduction in CO_2 emissions from on-site renewable energy.	**20 %**

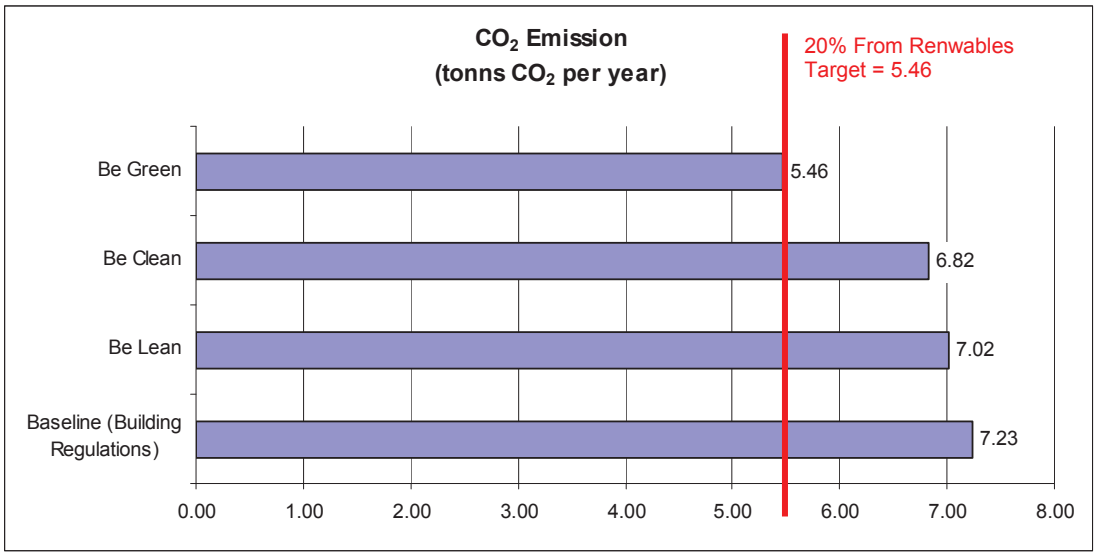


Figure 3.5: Site emissions at each stage of the energy hierarchy (tonnes CO_2 per year)

The proposal is to use the south elevation and install 3kWp of PV on the flat rood areas. Based on a preliminary SAP calculation a 3kWp PV array facing south at between 11 to 37 degrees will generate 2,575 kWh of electricity per year. This offsets a total of 1.36 tonnes CO_2 per year. Table 3.F shows the improvements outlined in sections 3.3 and 3.4 as well as the CO_2 saving from the additional allowable generation.

The included Code for Sustainable Homes Pre Assessment Tool confirm that if built to the specification detailed in this document the development can achieve **Level 4** certification in the Code for Sustainable Homes.

Appendix A:
Code for Sustainable Homes (Nov2010) Pre Assessment Tool output.

Code for Sustainable Homes

Technical Guide November 2010 - Full Technical Guide

Pre-Assessment Report

STROMA CERTIFIED CODE ASSESSOR

MES ENERGY SERVICES

Report Reference:	**TAG Architects - Kemplay Road - SAMPLE UNI**
Site Registration:	
Site Name:	**Kemplay Road 2013/08/07**
Assessor Number:	**STRO002281**
Company:	**MES Energy Services**
Assessor:	**Chris Jones**

THE CODE FOR SUSTAINABLE HOMES

CERTIFICATION MARK

Site Details

Site Name:	Kemplay Road 2013/08/07
Site Registration:	
Site Address:	Kemplay Road
City/Town:	London
County:	Greater London
Postcode:	NW3 1TA
No. of Dwellings:	1
No. of Dwelling Types:	0
Planning Authority:	Camden Council
Funding Body:	

Assessor Details

Company:	MES Energy Services
Assessor Name:	Chris Jones
Cert Number:	STRO002281
Address:	Newark Beacon Beacon Hill Office Park Cafferata Way
City/Town:	Newark
County:	Nottinghamshire
Postcode:	NG24 2TN
Tel:	01636 653 055
Email:	chris.jones@mesenergyservices.co.uk

Client Details

Company:	
Contact Name:	
Job Title:	
Email:	
Tel:	
Address:	
City/Town:	
County:	
Postcode:	

Architect Details

Company:	
Contact Name:	TAG Architects
Job Title:	
Email:	
Tel:	
Address:	
City/Town:	
County:	
Postcode:	

Developer Details

Company:	
Contact Name:	
Job Title:	
Email:	
Tel:	
Address:	
City/Town:	
County:	
Postcode:	

Dwelling ID	Plot No.	Address	Social Unit
1	1	Example Kemplay Road	No

Development Summary & Ratings

Dwelling ID	Dwelling Type	Description	Level	Score
		ExampleKemplay Road	4	68.69

Deviations from Standard

No deviations from standard

Score Sheet for Kemplay Road 2013/08/07

	ENE									WAT		MAT			SUR		WAS			POL		HEA				MAN				ECO					Summary	
Dwelling ID	1	2	3	4	5	6	7	8	9	1	2	1	2	3	1	2	1	2	3	1	2	1	2	3	4	1	2	3	4	1	2	3	4	5	Score	Level
1	4.4	0	2	1	2	2	2	0	1	3	1	12	4	2	1	2	4	3	1	0	0	2	3	1	4	3	2	2	2	1	1	1	4	1	68.69	4

Summary Score Sheet

Dwelling Type: Example Kemplay Road

Dwelling ID: 1

			Score Assessment				
	Credit Score	Credits Available	Sub Total	Credits Available	%	Weighting Factor	Points Score
Energy & CO2 Emissions							
ENE 1 Dwelling Emission Rate	4.4	10	14.4	31	46.45	36.4	16.91
ENE 2 Fabric Energy Efficiency	0	9					
ENE 3 Energy Display Device	2	2					
ENE 4 Drying Space	1	1					
ENE 5 Energy Labelled White Goods	2	2					
ENE 6 External Lighting	2	2					
ENE 7 Low or Zero Carbon Energy Technologies	2	2					
ENE 8 Cycle Storage	0	2					
ENE 9 Home Office	1	1					
Water							
WAT 1 Internal Water Use	3	5	4	6	66.67	9	6
WAT 2 External Water Use	1	1					
Materials							
MAT 1 Environmental Impact of Materials	12	15	18	24	75	7.2	5.4
MAT 2 Responsible Sourcing (Basic Building Elements)	4	6					
MAT 3 Responsible Sourcing (Finishing Elements)	2	3					
Surface Water Run-off							
SUR 1 Management of Surface Water Run-Off from Site	1	2	3	4	75	2.2	1.65
SUR 2 Flood Risk	2	2					
Waste							
WAS 1 Household Waste Storage and Recycling Facilities	4	4	8	8	100	6.4	6.4
WAS 2 Construction Site Waste Management	3	3					
WAS 3 Composting	1	1					
Pollution							
POL 1 Global Warming Potential of Insulants	0	1	0	4	0	2.8	0
POL 2 NOx Emissions	0	3					
Health & Wellbeing							
HEA 1 Daylighting	2	3	10	12	83.33	14	11.67
HEA 2 Sound Insulation	3	4					
HEA 3 Private Space	1	1					
HEA 4 Lifetime Homes	4	4					
Management							
MAN 1 Home User Guide	3	3	9	9	100	10	10
MAN 2 Considerate Constructors Scheme	2	2					
MAN 3 Construction Site Impacts	2	2					
MAN 4 Security	2	2					
Ecology							
ECO 1 Ecological Value of Site	1	1	8	9	88.89	12	10.67
ECO 2 Ecological Enhancement	1	1					
ECO 3 Protection of Ecological Features	1	1					
ECO 4 Change of Ecological Value of Site	4	4					
ECO 5 Building Footprint	1	2					
	Level Achieved: 4		**Total Points Scored: 68.69**				

Evidence for ENE 1 (Dwelling Emission Rate)
Improvement above Part L Building Regulations 2010. 4.4 credits allocated
A preliminary SAP calculation has been carried out and indicates 4.4 credits can be achieved.
Assumptions for ENE 1

Evidence for ENE 2 (Fabric Energy Efficiency)
Not Sought 0 credits allocated
Preliminary SAP calculation has been carried out and no credits are achieved for ENE2.
Assumptions for ENE 2

Evidence for ENE 3 (Energy Display Device)
Correctly specified display device showing current primary heating fuel consumption data. Correctly specified display device showing current consumption data.
It is assumed that a smart meter will be installed and will allow for monitoring and display of electricity use and primary heating.
Assumptions for ENE 3

Evidence for ENE 4 (Drying Space)
Compliant external drying space
It is assumed that compliant external drying space will be provided in the bathroom.
Assumptions for ENE 4

Evidence for ENE 5 (Energy Labelled White Goods)
A+ rated fridge & freezers or fridge/freezer A rated washing machine and dishwasher, AND EITHER a tumble dryer (a washer-dryer would be an acceptable alternative to a standalone tumble dryer) with a B rating or where a tumble dryer is not provided, the EU Energy Efficiency Labelling Scheme Information will be provided.
It is assumed that A+ rated fidge & freezer, A rated washing machine and dishwasher and B rated tumble dryer will be specified and the EU labelling information will be provided.
Assumptions for ENE 5

Evidence for ENE 6 (External Lighting)
Compliant space lighting Compliant security lighting
It is assumed that all external lighting will be low energy with adequate control.
Assumptions for ENE 6

Evidence for ENE 7 (Low or Zero Carbon Energy Technologies)
Contribution of low or zero carbon technologies greater than or equal to 15%
Based on the preliminary SAP calcualtion 2 credit should be achieved in ENE7 for a 15% contribution from PV.
Assumptions for ENE 7

Evidence for ENE 8 (Cycle Storage)
Credit(s) not sought or no compliant cycle storage
It is assumed that no covered secure storage will be provided due to site constraints.
Assumptions for ENE 8

Evidence for ENE 9 (Home Office)
Compliant home office
It is assumed that compliant home office facilities will be provided in each unit.
Assumptions for ENE 9

Evidence for WAT 1 (Internal Water Use)
Internal water use less than or equal to 105 litres per person per day
It is anticipated that fitting can be specified that restrict water use to achieve the minimum standards required for Level 4
Assumptions for WAT 1

Evidence for WAT 2 (External Water Use)
Compliant communal rainwater collection system
It is assumed that water butts will be provided in private and shared amenity spaces.
Assumptions for WAT 2

Evidence for MAT 1 (Environmental Impact of Materials)
Mandatory requirements met: At least 3 elements rated A+ to D, 12 credits scored
It is assumed that 12 credits will be achieved by specifying constructions that achieve A+ to D ratings in the Green Guide to Specification.
Assumptions for MAT 1

Evidence for MAT 2 (Responsible Sourcing (Basic Building Elements))
4 credits scored
At this stage the design team are targeting 4 credits here by specifying materials which are appropriately certified as legally and sustainably sourced.
Assumptions for MAT 2

Evidence for MAT 3 (Responsible Sourcing (Finishing Elements))
2 credits scored
At this stage the design team are targeting 2 credits here by specifying materials which are appropriately certified as legally and sustainably sourced.
Assumptions for MAT 3

Evidence for SUR 1 (Management of Surface Water Run-Off from Site)
Special Case: No change/decrease in impermeable area. Credits not available Run-off from all hard surfaces shall receive an appropriate level of treatment (as per the SudS manual) to minimise risk of pollution.
We have assumed that this development will meet the mandatory requirements in the Code by ensuring no increase in surface water run-off. There is an opportunity to achieve a tradable credit for the implementation of SUDs and a suitable SUD management/maintenance plan.
Assumptions for SUR 1

Evidence for SUR 2 (Flood Risk)
Low flood risk - zone 1
It is assumed that the site is in Zone 1 for flooding with low risk from all sources. A FRA will be required to confirm this assumption.
Assumptions for SUR 2

Evidence for WAS 1 (Household Waste Storage and Recycling Facilities)
Mandatory requirements met: Adequate storage of household waste with accessibility in line with checklist WAS 1. Local authority collection: After collection sorting with appropriate internal storage of recyclable materials
It is assumed that adequate provision will be provided for the storage of waste and recycling both internally and externally and be accessible in line with Checklist IDP. The local authority operate a kerbside recycling scheme with post collection sorting using orange bags. We assume all apartments will be supplied with a fixed 30L recycling bin within one of the kitchen cupboards.
Assumptions for WAS 1

Evidence for WAS 2 (Construction Site Waste Management)
Compliant site waste management plan containing benchmarks, procedures and commitments for the minimizing and diverting 80% waste from landfill in line with the criteria and with Checklist WAS 2a, 2b & 2c
We assume a site waste management plan will be implemented with benchmarks, commitments and procedures for minimising and diverting 85% of waste from landfill in line with Checklist WAS2a, b and c
Assumptions for WAS 2

Evidence for WAS 3 (Composting)
Individual compositing facility/facilities Communal/community composting service run by the local authority
We assume that composting bins will be provided in the garden.
Assumptions for WAS 3

Evidence for POL 1 (Global Warming Potential of Insulants)
Credit not sought or not all insulants have a GWP of less than 5
We assume no credits will be achieved.
Assumptions for POL 1

Evidence for POL 2 (NOx Emissions)
Credit(s) not sought
We assume no credits will be achieved.
Assumptions for POL 2

Evidence for HEA 1 (Daylighting)
Kitchen: Average daylight factor of at least 2% Living room: Average daylight factor of at least 1.5% Dining room: Average daylight factor of at least 1.5%
It is assumed that two credits are achievable. This will need to be confirmed via daylighting calculations at Design Stage.
Assumptions for HEA 1

Evidence for HEA 2 (Sound Insulation)
Robust details have been incorporated Airborne 5dB higher, impact 5dB lower
It is assumed that robust details will be used to ensure performance 5dB better than required by Building Regulations.
Assumptions for HEA 2

Evidence for HEA 3 (Private Space)
Individual private space provided.
The house has its own outdoor space.
Assumptions for HEA 3

Evidence for HEA 4 (Lifetime Homes)
All criteria of Lifetime Homes in line with all 16 principals of Lifetime Homes
All apartments are required to comply with the 16 Lifetime Homes design criteria.
Assumptions for HEA 4

Evidence for MAN 1 (Home User Guide)
All criteria inline with checklist MAN 1 Part 1 - Operational Issues will be met All criteria inline with checklist MAN 1 Part 2 - Site and Surroundings will be met
It is assumed that a HUG will be provided to each apartment covering operational issues and site and surroundings in line with Checklist MAN1 parts 1 & 2.
Assumptions for MAN 1

Evidence for MAN 2 (Considerate Constructors Scheme)
Considerate constructors scheme: Significantly beyond best practise, a score of between 35 - 50, and at least a score of 7 in each section*
It is assumed that the site will be registered with the Considerate Contractors Scheme and that a beyond best practice score of at least 35 achieved.
Assumptions for MAN 2

Evidence for MAN 3 (Construction Site Impacts)
Monitor, report and set targets for CO2 production or energy use from site activities Monitor, report and set targets for water consumption from site activities Adopt best practise policies in respects to air (dust) pollution from site activities Adopt best practise policies in respects to water (ground and surface) pollution
It is assumed that procedures will be put in pace to monitor, report and set targets for site energy and water use. It is also assumed that best practice policies will be in place with regard to air (dust) and water pollution.
Assumptions for MAN 3

Evidence for MAN 4 (Security)
Secured by design section 2 compliant
It is assumed that the advice of an ALO will be sought and their recommendations implemented so that the development meets the requirements of Secured by Design (Part 2 Physical Security).
Assumptions for MAN 4

Evidence for ECO 1 (Ecological Value of Site)
Land of low ecological value, achieved through checklist ECO 1. Development site has been identified as low ecological value by a suitably qualified ecologist
It is assumed that the undeveloped site is of low ecological value. This will need to be confirmed either by an ecologist or using Checklist ECO1.
Assumptions for ECO 1

Evidence for ECO 2 (Ecological Enhancement)
Key recommendations and 30% additional recommendations by a suitably qualified ecologist
It is assumed that this credit will be achieved. This will need to be confirmed either by an ecologist or using Checklist ECO1.
Assumptions for ECO 2

Evidence for ECO 3 (Protection of Ecological Features)
Land of low ecological value as identified under ECO 1
It is assumed that the undeveloped site is of low ecological value. This will need to be confirmed either by an ecologist or using Checklist ECO1.
Assumptions for ECO 3

Evidence for ECO 4 (Change of Ecological Value of Site)
Major enhancement: Greater than +9
It is assumed that a minor improvement in ecological value will be achieved by introcucing planting to the amenity spaces.
Assumptions for ECO 4

Evidence for ECO 5 (Building Footprint)
Housing ratio of 2.5:1
Initial calculation indicate that one credit is acheivable.
Assumptions for ECO 5

Assessor Declaration

I Chris Jones, can confirm that I have compiled this report to the best of my ability, I have based all findings on the information that is referenced within this report, and that this report is appropriate for the registered site.

To the best of my knowledge all the information contained within this report is correct and accurate. I have within my possession all the reference material that relates to this report, which is available for inspection by the client, the clients representative or Stroma Certification for Quality Assurance monitoring.

Signed:

Chris Jones
MES Energy Services
08 August 2013

Information about Code for Sustainable Homes

The Code for Sustainable Homes (the Code) is an environmental assessment method for rating and certifying the performance of new homes. It is a national standard for use in the design and construction of new homes with a view to encouraging continuous improvement in sustainable home building. The Code is based on EcoHomes©.

It was launched in December 2006 with the publication of 'Code for Sustainable Homes: A stepchange in sustainable home building practice' (Communities and Local Government, 2006), and became operational in England from April 2007.

The Code for Sustainable Homes covers nine categories of sustainable design. Each category includes a number of environmental issues. Each issue is a source of impact on the environment which can be assessed against a performance target and awarded one or more credits. Performance targets are more demanding than the minimum standards needed to satisfy Building Regulations or other legislation. They represent good or best practice, are technically feasible, and can be delivered by the building industry. The issues and categories are as follows:

- Energy & CO2 Emissions
  - Dwelling Emission Rate
  - Building Fabric
  - Internal Lighting
  - Drying Space
  - Energy Labelled White Goods
  - External Lighting
  - Low or Zero Carbon Technologies
  - Cycle Storage
  - Home Office
- Water
  - Internal Water Use
  - External Water Use
- Materials
  - Environmental Impact of Materials
  - Responsible Sourcing of Materials - Basic Building Elements
  - Responsible Sourcing of Materials - Finishing Elements
- Surface Water Run-off
  - Management of Surface Water Run-off from the Development
  - Flood Risk
- Waste
  - Storage of Non-Recyclable Waste and Recyclable Household Waste
  - Construction Site Waste Management
  - Composting
- Pollution
  - Global Warming Potential of Insulants
  - NOx Emissions

- Health & Wellbeing
  - Daylighting
  - Sound Insulation
  - Private Space
  - Lifetime Homes
- Management
  - Home User Guide
  - Considerate Constructors Scheme
  - Construction Site Impacts
  - Security
- Ecology
  - Ecological Value of Site
  - Ecological Enhancement
  - Protection of Ecological Features
  - Change in Ecological Value of Site
  - Building Footprint

The Code assigns one or more performance requirements (assessment criteria) to all of the above environmental issues. When each performance requirement is achieved a credit is awarded (with the exception of the four mandatory requirements which have no associated credits). The total number of credits available to a category is the sum of credits available for all the issues within it.

Mandatory minimum performance standards are set for some issues. For four of these, a single mandatory requirement is set which must be met, whatever Code level rating is sought. Credits are not awarded for these issues. Confirmation that the performance requirements are met for all four is a minimum entry requirement for achieving a level 1 rating. The four un-credited issues are:

- Environmental Impacts of Materials
- Management of Surface Water Run-off from Developments
- Storage of Non-Recyclable Waste and Recyclable Household Waste
- Construction Site Waste Management

If the mandatory minimum performance standard is met for the four un-credited issues, four further mandatory issues need to be considered. These are agreed to be such important issues that separate Government policies are being pursued to mitigate their effects. For two of these, credits are awarded for every level of achievement recognised within the Code, and minimum mandatory standards increase with increasing rating levels.

The two issues with increasing mandatory minimum standards are:

- Dwelling Emission Rate
- Indoor Water Use

For one issue a mandatory requirement at Level 5 or 6:

- Fabric Energy Efficiency

The final issue with a mandatory requirement for Level 6 of the Code is:

- Lifetime Homes

Further credits are available on a free-choice or tradable basis from other issues so that the developer may choose how to add performance credits (converted through weighting to percentage points) achieve the rating which they are aiming for.

The environmental impact categories within the Code are not of equal importance. Their relative value is conveyed by applying a consensus-based environmental weighting factor (see details below) to the sum of all the raw credit scores in a category, resulting in a score expressed as percentage points. The points for each category add up to 100.

The weighting factors used in the Code have been derived from extensive studies involving a wide range of stakeholders who were asked to rank (in order of importance) a range of environmental impacts. Stakeholders included international experts and industry representatives.

It is also important to note that achieving a high performance in one category of environmental impact can sometimes result in a lower level of performance for another. For instance, if biomass is used to meet heating demands, credits will be available for performance in respect of energy supplied from a renewable source, but credits cannot be awarded for low NOX emission. It is therefore impossible to achieve a total percentage points score of 100.

The Code uses a rating system of one to six stars. A star is awarded for each level achieved. Where an assessment has taken place by where no rating is achieved, the certificate states that zero stars have been awarded:

Code Levels	Total Points Score (Equal to or Greater Than)
Level 1 ★☆☆☆☆☆	36 Points
Level 2 ★★☆☆☆☆	48 Points
Level 3 ★★★☆☆☆	57 Points
Level 4 ★★★★☆☆	68 Points
Level 5 ★★★★★☆	84 Points
Level 6 ★★★★★★	90 Points

Formal assessment of dwellings using the Code for Sustainable Homes may only be carried out using Certified assessors, who are qualified ‘competent persons’ for the purpose of carrying out Code assessments.

Energy & CO2 Emissions
ENE 1: Dwelling Emission Rate **Available Credits:**10 **Aim:**To limit CO2 emissions arising from the operation of a dwelling and its services in line with current policy on the future direction of regulations.
ENE 2: Fabric Energy Efficiency **Available Credits:**9 **Aim:**To improve fabric energy efficiency performance thus future-proofing reductions in CO2 for the life of the dwelling.
ENE 3: Energy Display Device **Available Credits:**2 **Aim:**To promote the specification of equipment to display energy consumption data, thus empowering dwelling occupants to reduce energy use.
ENE 4: Drying Space **Available Credits:**1 **Aim:**To promote a reduced energy means of drying clothes.
ENE 5: Energy Labelled White Goods **Available Credits:**2 **Aim:**To promote the provision or purchase of energy efficient white goods, thus reducing the CO2 emissions from appliance use in the dwelling.
ENE 6: External Lighting **Available Credits:**2 **Aim:**To promote the provision of energy efficient external lighting, thus reducing CO2 emissions associated with the dwelling.
ENE 7: Low or Zero Carbon Technologies **Available Credits:**2 **Aim:**To limit CO2 emissions and running costs arising from the operation of a dwelling and its services by encouraging the specification of low and zero carbon energy sources to supply a significant proportion of energy demand.
ENE 8: Cycle Storage **Available Credits:**2 **Aim:**To promote the wider use of bicycles as transport by providing adequate and secure cycle storage facilities, thus reducing the need for short car journeys and the associated CO2 emissions.
ENE 9: Home Office **Available Credits:**1 **Aim:**To promote working from home by providing occupants with the necessary space and services thus reducing the need to commute.

Water
WAT 1: Indoor Water Use **Available Credits:**5 **Aim:**To reduce the consumption of potable water in the home from all sources, including borehole well water, through the use of water efficient fittings, appliances and water recycling systems.
WAT 2: External Water Use **Available Credits:**1 **Aim:**To promote the recycling of rainwater and reduce the amount of mains potable water used for external water uses.

Materials
MAT 1: Environmental Impact of Materials **Available Credits:**15 **Aim:**To specify materials with lower environmental impacts over their life-cycle.
MAT 2: Responsible Sourcing of Materials - Basic Building Elements **Available Credits:**6 **Aim:**To promote the specification of responsibly sourced materials for the basic building elements.
MAT 3: Responsible Sourcing of Materials - Finishing Elements **Available Credits:**3 **Aim:**To promote the specification of responsibly sourced materials for the finishing elements.

Surface Water Run-off
SUR 1: Management of Surface Water Run-off from developments **Available Credits:**2 **Aim:**To design surface water drainage for housing developments which avoid, reduce and delay the discharge of rainfall run-off to watercourses and public sewers using SuDS techniques. This will protect receiving waters from pollution and minimise the risk of flooding and other environmental damage in watercourses.
SUR 2: Flood Risk **Available Credits:**2 **Aim:**To promote housing development in low flood risk areas, or to take measures to reduce the impact of flooding on houses built in areas with a medium or high risk of flooding.

Waste
WAS 1: Storage of non-recyclable waste and recyclable household waste **Available Credits:**4 **Aim:**To promote resource efficiency via the effective and appropriate management of construction site waste.
WAS 2: Construction Site Waste Management **Available Credits:**3 **Aim:**To promote resource efficiency via the effective and appropriate management of construction site waste.
WAS 3: Composting **Available Credits:**1 **Aim:**To promote the provision of compost facilities to reduce the amount of household waste send to landfill.

Pollution
POL 1: Global Warming Potential of Insulants **Available Credits:**1 **Aim:**To promote the reduction of emissions of gases with high GWP associated with the manufacture, installation, use and disposal of foamed thermal and acoustic insulating materials.
POL 2:NOx Emissions **Available Credits:**3 **Aim:**To promote the reduction of nitrogen oxide (NOX) emissions into the atmosphere.

Health & Wellbeing
HEA 1: Daylighting **Available Credits:**3 **Aim:**To promote good daylighting and thereby improve quality of life and reduce the need for energy to light the home.
HEA 2: Sound Insulation **Available Credits:**4 **Aim:**To promote the provision of improved sound insulation to reduce the likelihood of noise complaints from neighbours.
HEA 3: Private Space **Available Credits:**1 **Aim:**To improve quality of life by promoting the provision of an inclusive outdoor space which is at least partially private.
HEA 4: Lifetime Homes **Available Credits:**4 **Aim:**To encourage the construction of homes that are accessible and easily adaptable to meet the changing needs of current and future occupants.

Management
MAN 1: Home User Guide **Available Credits:**3 **Aim:**To promote the provision of guidance enabling occupants to understand and operate their home efficiently and make the best use of local facilities.
MAN 2: Considerate Constructors Scheme **Available Credits:**3 **Aim:**To promote the environmentally and socially considerate, and accountable management of construction sites.
MAN 3: Construction Site Impacts **Available Credits:**2 **Aim:**To promote construction sites managed in a manner that mitigates environmental impacts.
MAN 4: Security **Available Credits:**2 **Aim:**To promote the design of developments where people feel safe and secure- where crime and disorder, or the fear of crime, does not undermine quality of life or community cohesion.

Ecology
ECO 1: Ecological value of site **Available Credits:**1 **Aim:**To promote development on land that already has a limited value to wildlife, and discourage the development of ecologically valuable sites.
ECO 2: Ecological enhancement **Available Credits:**1 **Aim:**To enhance the ecological value of a site.
ECO 3: Protection of ecological features **Available Credits:**1 **Aim:**To promote the protection of existing ecological features from substantial damage during the clearing of the site and the completion of construction works.
ECO 4: Change in ecological value of site **Available Credits:**4 **Aim:**To minimise reductions and promote an improvement in ecological value.
ECO 5: Building footprint **Available Credits:**2 **Aim:**To promote the most efficient use of a building’s footprint by ensuring that land and material use is optimised across the development.

Disclaimer

The contents of this publication reflect the assessment produced by the licensed Code assessor. Stroma Certification Ltd is not liable for any loss or damage sustained as a consequence of this report or any related information.

Copyright

Appendix B:
Preliminary SAP calculation

MES Energy Services
Newark Beacon, Cafferata Way
Newark
Nottingham
01636 653055

Full SAP Calculation Printout

Property Reference: 0006-Kemplay-Road
Survey Reference: Baseline
Property: Kemplay Road, London, NW3

Issued on Date: 08.Aug.2013
Prop Type Ref: TAG Architects

SAP Rating:	80 C	**CO2 Emissions (t/year):**	4.18	**DER:** 15.19 Pass	**Reduction:** 0.3%	**FEE:** 60.8	**ZC8:**	0.00
Environmental:	83 B	**General Requirements Compliance:**	Pass	**TER:** 15.24		**HLP:** 1.56	**Energy cost:**	£ 1218

CfSH Results	**Version:** CfSH November 2010	**ENE1 Credits:** 0.0	**ENE2 Credits:** 0.0	**ENE7 Credits:** 0		**CfSH Level:**	3

Surveyor: Matthew Crowther, Tel: 01636 653005 Surveyor ID: 8440-0006
Address: Cafferata Way, Newark, Nottinghamshire, NG24 2TN
Client:

Software Version: Elmhurst Energy Systems SAP2009 Calculator (Design System) version 4.01r01
SAP version: SAP 2009, Regs Region: England and Wales (Part L1A 2010), Calculation Type: New Dwelling As Designed

CALCULATION DETAILS for survey reference no 'Baseline'
SAP2009 - 9.81 input data (DesignData) -

SAP2009 Input Data

FullRefNo:	Baseline
Sap Version:	SAP 2009
Regs Region:	England & Wales
Region:	Thames Valley
Calculation Type:	New Build (As Designed)
DwellingOrientation:	North
Property Type:	House, Mid-Terrace
Storeys:	4
Date Built:	2013
Sheltered Sides:	3
Sunlight Shade:	Average or unknown
Measurements	Perimeter, Floor Area, Storey Height
Basement:	28.92, 42.66, 2.8
1st Storey:	42.73, 111.94, 2.53
2nd Storey:	40.44, 79.72, 2.65
3rd Storey:	30.92, 51.27, 2.31
4th Storey:	0, 0, 0
Living Area:	75.35 m2, fraction: 26.4%
Thermal Mass:	Simple calculation
Thermal Mass Simple:	Low
Thermal MassValue:	100
External Walls	Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Basement Wall	84.18, 84.18, 190, , Other, , Solid, 0, 0.3, Gross
External Wall	144.02, 233.77, 0, , Other, , Cavity, 0, 0.3, Gross
Room in Roof	14.51, 14.51, 0, , Other, , TimberFrame, 0, 0.13, Gross
Party Walls	Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall	51.05, 0, , Other, , FilledWithEdge, 0, 0
External Roofs	Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
Flat Roof	80.44, 89.26, 9, PlasterInsulatedFlatRoof, , , 0.18
Sloped Roof	21.65, 23.12, 9, PlasterInsulatedSlope, , , 0.18
Room in Roof	14.72, 14.72, 0, Other, , , 0.13
Heat Loss Floors	Area, Kappa, Construction, Element, Type, UValueFinal, ShelterFactor
Basement Floor	42.66, 0, Other, , GroundSolid, 0, 0.18
Ground Floor	77.75, 0, Other, , GroundSolid, 0, 0.2
Description	Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
Window/Glazed Door	Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
Solid Door	Manufacturer, Solid Door, , , , , , ,
Roof Lights	Manufacturer, Roof Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
Openings	Opening Type, Location, Orientation, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
Opening 1	Solid Door, External Wall, North, , , , 0, 0, 0, 3.27,
Opening 2	Window, External Wall, North, None, 0, , 0, 0, 0, 20.91,
Opening 3	Window, External Wall, East, None, 0, , 0, 0, 0, 12.73,
Opening 4	Window, External Wall, South, None, 0, , 0, 0, 0, 41.09,
Opening 5	Window, External Wall, West, None, 0, , 0, 0, 0, 11.75,
Opening 6	Roof Window, Sloped Roof, North, None, , , 0, 0, 0, 1.47,
Opening 7	Roof Window, Flat Roof, Horizontal, None, , , 0, 0, 0, 8.82,
Conservatory:	None
Draught Proofing:	100
Draught Lobby:	No
Thermal Bridges	User Input, ACDs Assumed
Y	0.08
Pressure Test:	True
Designed q50:	5.1
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:	1
Open Flues Other:	0
Open Flues Total:	1
Intermittent Fans:	8
Passive Vents:	0
Flueless Gas Fires:	0
Cooling System	
Cooled Area	130.99
Data Source	SAP table
Type	Split or Multi-Split
Class	A
Control	Modulating
Light Fittings:	20
LEL Fittings:	15

```
Percentage of LEL Fittings:   75
External Lights Fitted:       Yes
External LELs Fitted:         Yes
Electricity Tariff:           Standard
Main Heating 1
    Description
    Percentage                54
    MHS                       Mains gas BGB Post 98 Regular condens. with auto ign.
    SAP Code                  102
    Boiler Efficiency Type    Sedbuk 2009
    Efficiency                89
    Model Name                TBC
    Manufacturer              TBC
    MHS Controls              CBI Time and temperature zone control
    Delayed Start Stat        No
    Ctrl SAP Code             2110
    Burner Control            Modulating
    Boiler Compensator        None
    Flue Type                 Balanced
    Fan Assisted Flue         Yes
    Pumped                    Pump in heated space
    Heat Emitter              Underfloor
    Under Floor Heating       Yes - Pipes in thin screed
Main Heating 2
    Description
    Percentage                46
    MHS                       Electricity PEH Heat pump air-to-air
    SAP Code                  524
    Boiler Efficiency Type    SAP Table
    Efficiency                250
    MHS Controls              CWD Time and temperature zone control
    Delayed Start Stat        No
    Ctrl SAP Code             2506
Smoke Control Area             Unknown
Community Heating              None
Secondary Heating
    SHS                       RWJ - Wood Logs RWJ Open fire in grate
    SAP Code                  631
    Hetas Approved System     True
    Efficiency                37
Water Heating
    Type                      MainHeating1
    WHS                       HWP From main heating 1
    Low Water Usage           Yes
    SAP Code                  901
    Hot Water Cylinder
    Cylinder Type             HotWaterCylinder
    Cylinder Insulation Type  Foam
    Insulation Thickness      80 mm
    Cylinder Volume           300.00
    Cylinder Stat             Yes
    Pipes Insulated           Yes
    Cylinder in Heated Space  Yes
    Separate Time Control     Yes
Flue Gas Heat Recovery System None
Waste Water Heat Recovery      none
PV Unit                        None
Wind Turbine                   None
Terrain Type:                  Urban
Small Scale Hydro              None
Special Features               None
```

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF FABRIC ENERGY EFFICIENCY
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

---

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480 (1a) - (3a)	
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082 (1b) - (3b)	
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580 (1c) - (3c)	
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479	(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	+	1	+	0	=	1 * 20	=	20.0000	(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) =	60.0000 / (5) =	0.0819	(8)
Pressure test		Yes	
Measured/design q50		5.1000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3369	(18)
Number of sides on which dwelling is 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) =	0.2864	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.3866	0.3651	0.3651	0.3222	0.2935	0.2792	0.2649	0.2649	0.3007	0.3222	0.3437	0.3651	(22b)
Effective ach	0.5747	0.5667	0.5667	0.5519	0.5431	0.5390	0.5351	0.5351	0.5452	0.5519	0.5591	0.5667	(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	
Solid Door			3.2700	1.8000	5.8860			(26)
Window/Glazed Door (Uw = 1.60)			86.4800	1.5038	130.0451			(27)
Roof Lights (Uw = 1.60)			10.2900	1.5038	15.4737			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.3000	25.2540			(29a)
External Wall	233.7700	89.7500	144.0200	0.3000	43.2060			(29a)
Room in Roof	14.5100		14.5100	0.1300	1.8863			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1800	14.4792			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1800	3.8970			(30)
Room in Roof	14.7200		14.7200	0.1300	1.9136			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		265.2697			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area) 46.3976 (36)
Total fabric heat loss (33) + (36) = 311.6673 (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	138.9001	136.9488	136.9488	133.3809	131.2501	130.2590	129.3174	129.3174	131.7642	133.3809	135.1091	136.9488	(38)
(39)m	450.5674	448.6161	448.6161	445.0482	442.9174	441.9263	440.9847	440.9847	443.4315	445.0482	446.7764	448.6161	(39)
									Average = Sum(39)m / 12 =			445.2944	(39)
(40)m	1.5777	1.5708	1.5708	1.5583	1.5509	1.5474	1.5441	1.5441	1.5527	1.5583	1.5644	1.5708	(40)
									Average = Sum(40)m / 12 =			1.5592	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N 3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 108.1384 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)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:													
(57)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	(57)
Primary circuit loss (annual) from Table 3												0.0000	(58)
(59)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	(59)
(65)m	37.5753	32.8636	33.9123	29.5655	28.3688	24.4801	22.6845	26.0307	26.3416	30.6986	33.5100	36.3896	(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	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	(66)
(67)m	39.8048	35.3543	28.7520	21.7671	16.2712	13.7368	14.8431	19.2936	25.8959	32.8808	38.3767	40.9111	(67)
(68)m	446.4885	451.1217	439.4463	414.5908	383.2151	353.7264	334.0261	329.3930	341.0684	365.9239	397.2996	426.7883	(68)
(69)m	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	(69)
(70)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	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	50.5044	48.9041	45.5810	41.0632	38.1301	34.0002	30.4899	34.9876	36.5856	41.2616	46.5416	48.9108	(72)
(73)m	606.4957	605.0780	583.4773	547.1191	507.3144	471.1614	449.0571	453.3721	473.2478	509.7643	551.9159	586.3081	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457	(74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133	(76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691	(78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614	(80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754	(82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199	(83)
(84)m	1515.2606	2193.5046	2788.9303	3457.1257	3892.1918	3996.9487	3868.0598	3494.7788	2972.1545	2342.8651	1648.5572	1358.3280	(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	17.6068	17.6834	17.6834	17.8252	17.9109	17.9511	17.9894	17.9894	17.8901	17.8252	17.7562	17.6834	
alpha	2.1738	2.1789	2.1789	2.1883	2.1941	2.1967	2.1993	2.1993	2.1927	2.1883	2.1837	2.1789	
(86)m	0.9748	0.9463	0.8998	0.8247	0.7062	0.5629	0.4162	0.4506	0.6866	0.8705	0.9594	0.9786	(86)
(87)m	17.7542	18.2144	18.8921	19.5626	20.2471	20.6820	20.8909	20.8717	20.4894	19.6299	18.4436	17.7824	(87)
(88)m	19.6339	19.6389	19.6389	19.6481	19.6536	19.6561	19.6585	19.6585	19.6522	19.6481	19.6436	19.6389	(88)
(89)m	0.9702	0.9370	0.8820	0.7939	0.6521	0.4776	0.2971	0.3250	0.6068	0.8393	0.9509	0.9746	(89)
(90)m	16.7197	17.1756	17.8373	18.4820	19.1126	19.4772	19.6216	19.6142	19.3394	18.5676	17.4111	16.7517	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	16.9926	17.4497	18.1156	18.7671	19.4119	19.7951	19.9565	19.9460	19.6428	18.8479	17.6835	17.0236	(92)
Temperature adjustment												0.0000	
(93)m	16.9926	17.4497	18.1156	18.7671	19.4119	19.7951	19.9565	19.9460	19.6428	18.8479	17.6835	17.0236	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9572	0.9165	0.8564	0.7698	0.6411	0.4873	0.3253	0.3540	0.6062	0.8158	0.9335	0.9630	(94)
(95)m	1450.3695	2010.2889	2388.4971	2661.2021	2495.0932	1947.6054	1258.3675	1237.2829	1801.6743	1911.2620	1538.9524	1308.1243	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5628.7733	5585.1157	5076.3609	4480.3414	3415.7495	2295.8552	1347.8628	1343.2200	2369.1821	3581.7028	4773.1353	5438.8497	(97)
(98)m	3108.7324	2402.2836	1999.7706	1309.7803	684.9684	0.0000	0.0000	0.0000	0.0000	1242.8079	2328.6117	3073.2597	(98)
Space heating (October to May) (kWh/year)												16150.2146	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	56.5504	(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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	3800.5659	2734.1054	2734.1054	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.7729	0.8476	0.8272	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	2937.2825	2317.3097	2261.7086	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	4962.0232	4738.7840	4352.4198	0.0000	0.0000	0.0000	0.0000	(103)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1457.8133	1801.5768	1555.4891	0.0000	0.0000	0.0000	0.0000	(104)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	122.2638	17.5651	20.6581	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1457.8133	1801.5768	1555.4891	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	364.4533	450.3942	388.8723	0.0000	0.0000	0.0000	0.0000	(107)
										Total = Sum(107)6..8 =		1203.7198	(107)
Space cooling requirement in kWh/m2/year											(107) / (4) =	4.2149	(108)

8f. Fabric Energy Efficiency

Fabric Energy Efficiency	(99) + (108) =	60.7652	
Fabric Energy Efficiency rounded		60.8	(109)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF DATA FOR RENEWABLE HEAT INCENTIVE (RHI)
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600	(1a)	x 2.8000	(2a) =	119.4480	(1a) - (3a)
Ground floor	111.9400	(1b)	x 2.5300	(2b) =	283.2082	(1b) - (3b)
First floor	79.7200	(1c)	x 2.6500	(2c) =	211.2580	(1c) - (3c)
Second floor	51.2700	(1d)	x 2.3100	(2d) =	118.4337	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		732.3479	(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	+	1	+	0	=	1 * 20 =	20.0000	(6b)
Number of intermittent fans							8 * 10 =	80.0000	(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) =	100.0000 / (5) =	0.1365	(8)
Pressure test		Yes	
Measured/design q50		5.1000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915	(18)
Number of sides on which dwelling is sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.8000	5.8860			(26)
Window/Glazed Door (Uw = 1.60)			86.4800	1.5038	130.0451			(27)
Roof Lights (Uw = 1.60)			10.2900	1.5038	15.4737			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.3000	25.2540			(29a)
External Wall	233.7700	89.7500	144.0200	0.3000	43.2060			(29a)
Room in Roof	14.5100		14.5100	0.1300	1.8863			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1800	14.4792			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1800	3.8970			(30)
Room in Roof	14.7200		14.7200	0.1300	1.9136			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		265.2697			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area) 46.3976 (36)
Total fabric heat loss (33) + (36) = 311.6673 (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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	452.7834	450.5928	450.5928	446.5871	444.1949	443.0822	442.0251	442.0251	444.7721	446.5871	448.5274	450.5928	(39)
									Average = Sum(39)m / 12 =			446.8636	(39)
(40)m	1.5854	1.5778	1.5778	1.5637	1.5554	1.5515	1.5478	1.5478	1.5574	1.5637	1.5705	1.5778	(40)
									Average = Sum(40)m / 12 =			1.5647	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N 3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 108.1384 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:
b) If manufacturer declared cylinder loss factor is not known :
Cylinder volume (litres) including any solar storage within same cylinder 300.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0115 (51)
Volume factor from Table 2a 0.7368 (52)
Temperature factor from Table 2b 0.5400 (53)
Enter (49) or (54) in (55) 1.3784 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)
Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
								Total per year (kWh/year) = Sum(64)m =				2568.6082	(64)
RHI water heating demand												2569	(64)
(65)m	117.4377	104.3901	111.7062	103.0131	103.0323	95.0560	94.1380	99.3739	97.9686	106.6778	109.1850	115.5825	(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	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	(66)
(67)m	124.3899	110.4820	89.8500	68.0223	50.8474	42.9275	46.3847	60.2926	80.9246	102.7524	119.9272	127.8471	(67)
(68)m	666.4008	673.3160	655.8900	618.7922	571.9628	527.9499	498.5465	491.6313	509.0573	546.1551	592.9845	636.9974	(68)
(69)m	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	(69)
(70)m	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	157.8464	155.3424	150.1427	143.0737	138.4843	132.0222	126.5295	133.5671	136.0675	143.3841	151.6458	155.3529	(72)
(73)m	1121.6343	1112.1376	1068.8799	1002.8853	934.2918	875.8968	844.4579	858.4882	899.0467	965.2888	1037.5546	1093.1946	(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	20.9100	11.6736	0.6300	0.7000	0.7700	74.5983	(74)
East	12.7300	21.7895	0.6300	0.7000	0.7700	84.7712	(76)
South	41.0900	49.8711	0.6300	0.7000	0.7700	626.2638	(78)
West	11.7500	21.7895	0.6300	0.7000	0.7700	78.2452	(80)
Horizontal	10.2900	29.0000	0.6300	0.7000	1.0000	108.3299	(82)

(83)m	972.2084	1553.2515	2241.4738	2899.5718	3389.8706	3749.2269	3578.4110	3225.2609	2588.1426	1891.7704	1243.2165	811.0012	(83)
(84)m	2093.8427	2665.3891	3310.3538	3902.4571	4324.1623	4625.1237	4422.8689	4083.7491	3487.1892	2857.0592	2280.7711	1904.1958	(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	17.5206	17.6058	17.6058	17.7637	17.8594	17.9043	17.9471	17.9471	17.8362	17.7637	17.6869	17.6058	
alpha	2.1680	2.1737	2.1737	2.1842	2.1906	2.1936	2.1965	2.1965	2.1891	2.1842	2.1791	2.1737	
(86)m	0.9503	0.9201	0.8595	0.7789	0.6347	0.4630	0.3015	0.3235	0.5849	0.8049	0.9213	0.9561	(86)
(87)m	18.4841	18.7980	19.3867	19.8997	20.4660	20.7728	20.8960	20.8901	20.6570	20.0356	19.0876	18.5003	(87)
(88)m	19.6282	19.6338	19.6338	19.6441	19.6503	19.6531	19.6559	19.6559	19.6488	19.6441	19.6391	19.6338	(88)
(89)m	0.9415	0.9066	0.8356	0.7416	0.5710	0.3717	0.1817	0.1961	0.4904	0.7603	0.9056	0.9481	(89)
(90)m	16.3670	16.8157	17.6459	18.3542	19.0945	19.4424	19.5484	19.5464	19.3355	18.5653	17.2412	16.3950	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	16.9256	17.3387	18.1052	18.7620	19.4564	19.7934	19.9039	19.9009	19.6842	18.9532	17.7284	16.9504	(92)
Temperature adjustment												0.0000	
(93)m	16.9256	17.3387	18.1052	18.7620	19.4564	19.7934	19.9039	19.9009	19.6842	18.9532	17.7284	16.9504	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9162	0.8755	0.8015	0.7128	0.5608	0.3819	0.2048	0.2206	0.4932	0.7322	0.8751	0.9245	(94)
(95)m	1918.3613	2333.5573	2653.2616	2781.5944	2424.8849	1766.3798	905.9275	900.6840	1719.7255	2092.0317	1995.8787	1760.4938	(95)
(96)m	5.1000	5.5000	7.4000	9.3000	12.6000	15.4000	17.8000	17.8000	15.1000	11.6000	7.6000	5.5000	(96)
(97)m	5354.4345	5334.4334	4823.6894	4225.5952	3045.5580	1946.6363	929.9955	928.6658	2038.9182	3283.8559	4542.8518	5159.4859	(97)
(98)m	2556.4385	2016.5888	1614.7983	1039.6806	461.7808	0.0000	0.0000	0.0000	0.0000	886.7172	1833.8206	2528.8501	(98)

Space heating (October to May) (kWh/year) 12938.6749 (98)
RHI space heating demand 12939 (98)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF ENERGY RATINGS
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

---

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480 (1a) - (3a)	
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082 (1b) - (3b)	
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580 (1c) - (3c)	
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479	(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	+	1	+	0	=	1 * 20 =	20.0000	(6b)
Number of intermittent fans							8 * 10 =	80.0000	(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) =	100.0000 / (5) =	0.1365	(8)
Pressure test		Yes	
Measured/design q50		5.1000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915	(18)
Number of sides on which dwelling is sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.8000	5.8860			(26)
Window/Glazed Door (Uw = 1.60)			86.4800	1.5038	130.0451			(27)
Roof Lights (Uw = 1.60)			10.2900	1.5038	15.4737			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.3000	25.2540			(29a)
External Wall	233.7700	89.7500	144.0200	0.3000	43.2060			(29a)
Room in Roof	14.5100		14.5100	0.1300	1.8863			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1800	14.4792			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1800	3.8970			(30)
Room in Roof	14.7200		14.7200	0.1300	1.9136			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		265.2697			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area)		46.3976 (36)
Total fabric heat loss	(33) + (36) =	311.6673 (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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	452.7834	450.5928	450.5928	446.5871	444.1949	443.0822	442.0251	442.0251	444.7721	446.5871	448.5274	450.5928	(39)
									Average = Sum(39)m / 12 =			446.8636	(39)
(40)m	1.5854	1.5778	1.5778	1.5637	1.5554	1.5515	1.5478	1.5478	1.5574	1.5637	1.5705	1.5778	(40)
									Average = Sum(40)m / 12 =			1.5647	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.1384 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:		
b) If manufacturer declared cylinder loss factor is not known :		
Cylinder volume (litres) including any solar storage within same cylinder		300.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.0115 (51)
Volume factor from Table 2a		0.7368 (52)
Temperature factor from Table 2b		0.5400 (53)
Enter (49) or (54) in (55)		1.3784 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)

Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
								Total per year (kWh/year) = Sum(64)m =				2568.6082	(64)
(65)m	117.4377	104.3901	111.7062	103.0131	103.0323	95.0560	94.1380	99.3739	97.9686	106.6778	109.1850	115.5825	(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	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	(66)
(67)m	124.3899	110.4820	89.8500	68.0223	50.8474	42.9275	46.3847	60.2926	80.9246	102.7524	119.9272	127.8471	(67)
(68)m	666.4008	673.3160	655.8900	618.7922	571.9628	527.9499	498.5465	491.6313	509.0573	546.1551	592.9845	636.9974	(68)
(69)m	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	(69)
(70)m	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	157.8464	155.3424	150.1427	143.0737	138.4843	132.0222	126.5295	133.5671	136.0675	143.3841	151.6458	155.3529	(72)
(73)m	1121.6343	1112.1376	1068.8799	1002.8853	934.2918	875.8968	844.4579	858.4882	899.0467	965.2888	1037.5546	1093.1946	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457	(74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133	(76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691	(78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614	(80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754	(82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199	(83)
(84)m	2030.3993	2700.5642	3274.3330	3912.8919	4319.1692	4401.6841	4263.4606	3899.8949	3397.9533	2798.3897	2134.1960	1865.2145	(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	17.5206	17.6058	17.6058	17.7637	17.8594	17.9043	17.9471	17.9471	17.8362	17.7637	17.6869	17.6058	
alpha	2.1680	2.1737	2.1737	2.1842	2.1906	2.1936	2.1965	2.1965	2.1891	2.1842	2.1791	2.1737	
(86)m	0.9561	0.9226	0.8708	0.7924	0.6712	0.5284	0.3852	0.4141	0.6404	0.8312	0.9350	0.9607	(86)
(87)m	18.3336	18.7103	19.2620	19.8017	20.3496	20.6922	20.8534	20.8406	20.5529	19.8790	18.9106	18.3593	(87)
(88)m	19.6282	19.6338	19.6338	19.6441	19.6503	19.6531	19.6559	19.6559	19.6488	19.6441	19.6391	19.6338	(88)
(89)m	0.9485	0.9099	0.8492	0.7583	0.6152	0.4445	0.2725	0.2953	0.5585	0.7939	0.9223	0.9537	(89)
(90)m	16.1492	16.6887	17.4698	18.2193	18.9478	19.3610	19.5206	19.5136	19.2190	18.3524	16.9885	16.1905	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	16.7256	17.2221	17.9427	18.6368	19.3177	19.7122	19.8723	19.8637	19.5709	18.7552	17.4957	16.7628	(92)
Temperature adjustment												0.0000	
(93)m	16.7256	17.2221	17.9427	18.6368	19.3177	19.7122	19.8723	19.8637	19.5709	18.7552	17.4957	16.7628	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9249	0.8791	0.8150	0.7279	0.5997	0.4485	0.2917	0.3150	0.5531	0.7632	0.8939	0.9316	(94)
(95)m	1877.8989	2374.1424	2668.6186	2848.2927	2590.1867	1974.2654	1243.6922	1228.3041	1879.4614	2135.6621	1907.7872	1737.5478	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5535.5313	5507.1785	5020.8144	4437.6408	3383.7235	2265.1449	1313.8128	1310.0330	2344.3490	3552.6747	4707.5889	5345.2731	(97)
(98)m	2721.2785	2105.4003	1750.0337	1144.3306	590.3914	0.0000	0.0000	0.0000	0.0000	1054.2574	2015.8572	2684.1476	(98)
Space heating (October to May) (kWh/year)												14065.6966	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	49.2514	(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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	3810.5067	2740.5558	2740.5558	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.7780	0.8517	0.8325	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	2964.5506	2334.1726	2281.6228	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	5068.6307	4844.1006	4463.0578	0.0000	0.0000	0.0000	0.0000	(103)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1514.9377	1867.3864	1622.9876	0.0000	0.0000	0.0000	0.0000	(104)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	110.3671	14.7209	17.2019	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1514.9377	1867.3864	1622.9876	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area / (4) =			0.4587	(105)
(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	173.7120	214.1260	186.1017	0.0000	0.0000	0.0000	0.0000	(107)
									Total = Sum(107)6..8 =			573.9397	(107)
Space cooling requirement in kWh/m2/year											(107) / (4) =	2.0097	(108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000 (201)
Fraction of space heat from main system(s)	0.9000 (202)
Fraction of main heating from main system 2	0.4600 (203)
Fraction of total heating from main system 1	0.4860 (204)
Fraction of total heating from main system 2	0.4140 (205)
Efficiency of main space heating system 1 (in %)	90.0000 (206)
Efficiency of main space heating system 2 (in %)	250.0000 (207)
Efficiency of secondary/supplementary heating system, %	37.0000 (208)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.3200 (209)
Space heating:	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	2721.2785	2105.4003	1750.0337	1144.3306	590.3914	0.0000	0.0000	0.0000	0.0000	1054.2574	2015.8572	2684.1476	(98)
(211)m	1469.4904	1136.9161	945.0182	617.9385	318.8113	0.0000	0.0000	0.0000	0.0000	569.2990	1088.5629	1449.4397	(211)
(213)m	450.6437	348.6543	289.8056	189.5012	97.7688	0.0000	0.0000	0.0000	0.0000	174.5850	333.8260	444.4948	(213)
(215)m	735.4807	569.0271	472.9821	309.2785	159.5652	0.0000	0.0000	0.0000	0.0000	284.9344	544.8263	725.4453	(215)
Annual totals kWh/year													
Space heating fuel used, main system 1												7595.4762	(211)
Space heating fuel used, main system 2												2329.2794	(213)
Space heating fuel used, secondary												3801.5396	(215)
Water heating													
(64)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
Efficiency of water heater												79.3000	(216)
(217)m	88.1091	87.8946	87.4631	86.7894	85.1856	79.3000	79.3000	79.3000	79.3000	86.5182	87.7594	88.1228	(217)
(219)m	283.8855	251.2811	266.2738	242.0476	242.7696	234.7293	227.0551	246.9129	245.7759	251.7026	260.5230	277.5100	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	40.2111	49.5662	43.0791	0.0000	0.0000	0.0000	0.0000	(221)
Water heating fuel used												3030.4665	(219)
Space cooling fuel used												132.8564	(221)
Electricity for pumps, fans and electric keep-hot (Table 4f):													
warm air heating system fans												439.4087	(230b)
central heating pump												130.0000	(230c)
boiler with a fan-assisted flue												45.0000	(230e)
Total electricity for the above, kWh/year												614.4087	(231)
Electricity for lighting (calculated in Appendix L)												878.7060	(232)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	7595.4762	3.1000	235.4598	(240)
Space heating - main system 2	2329.2794	11.4600	266.9354	(241)
Space heating - secondary	3801.5396	3.4200	130.0127	(242)
Water heating cost (other fuel)	3030.4665	3.1000	93.9445	(247)
Space cooling	132.8564	11.4600	15.2253	(248)
Pumps and fans for heating	614.4087	11.4600	70.4112	(249)
Energy for lighting	878.7060	11.4600	100.6997	(250)
Additional standing charges			106.0000	(251)
Total energy cost			1018.6886	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4700	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.4483	(257)
SAP value		79.7966	
SAP rating (Section 12)		80	(258)
SAP band		C	

10a. Fuel costs - using BEDF prices (341)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	7595.4762	3.6400	276.4753	(240)
Space heating - main system 2	2329.2794	13.5900	316.5491	(241)
Space heating - secondary	3801.5396	4.6000	174.8708	(242)
Water heating cost (other fuel)	3030.4665	3.6400	110.3090	(247)
Space cooling	132.8564	13.5900	18.0552	(248)
Pumps and fans for heating	614.4087	13.5900	83.4981	(249)
Energy for lighting	878.7060	13.5900	119.4161	(250)
Additional standing charges			119.0000	(251)
Total energy cost			1218.1737	(255)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7595.4762	0.1980	1503.9043	(261)
Space heating - main system 2	2329.2794	0.5170	1204.2374	(262)
Space heating - secondary	3801.5396	0.0080	30.4123	(263)
Water heating cost (other fuel)	3030.4665	0.1980	600.0324	(264)
Space and water heating			3338.5864	(265)
Space cooling	132.8564	0.5170	68.6868	(266)
Pumps and fans	614.4087	0.5170	317.6493	(267)
Energy for lighting	878.7060	0.5170	454.2910	(268)
Total CO2, kg/year			4179.2135	(272)
CO2 emissions per m2			14.6300	(273)
EI value			83.0601	
EI rating			83	(274)
EI band			B	

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	7595.4762	1.0200	7747.3857	(261)
Space heating - main system 2	2329.2794	2.9200	6801.4957	(262)
Space heating - secondary	3801.5396	1.0500	3991.6166	(263)
Water heating cost (other fuel)	3030.4665	1.0200	3091.0759	(264)
Space and water heating			21631.5739	(265)
Space cooling	132.8564	2.9200	387.9407	(266)
Pumps and fans	614.4087	2.9200	1794.0735	(267)
Energy for lighting	878.7060	2.9200	2565.8216	(268)
Primary energy kWh/year			26379.4098	(272)
Primary energy kWh/m2/year			92.3681	(273)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480 (1a) - (3a)	
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082 (1b) - (3b)	
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580 (1c) - (3c)	
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479	(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	+	1	+	0	=	1 * 20 =	20.0000	(6b)
Number of intermittent fans							8 * 10 =	80.0000	(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) =	100.0000 / (5) =	0.1365 (8)
Pressure test		Yes
Measured/design q50		5.1000
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915 (18)
Number of sides on which dwelling is sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.8000	5.8860			(26)
Window/Glazed Door (Uw = 1.60)			86.4800	1.5038	130.0451			(27)
Roof Lights (Uw = 1.60)			10.2900	1.5038	15.4737			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.3000	25.2540			(29a)
External Wall	233.7700	89.7500	144.0200	0.3000	43.2060			(29a)
Room in Roof	14.5100		14.5100	0.1300	1.8863			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1800	14.4792			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1800	3.8970			(30)
Room in Roof	14.7200		14.7200	0.1300	1.9136			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		265.2697			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area)		46.3976 (36)
Total fabric heat loss	(33) + (36) =	311.6673 (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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	452.7834	450.5928	450.5928	446.5871	444.1949	443.0822	442.0251	442.0251	444.7721	446.5871	448.5274	450.5928	(39)
									Average = Sum(39)m / 12 =			446.8636	(39)
(40)m	1.5854	1.5778	1.5778	1.5637	1.5554	1.5515	1.5478	1.5478	1.5574	1.5637	1.5705	1.5778	(40)
									Average = Sum(40)m / 12 =			1.5647	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.1384 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:		
b) If manufacturer declared cylinder loss factor is not known :		
Cylinder volume (litres) including any solar storage within same cylinder		300.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.0115 (51)
Volume factor from Table 2a		0.7368 (52)
Temperature factor from Table 2b		0.5400 (53)
Enter (49) or (54) in (55)		1.3784 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)
Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(62)
(63)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	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Water heat.	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)

												Total per year (kWh/year) = Sum(64)m =	2568.6082 (64)
(65)m	117.4377	104.3901	111.7062	103.0131	103.0323	95.0560	94.1380	99.3739	97.9686	106.6778	109.1850	115.5825	(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	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	(66)
(67)m	49.7560	44.1928	35.9400	27.2089	20.3390	17.1710	18.5539	24.1170	32.3699	41.1010	47.9709	51.1388	(67)
(68)m	446.4885	451.1217	439.4463	414.5908	383.2151	353.7264	334.0261	329.3930	341.0684	365.9239	397.2996	426.7883	(68)
(69)m	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	(69)
(70)m	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	157.8464	155.3424	150.1427	143.0737	138.4843	132.0222	126.5295	133.5671	136.0675	143.3841	151.6458	155.3529	(72)
(73)m	777.7297	774.2958	749.1678	708.5122	665.6772	626.5584	602.7484	610.7160	633.1446	674.0478	720.5551	756.9188	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457	(74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133	(76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691	(78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614	(80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754	(82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199	(83)
(84)m	1686.4947	2362.7223	2954.6209	3618.5188	4050.5547	4152.3457	4021.7511	3652.1226	3132.0513	2507.1487	1817.1964	1528.9388	(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	17.5206	17.6058	17.6058	17.7637	17.8594	17.9043	17.9471	17.9471	17.8362	17.7637	17.6869	17.6058	
alpha	2.1680	2.1737	2.1737	2.1842	2.1906	2.1936	2.1965	2.1965	2.1891	2.1842	2.1791	2.1737	
(86)m	0.9690	0.9387	0.8902	0.8135	0.6933	0.5497	0.4040	0.4362	0.6692	0.8566	0.9514	0.9731	(86)
(87)m	18.1892	18.5814	19.1579	19.7275	20.3066	20.6715	20.8452	20.8301	20.5150	19.7945	18.7847	18.2160	(87)
(88)m	19.6282	19.6338	19.6338	19.6441	19.6503	19.6531	19.6559	19.6559	19.6488	19.6441	19.6391	19.6338	(88)
(89)m	0.9635	0.9283	0.8711	0.7814	0.6384	0.4648	0.2872	0.3130	0.5883	0.8230	0.9415	0.9681	(89)
(90)m	15.9425	16.5070	17.3274	18.1229	18.8982	19.3424	19.5161	19.5078	19.1807	18.2430	16.8108	15.9849	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	16.5353	17.0543	17.8103	18.5463	19.2698	19.6931	19.8668	19.8566	19.5328	18.6524	17.3316	16.5736	(92)
Temperature adjustment												0.0000	
(93)m	16.5353	17.0543	17.8103	18.5463	19.2698	19.6931	19.8668	19.8566	19.5328	18.6524	17.3316	16.5736	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9443	0.9004	0.8375	0.7498	0.6207	0.4675	0.3068	0.3329	0.5803	0.7914	0.9167	0.9507	(94)
(95)m	1592.6215	2127.3670	2474.6125	2713.1650	2514.3079	1941.2673	1233.8394	1215.6743	1817.4233	1984.0417	1665.8393	1453.5137	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5449.3810	5431.5873	4961.1799	4397.2143	3362.4753	2256.6538	1311.3955	1306.9122	2327.3823	3506.7720	4633.9838	5260.0226	(97)
(98)m	2869.4291	2220.4361	1850.0062	1212.5154	631.0366	0.0000	0.0000	0.0000	0.0000	1132.9113	2137.0641	2832.0427	(98)
Space heating (October to May) (kWh/year)												14885.4414	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	52.1217	(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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	3810.5067	2740.5558	2740.5558	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.7780	0.8517	0.8325	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	2964.5506	2334.1726	2281.6228	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	5068.6307	4844.1006	4463.0578	0.0000	0.0000	0.0000	0.0000	(103)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1514.9377	1867.3864	1622.9876	0.0000	0.0000	0.0000	0.0000	(104)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	110.3671	14.7209	17.2019	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1514.9377	1867.3864	1622.9876	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area / (4) =			0.4587	(105)
(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	173.7120	214.1260	186.1017	0.0000	0.0000	0.0000	0.0000	(107)
										Total = Sum(107)6..8 =		573.9397	(107)
Space cooling requirement in kWh/m2/year											(107) / (4) =	2.0097	(108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Fraction of main heating from main system 2	0.4600	(203)
Fraction of total heating from main system 1	0.4860	(204)
Fraction of total heating from main system 2	0.4140	(205)
Efficiency of main space heating system 1 (in %)	90.0000	(206)
Efficiency of main space heating system 2 (in %)	250.0000	(207)
Efficiency of secondary/supplementary heating system, %	37.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.3200	(209)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	2869.4291	2220.4361	1850.0062	1212.5154	631.0366	0.0000	0.0000	0.0000	0.0000	1132.9113	2137.0641	2832.0427	(98)
(211)m	1549.4917	1199.0355	999.0033	654.7583	340.7597	0.0000	0.0000	0.0000	0.0000	611.7721	1154.0146	1529.3030	(211)
(213)m	475.1775	367.7042	306.3610	200.7926	104.4997	0.0000	0.0000	0.0000	0.0000	187.6101	353.8978	468.9863	(213)
(215)m	775.5214	600.1179	500.0017	327.7069	170.5504	0.0000	0.0000	0.0000	0.0000	306.1923	577.5849	765.4169	(215)
Annual totals kWh/year													

Space heating fuel used, main system 1												8038.1383	(211)
Space heating fuel used, main system 2												2465.0291	(213)
Space heating fuel used, secondary												4023.0923	(215)
Water heating													
(64)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
Efficiency of water heater												79.3000	(216)
(217)m	88.1903	87.9831	87.5691	86.9179	85.3612	79.3000	79.3000	79.3000	79.3000	86.6850	87.8611	88.2044	(217)
(219)m	283.6244	251.0283	265.9517	241.6897	242.2700	234.7293	227.0551	246.9129	245.7759	251.2181	260.2216	277.2533	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	40.2111	49.5662	43.0791	0.0000	0.0000	0.0000	0.0000	(221)
Water heating fuel used												3027.7303	(219)
Space cooling fuel used												132.8564	(221)
Electricity for pumps, fans and electric keep-hot (Table 4f):													
warm air heating system fans												439.4087	(230b)
central heating pump												130.0000	(230c)
boiler with a fan-assisted flue												45.0000	(230e)
Total electricity for the above, kWh/year												614.4087	(231)
Electricity for lighting (calculated in Appendix L)												878.7060	(232)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	8038.1383	0.1980	1591.5514	(261)
Space heating - main system 2	2465.0291	0.5170	1274.4200	(262)
Space heating - secondary	4023.0923	0.0080	32.1847	(263)
Water heating cost (other fuel)	3027.7303	0.1980	599.4906	(264)
Space and water heating			3497.6468	(265)
Space cooling	132.8564	0.5170	68.6868	(266)
Pumps and fans	614.4087	0.5170	317.6493	(267)
Energy for lighting	878.7060	0.5170	454.2910	(268)
Total CO2, kg/year			4338.2739	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.1900	(273)

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

DER		15.1900	ZC1
Total Floor Area	TFA	285.5900	
Assumed number of occupants	N	3.1132	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5290	
CO2 emissions from appliances, equation (L14)		9.4428	ZC2
CO2 emissions from cooking, equation (L16)		0.6783	ZC3
Total CO2 emissions		25.3111	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		25.3111	ZC8

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF TARGET EMISSIONS
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480 (1a) - (3a)	
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082 (1b) - (3b)	
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580 (1c) - (3c)	
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5)	=	0.0410	(8)
Pressure test			Yes	
Measured/design q50			10.0000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)			0.5410	(18)
Number of sides on which dwelling is 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)	=	0.4598	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.6208	0.5863	0.5863	0.5173	0.4713	0.4483	0.4253	0.4253	0.4828	0.5173	0.5518	0.5863	(22b)
Effective ach	0.6927	0.6719	0.6719	0.6338	0.6111	0.6005	0.5905	0.5905	0.6166	0.6338	0.6522	0.6719	(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	
Doors			1.8500	2.0000	3.7000			(26)
Windows (Uw = 2.00)			69.5475	1.8519	128.7917			(27)

Basement Floor			42.6600	0.2500	10.6650		(28a)
Ground Floor			77.7500	0.2500	19.4375		(28a)
Basement Wall	332.4600	71.3975	261.0625	0.3500	91.3719		(29a)
Flat Roof	127.1000		127.1000	0.1600	20.3360		(30)
Total net area of external elements Aum(A, m2)			579.9700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		274.3020		(33)
Party Wall			51.0500	0.0000	0.0000		(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
Thermal bridges (User defined value 0.110 * total exposed area) 63.7967 (36)
Total fabric heat loss (33) + (36) = 338.0987 (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	167.4007	162.3707	162.3707	153.1730	147.6800	145.1250	142.6979	142.6979	149.0053	153.1730	157.6282	162.3707	(38)
(39)m	505.4994	500.4695	500.4695	491.2718	485.7787	483.2238	480.7966	480.7966	487.1041	491.2718	495.7269	500.4695	(39)
									Average = Sum(39)m / 12 =			491.9065	(39)
(40)m	1.7700	1.7524	1.7524	1.7202	1.7010	1.6920	1.6835	1.6835	1.7056	1.7202	1.7358	1.7524	(40)
									Average = Sum(40)m / 12 =			1.7224	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N 3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 113.8299 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	125.2129	120.6597	116.1065	111.5533	107.0001	102.4469	102.4469	107.0001	111.5533	116.1065	120.6597	125.2129	(44)
(45)m	186.1314	162.7917	167.9864	146.4546	140.5267	121.2639	112.3688	128.9448	130.4849	152.0675	165.9936	180.2583	(45)
Energy content (annual)										Total = Sum(45)m =		1795.2726	(45)
(46)m	27.9197	24.4188	25.1980	21.9682	21.0790	18.1896	16.8553	19.3417	19.5727	22.8101	24.8990	27.0387	(46)

Water storage loss:
b) If manufacturer declared cylinder loss factor is not known :
Cylinder volume (litres) including any solar storage within same cylinder 150.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0191 (51)
Volume factor from Table 2a 0.9283 (52)
Temperature factor from Table 2b 0.5400 (53)
Enter (49) or (54) in (55) 1.4364 (55)

(57)m	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(57)
Primary circuit loss (annual) from Table 3												610.0000	(58)
(59)m	51.8082	46.7945	51.8082	50.1370	51.8082	50.1370	51.8082	51.8082	50.1370	51.8082	50.1370	51.8082	(59)
(62)m	282.4678	249.8052	264.3228	239.6834	236.8631	214.4927	208.7052	225.2813	223.7136	248.4039	259.2224	276.5947	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	282.4678	249.8052	264.3228	239.6834	236.8631	214.4927	208.7052	225.2813	223.7136	248.4039	259.2224	276.5947	(64)
								Total per year (kWh/year) = Sum(64)m =				2929.5561	(64)
(65)m	138.9578	123.7391	132.9246	123.2792	123.7943	114.9033	114.4318	119.9433	117.9692	127.6316	129.7759	137.0050	(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	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	(66)
(67)m	67.6681	60.1022	48.8784	37.0041	27.6610	23.3526	25.2333	32.7992	44.0230	55.8973	65.2404	69.5488	(67)
(68)m	446.4885	451.1217	439.4463	414.5908	383.2151	353.7264	334.0261	329.3930	341.0684	365.9239	397.2996	426.7883	(68)
(69)m	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	(69)
(70)m	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	186.7712	184.1355	178.6621	171.2211	166.3901	159.5879	153.8061	161.2141	163.8462	171.5478	180.2443	184.1465	(72)
(73)m	780.6259	775.0574	746.6848	702.5139	656.9642	616.3648	592.7635	603.1042	628.6355	673.0670	722.4823	760.1816	(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	
East	69.5475	19.8726	0.7200	0.7000	0.7700	482.7244	(76)

(83)m	482.7244	935.6570	1495.4811	2220.4346	2701.6367	2819.0202	2736.1785	2381.3561	1787.9087	1139.4543	600.1517	398.2000	(83)
(84)m	1263.3502	1710.7144	2242.1659	2922.9485	3358.6009	3435.3850	3328.9420	2984.4603	2416.5443	1812.5213	1322.6340	1158.3816	(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	39.2338	39.6281	39.6281	40.3700	40.8265	41.0423	41.2495	41.2495	40.7154	40.3700	40.0072	39.6281	
alpha	3.6156	3.6419	3.6419	3.6913	3.7218	3.7362	3.7500	3.7500	3.7144	3.6913	3.6671	3.6419	
(86)m	0.9991	0.9972	0.9897	0.9634	0.8870	0.7456	0.5552	0.6055	0.8878	0.9849	0.9981	0.9993	(86)
(87)m	18.9084	19.1326	19.5516	20.0388	20.5402	20.8410	20.9632	20.9508	20.6661	20.0390	19.3300	18.9553	(87)
(88)m	19.4963	19.5086	19.5086	19.5313	19.5450	19.5513	19.5574	19.5574	19.5417	19.5313	19.5203	19.5086	(88)
(89)m	0.9987	0.9960	0.9854	0.9475	0.8349	0.6297	0.3772	0.4178	0.8090	0.9756	0.9973	0.9990	(89)
(90)m	17.6292	17.8618	18.2786	18.7711	19.2441	19.4827	19.5508	19.5481	19.3630	18.7802	18.0680	17.6850	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	17.9667	18.1971	18.6144	19.1056	19.5861	19.8411	19.9234	19.9182	19.7068	19.1123	18.4010	18.0201	(92)
Temperature adjustment												0.0000	
(93)m	17.9667	18.1971	18.6144	19.1056	19.5861	19.8411	19.9234	19.9182	19.7068	19.1123	18.4010	18.0201	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9982	0.9946	0.9816	0.9413	0.8367	0.6560	0.4255	0.4689	0.8204	0.9716	0.9963	0.9985	(94)
(95)m	1261.0173	1701.4418	2200.9766	2751.5158	2810.2301	2253.7504	1416.3054	1399.5589	1982.5000	1761.1131	1317.7009	1156.6610	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)

(97)m	6807.4065	6604.7532	5912.7688	5111.9727	3830.8807	2532.6058	1453.6643	1451.1440	2633.6768	4083.6177	5651.7641	6566.2302	(97)
(98)m	4126.5136	3295.0253	2761.5734	1699.5289	759.3640	0.0000	0.0000	0.0000	0.0000	1727.9434	3120.5255	4024.7195	(98)
Space heating (October to May) (kWh/year)												21515.1937	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	75.3359	(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)	0.1000 (201)
Fraction of space heat from main system(s)	0.9000 (202)
Efficiency of main space heating system 1 (in %)	78.9000 (206)
Efficiency of secondary/supplementary heating system, %	100.0000 (208)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	4126.5136	3295.0253	2761.5734	1699.5289	759.3640	0.0000	0.0000	0.0000	0.0000	1727.9434	3120.5255	4024.7195	(98)
(211)m	4707.0498	3758.5840	3150.0837	1938.6262	866.1947	0.0000	0.0000	0.0000	0.0000	1971.0381	3559.5348	4590.9348	(211)
(215)m	412.6514	329.5025	276.1573	169.9529	75.9364	0.0000	0.0000	0.0000	0.0000	172.7943	312.0526	402.4720	(215)

Annual totals kWh/year	
Space heating fuel used, main system 1	24542.0460 (211)
Space heating fuel used, secondary	2151.5194 (215)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(64)m	282.4678	249.8052	264.3228	239.6834	236.8631	214.4927	208.7052	225.2813	223.7136	248.4039	259.2224	276.5947	(64)
Efficiency of water heater												68.8000	(216)
(217)m	78.0897	78.0103	77.8021	77.3615	76.0274	68.8000	68.8000	68.8000	68.8000	77.3363	77.9332	78.0868	(217)
(219)m	361.7221	320.2210	339.7375	309.8227	311.5497	311.7626	303.3506	327.4437	325.1652	321.1995	332.6210	354.2146	(219)

Water heating fuel used	3918.8101 (219)
Electricity for pumps, fans and electric keep-hot (Table 4f):	
central heating pump	130.0000 (230c)
boiler with a fan-assisted flue	45.0000 (230e)
Total electricity for the above, kWh/year	175.0000 (231)
Electricity for lighting (calculated in Appendix L)	1195.0402 (232)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	24542.0460	0.1940	4761.1569	(261)
Space heating - secondary	2151.5194	0.4220	907.9412	(263)
Water heating cost (other fuel)	3918.8101	0.1940	760.2492	(264)
Space and water heating			6429.3473	(265)
Pumps and fans	175.0000	0.4220	73.8500	(267)
Energy for lighting	1195.0402	0.4220	504.3070	(268)
Total CO2, kg/year			7007.5042	(272)
Emissions per m2 for space and water heating			22.7711	(272a)
Emissions per m2 for lighting			1.7658	(272b)
Target Carbon Dioxide Emission Rate (TER)			15.2400	(273)

= [(22.7711 * 1.00 * 1.0206) + (1.7658 * 1.2251)] * 0.60

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF STANDARD ENE7 CO2
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480 (1a) - (3a)	
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082 (1b) - (3b)	
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580 (1c) - (3c)	
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479 (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	+	1	+	0	=	1 * 20 =	20.0000	(6b)
Number of intermittent fans							8 * 10 =	80.0000	(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) =	100.0000 / (5) =	0.1365 (8)
Pressure test		Yes
Measured/design q50		5.1000
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915 (18)
Number of sides on which dwelling is sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.8000	5.8860			(26)
Window/Glazed Door (Uw = 1.60)			86.4800	1.5038	130.0451			(27)
Roof Lights (Uw = 1.60)			10.2900	1.5038	15.4737			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.3000	25.2540			(29a)
External Wall	233.7700	89.7500	144.0200	0.3000	43.2060			(29a)
Room in Roof	14.5100		14.5100	0.1300	1.8863			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1800	14.4792			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1800	3.8970			(30)
Room in Roof	14.7200		14.7200	0.1300	1.9136			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		265.2697			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area) 46.3976 (36)
Total fabric heat loss (33) + (36) = 311.6673 (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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	452.7834	450.5928	450.5928	446.5871	444.1949	443.0822	442.0251	442.0251	444.7721	446.5871	448.5274	450.5928	(39)
									Average = Sum(39)m / 12 =			446.8636	(39)
(40)m	1.5854	1.5778	1.5778	1.5637	1.5554	1.5515	1.5478	1.5478	1.5574	1.5637	1.5705	1.5778	(40)
									Average = Sum(40)m / 12 =			1.5647	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N 3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 108.1384 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of
not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:
b) If manufacturer declared cylinder loss factor is not known :
Cylinder volume (litres) including any solar storage within same cylinder 150.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0191 (51)
Volume factor from Table 2a 0.9283 (52)
Temperature factor from Table 2b 0.5400 (53)
Enter (49) or (54) in (55) 1.4364 (55)

(57)m	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(57)
Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	251.9283	222.4875	234.6906	211.8127	208.6039	187.8815	181.8539	197.6011	196.6415	219.5677	230.3747	246.3489	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	251.9283	222.4875	234.6906	211.8127	208.6039	187.8815	181.8539	197.6011	196.6415	219.5677	230.3747	246.3489	(64)
								Total per year (kWh/year) = Sum(64)m =				2589.7925	(64)
(65)m	118.8771	105.6902	113.1455	104.4060	104.4717	96.4489	95.5773	100.8133	99.3616	108.1172	110.5779	117.0219	(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	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	(66)
(67)m	49.7560	44.1928	35.9400	27.2089	20.3390	17.1710	18.5539	24.1170	32.3699	41.1010	47.9709	51.1388	(67)
(68)m	446.4885	451.1217	439.4463	414.5908	383.2151	353.7264	334.0261	329.3930	341.0684	365.9239	397.2996	426.7883	(68)
(69)m	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	(69)
(70)m	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	159.7810	157.2771	152.0773	145.0084	140.4190	133.9568	128.4641	135.5017	138.0022	145.3188	153.5804	157.2875	(72)
(73)m	735.7235	732.2895	707.1616	666.5060	623.6710	584.5522	560.7421	568.7097	591.1384	632.0416	678.5488	714.9126	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457	(74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133	(76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691	(78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614	(80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754	(82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199	(83)
(84)m	1644.4884	2320.7161	2912.6147	3576.5126	4008.5484	4110.3395	3979.7449	3610.1164	3090.0450	2465.1425	1775.1902	1486.9325	(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	17.5206	17.6058	17.6058	17.7637	17.8594	17.9043	17.9471	17.9471	17.8362	17.7637	17.6869	17.6058	
alpha	2.1680	2.1737	2.1737	2.1842	2.1906	2.1936	2.1965	2.1965	2.1891	2.1842	2.1791	2.1737	
(86)m	0.9705	0.9407	0.8927	0.8165	0.6968	0.5534	0.4074	0.4401	0.6739	0.8602	0.9534	0.9745	(86)

(87)m	17.8065	18.2615	18.9306	19.5924	20.2663	20.6919	20.8951	20.8772	20.5079	19.6679	18.4955	17.8370	(87)
(88)m	19.6282	19.6338	19.6338	19.6441	19.6503	19.6531	19.6559	19.6559	19.6488	19.6441	19.6391	19.6338	(88)
(89)m	0.9652	0.9305	0.8739	0.7848	0.6421	0.4683	0.2900	0.3162	0.5932	0.8273	0.9439	0.9697	(89)
(90)m	16.7677	17.2179	17.8700	18.5057	19.1250	19.4807	19.6206	19.6137	19.3495	18.5989	17.4587	16.8024	(90)
Living area fraction										fLA = Living area / (4) =		0.2638	(91)
(92)m	17.0418	17.4932	18.1498	18.7924	19.4261	19.8003	19.9568	19.9471	19.6551	18.8809	17.7322	17.0753	(92)
Temperature adjustment												0.0000	
(93)m	17.0418	17.4932	18.1498	18.7924	19.4261	19.8003	19.9568	19.9471	19.6551	18.8809	17.7322	17.0753	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9507	0.9089	0.8479	0.7609	0.6319	0.4784	0.3179	0.3451	0.5936	0.8039	0.9251	0.9566	(94)
(95)m	1563.3343	2109.2750	2469.6144	2721.5310	2532.8665	1966.5370	1265.2733	1245.7289	1834.3954	1981.6918	1642.1556	1422.4411	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5678.6977	5629.3469	5114.1591	4507.1324	3431.9138	2304.1439	1351.1947	1346.8934	2381.8187	3608.8417	4813.7020	5486.1198	(97)
(98)m	3061.8304	2365.4883	1967.5413	1285.6331	668.8912	0.0000	0.0000	0.0000	0.0000	1210.5995	2283.5134	3023.3769	(98)
Space heating (October to May) (kWh/year)												15866.8741	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	55.5582	(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)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Fraction of main heating from main system 2	0.4600	(203)
Fraction of total heating from main system 1	0.4860	(204)
Fraction of total heating from main system 2	0.4140	(205)
Efficiency of main space heating system 1 (in %)	88.9000	(206)
Efficiency of main space heating system 2 (in %)	88.9000	(207)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	3061.8304	2365.4883	1967.5413	1285.6331	668.8912	0.0000	0.0000	0.0000	0.0000	1210.5995	2283.5134	3023.3769	(98)
(211)m	1673.8465	1293.1691	1075.6187	702.8320	365.6705	0.0000	0.0000	0.0000	0.0000	661.8126	1248.3549	1652.8247	(211)
(213)m	1425.8693	1101.5885	916.2678	598.7088	311.4971	0.0000	0.0000	0.0000	0.0000	563.7663	1063.4135	1407.9618	(213)
(215)m	306.1830	236.5488	196.7541	128.5633	66.8891	0.0000	0.0000	0.0000	0.0000	121.0600	228.3513	302.3377	(215)

Annual totals kWh/year

Space heating fuel used, main system 1	8674.1292	(211)
Space heating fuel used, main system 2	7389.0730	(213)
Space heating fuel used, secondary	1586.6874	(215)
Water heating		
(64)m	251.9283	222.4875	234.6906	211.8127	208.6039	187.8815	181.8539	197.6011	196.6415	219.5677	230.3747	246.3489	(64)
Efficiency of water heater												78.8000	(216)
(217)m	87.2803	87.0900	86.7098	86.1059	84.6587	78.8000	78.8000	78.8000	78.8000	85.9075	86.9835	87.2935	(217)
(219)m	288.6430	255.4685	270.6621	245.9911	246.4059	238.4283	230.7791	250.7629	249.5450	255.5860	264.8488	282.2077	(219)
Water heating fuel used												3079.3283	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):													
central heating pump												130.0000	(230c)
boiler with a fan-assisted flue												90.0000	(230e)
Total electricity for the above, kWh/year												220.0000	(231)
Electricity for lighting (calculated in Appendix L)												878.7060	(232)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	8674.1292	0.1980	1717.4776	(261)
Space heating - main system 2	7389.0730	0.1980	1463.0365	(262)
Space heating - secondary	1586.6874	0.5170	820.3174	(263)
Water heating cost (other fuel)	3079.3283	0.1980	609.7070	(264)
Space and water heating			4610.5384	(265)
Pumps and fans	220.0000	0.5170	113.7400	(267)
Energy for lighting	878.7060	0.5170	454.2910	(268)
Total CO2, kg/year			5178.5694	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.1300	(273)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600	(1a)	x 2.8000	(2a) =	119.4480	(1a) - (3a)
Ground floor	111.9400	(1b)	x 2.5300	(2b) =	283.2082	(1b) - (3b)
First floor	79.7200	(1c)	x 2.6500	(2c) =	211.2580	(1c) - (3c)
Second floor	51.2700	(1d)	x 2.3100	(2d) =	118.4337	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	732.3479	(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	+ 1	+ 0	= 1 * 20 =	20.0000	(6b)
Number of intermittent fans				8 * 10 =	80.0000	(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) =				100.0000 / (5) =	0.1365	(8)
Pressure test					Yes	
Measured/design q50					5.1000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)					0.3915	(18)
Number of sides on which dwelling is sheltered					3	(19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3034	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.8000	5.8860			(26)
Window/Glazed Door (Uw = 1.60)			86.4800	1.5038	130.0451			(27)
Roof Lights (Uw = 1.60)			10.2900	1.5038	15.4737			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.3000	25.2540			(29a)
External Wall	233.7700	89.7500	144.0200	0.3000	43.2060			(29a)
Room in Roof	14.5100		14.5100	0.1300	1.8863			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1800	14.4792			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1800	3.8970			(30)
Room in Roof	14.7200		14.7200	0.1300	1.9136			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		265.2697			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (User defined value 0.080 * total exposed area)	46.3976	(36)
Total fabric heat loss (33) + (36) =	311.6673	(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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	452.7834	450.5928	450.5928	446.5871	444.1949	443.0822	442.0251	442.0251	444.7721	446.5871	448.5274	450.5928	(39)
									Average = Sum(39)m / 12 =			446.8636	(39)
(40)m	1.5854	1.5778	1.5778	1.5637	1.5554	1.5515	1.5478	1.5478	1.5574	1.5637	1.5705	1.5778	(40)
									Average = Sum(40)m / 12 =			1.5647	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	3.1132	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.1384	(43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:		
b) If manufacturer declared cylinder loss factor is not known :		
Cylinder volume (litres) including any solar storage within same cylinder	300.0000	(50)
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115	(51)
Volume factor from Table 2a	0.7368	(52)
Temperature factor from Table 2b	0.5400	(53)
Enter (49) or (54) in (55)	1.3784	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)
Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
								Total per year (kWh/year) = Sum(64)m =				2568.6082	(64)
(65)m	117.4377	104.3901	111.7062	103.0131	103.0323	95.0560	94.1380	99.3739	97.9686	106.6778	109.1850	115.5825	(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	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	(66)
(67)m	124.3899	110.4820	89.8500	68.0223	50.8474	42.9275	46.3847	60.2926	80.9246	102.7524	119.9272	127.8471	(67)
(68)m	666.4008	673.3160	655.8900	618.7922	571.9628	527.9499	498.5465	491.6313	509.0573	546.1551	592.9845	636.9974	(68)
(69)m	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	(69)
(70)m	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	157.8464	155.3424	150.1427	143.0737	138.4843	132.0222	126.5295	133.5671	136.0675	143.3841	151.6458	155.3529	(72)
(73)m	1121.6343	1112.1376	1068.8799	1002.8853	934.2918	875.8968	844.4579	858.4882	899.0467	965.2888	1037.5546	1093.1946	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457	(74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133	(76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691	(78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614	(80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754	(82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199	(83)
(84)m	2030.3993	2700.5642	3274.3330	3912.8919	4319.1692	4401.6841	4263.4606	3899.8949	3397.9533	2798.3897	2134.1960	1865.2145	(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	17.5206	17.6058	17.6058	17.7637	17.8594	17.9043	17.9471	17.9471	17.8362	17.7637	17.6869	17.6058	
alpha	2.1680	2.1737	2.1737	2.1842	2.1906	2.1936	2.1965	2.1965	2.1891	2.1842	2.1791	2.1737	
(86)m	0.9561	0.9226	0.8708	0.7924	0.6712	0.5284	0.3852	0.4141	0.6404	0.8312	0.9350	0.9607	(86)
(87)m	18.3336	18.7103	19.2620	19.8017	20.3496	20.6922	20.8534	20.8406	20.5529	19.8790	18.9106	18.3593	(87)
(88)m	19.6282	19.6338	19.6338	19.6441	19.6503	19.6531	19.6559	19.6559	19.6488	19.6441	19.6391	19.6338	(88)
(89)m	0.9485	0.9099	0.8492	0.7583	0.6152	0.4445	0.2725	0.2953	0.5585	0.7939	0.9223	0.9537	(89)
(90)m	16.1492	16.6887	17.4698	18.2193	18.9478	19.3610	19.5206	19.5136	19.2190	18.3524	16.9885	16.1905	(90)

Living area fraction fLA = Living area / (4) = 0.2638 (91)

(92)m	16.7256	17.2221	17.9427	18.6368	19.3177	19.7122	19.8723	19.8637	19.5709	18.7552	17.4957	16.7628	(92)

Temperature adjustment 0.0000

(93)m	16.7256	17.2221	17.9427	18.6368	19.3177	19.7122	19.8723	19.8637	19.5709	18.7552	17.4957	16.7628	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9249	0.8791	0.8150	0.7279	0.5997	0.4485	0.2917	0.3150	0.5531	0.7632	0.8939	0.9316	(94)
(95)m	1877.8989	2374.1424	2668.6186	2848.2927	2590.1867	1974.2654	1243.6922	1228.3041	1879.4614	2135.6621	1907.7872	1737.5478	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5535.5313	5507.1785	5020.8144	4437.6408	3383.7235	2265.1449	1313.8128	1310.0330	2344.3490	3552.6747	4707.5889	5345.2731	(97)
(98)m	2721.2785	2105.4003	1750.0337	1144.3306	590.3914	0.0000	0.0000	0.0000	0.0000	1054.2574	2015.8572	2684.1476	(98)

Space heating (October to May) (kWh/year) 14065.6966 (98)

Space heating requirement in kWh/m2/year (98) / (4) = 49.2514 (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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	3810.5067	2740.5558	2740.5558	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.7780	0.8517	0.8325	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	2964.5506	2334.1726	2281.6228	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	5068.6307	4844.1006	4463.0578	0.0000	0.0000	0.0000	0.0000	(103)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1514.9377	1867.3864	1622.9876	0.0000	0.0000	0.0000	0.0000	(104)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	110.3671	14.7209	17.2019	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1514.9377	1867.3864	1622.9876	0.0000	0.0000	0.0000	0.0000	(104)

Cooled fraction fC = cooled area / (4) = 0.4587 (105)

(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	173.7120	214.1260	186.1017	0.0000	0.0000	0.0000	0.0000	(107)

Total = Sum(107)6..8 = 573.9397 (107)

Space cooling requirement in kWh/m2/year (107) / (4) = 2.0097 (108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000 (201)
Fraction of space heat from main system(s)	0.9000 (202)
Fraction of main heating from main system 2	0.4600 (203)
Fraction of total heating from main system 1	0.4860 (204)
Fraction of total heating from main system 2	0.4140 (205)
Efficiency of main space heating system 1 (in %)	90.0000 (206)
Efficiency of main space heating system 2 (in %)	250.0000 (207)
Efficiency of secondary/supplementary heating system, %	37.0000 (208)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.3200 (209)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	2721.2785	2105.4003	1750.0337	1144.3306	590.3914	0.0000	0.0000	0.0000	0.0000	1054.2574	2015.8572	2684.1476	(98)
(211)m	1469.4904	1136.9161	945.0182	617.9385	318.8113	0.0000	0.0000	0.0000	0.0000	569.2990	1088.5629	1449.4397	(211)
(213)m	450.6437	348.6543	289.8056	189.5012	97.7688	0.0000	0.0000	0.0000	0.0000	174.5850	333.8260	444.4948	(213)
(215)m	735.4807	569.0271	472.9821	309.2785	159.5652	0.0000	0.0000	0.0000	0.0000	284.9344	544.8263	725.4453	(215)

Annual totals kWh/year

Space heating fuel used, main system 1	7595.4762 (211)
Space heating fuel used, main system 2	2329.2794 (213)
Space heating fuel used, secondary	3801.5396 (215)

Water heating

(64)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)

Efficiency of water heater 79.3000 (216)

(217)m	88.1091	87.8946	87.4631	86.7894	85.1856	79.3000	79.3000	79.3000	79.3000	86.5182	87.7594	88.1228	(217)
(219)m	283.8855	251.2811	266.2738	242.0476	242.7696	234.7293	227.0551	246.9129	245.7759	251.7026	260.5230	277.5100	(219)

Space cooling fuel requirement

(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	40.2111	49.5662	43.0791	0.0000	0.0000	0.0000	0.0000	(221)

Water heating fuel used	3030.4665 (219)
Space cooling fuel used	132.8564 (221)

Electricity for pumps, fans and electric keep-hot (Table 4f):

warm air heating system fans	439.4087 (230b)
central heating pump	130.0000 (230c)
boiler with a fan-assisted flue	45.0000 (230e)
Total electricity for the above, kWh/year	614.4087 (231)
Electricity for lighting (calculated in Appendix L)	878.7060 (232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV Unit 0 (0.80 * 2.50 * 1073 * 0.80) -1716.8000 (233)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	7595.4762	3.1000	235.4598	(240)
Space heating - main system 2	2329.2794	11.4600	266.9354	(241)
Space heating - secondary	3801.5396	3.4200	130.0127	(242)
Water heating cost (other fuel)	3030.4665	3.1000	93.9445	(247)
Space cooling	132.8564	11.4600	15.2253	(248)
Pumps and fans for heating	614.4087	11.4600	70.4112	(249)
Energy for lighting	878.7060	11.4600	100.6997	(250)
Additional standing charges			106.0000	(251)
Energy saving/generation technologies				
PV Unit	-1716.8000	11.4600	-196.7453	(252)
Total energy cost			821.9433	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4700	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1686	(257)
SAP value		83.6986	
SAP rating (Section 12)		84	(258)
SAP band		B	

10a. Fuel costs - using BEDF prices (341)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	7595.4762	3.6400	276.4753	(240)
Space heating - main system 2	2329.2794	13.5900	316.5491	(241)
Space heating - secondary	3801.5396	4.6000	174.8708	(242)
Water heating cost (other fuel)	3030.4665	3.6400	110.3090	(247)
Space cooling	132.8564	13.5900	18.0552	(248)
Pumps and fans for heating	614.4087	13.5900	83.4981	(249)
Energy for lighting	878.7060	13.5900	119.4161	(250)
Additional standing charges			119.0000	(251)
Energy saving/generation technologies				
PV Unit	-1716.8000	13.5900	-233.3131	(252)
Total energy cost			984.8606	(255)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7595.4762	0.1980	1503.9043	(261)
Space heating - main system 2	2329.2794	0.5170	1204.2374	(262)
Space heating - secondary	3801.5396	0.0080	30.4123	(263)
Water heating cost (other fuel)	3030.4665	0.1980	600.0324	(264)
Space and water heating			3338.5864	(265)
Space cooling	132.8564	0.5170	68.6868	(266)
Pumps and fans	614.4087	0.5170	317.6493	(267)
Energy for lighting	878.7060	0.5170	454.2910	(268)
Energy saving/generation technologies				
PV Unit	-1716.8000	0.5290	-908.1872	(269)
Total CO2, kg/year			3271.0263	(272)
CO2 emissions per m2			11.4500	(273)
EI value			86.7414	
EI rating			87	(274)
EI band			B	

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	7595.4762	1.0200	7747.3857	(261)
Space heating - main system 2	2329.2794	2.9200	6801.4957	(262)
Space heating - secondary	3801.5396	1.0500	3991.6166	(263)
Water heating cost (other fuel)	3030.4665	1.0200	3091.0759	(264)
Space and water heating			21631.5739	(265)
Space cooling	132.8564	2.9200	387.9407	(266)
Pumps and fans	614.4087	2.9200	1794.0735	(267)
Energy for lighting	878.7060	2.9200	2565.8216	(268)
Energy saving/generation technologies				
PV Unit	-1716.8000	2.9200	-5013.0560	(269)
Primary energy kWh/year			21366.3538	(272)
Primary energy kWh/m2/year			74.8148	(273)

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2010 Edition
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

New Build (As Designed)

1 TER and DER
Fuels for main heating:Mains gas, Electricity
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.24 kg/m^2
Dwelling Carbon Dioxide Emission Rate (DER) 15.19 kg/m^{2}OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.29 (max. 0.30)	0.30 (max. 0.70)	OK

Floor	0.19 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.17 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.61 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.080

---

3 Air permeability

Air permeability at 50 pascals:	5.10 (design value)	
Maximum	10.0	OK

---

4 Heating efficiency

Main heating system 1:	Boiler system with radiators or underfloor - Mains gas	
Data from manufacturer		
TBC TBC		
Efficiency: 89.0% SEDBUK2009		
Minimum: 88.0%	OK	
Main heating system 2:	Heat pump with warm air distribution - Electric	
Secondary heating system:	Room heaters - Wood Logs	
RWJ Open fire in grate		
Efficiency: 37%		
Minimum: 37%	OK	

---

5 Cylinder insulation

Hot water storage	Nominal cylinder loss: 2.55 kWh/day	
Permitted by DBSCG 2.86	OK	
Primary pipework insulated:	Yes	OK

---

6 Controls

Space heating controls 1:	Time and temperature zone control	OK
Space heating controls 2:	Time and temperature zone control	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
Boiler interlock	Yes	OK

---

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

Minimum	75%	OK

---

8 Mechanical ventilation
Not applicable

---

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing North:	22.38 m^2, No overhang	
Windows facing East:	12.73 m^2, No overhang	
Windows facing South:	41.09 m^2, No overhang	
Windows facing West:	11.75 m^2, No overhang	
Windows facing Horizontal:	8.82 m^2, No overhang	
Ventilation rate:	8.00	
Blinds/curtains:	None	

---

10 Key features

External wall U-value	0.13 W/m^2K
Floor U-value	0.18 W/m^2K
Party wall U-value	0.00 W/m^2K
Secondary heating (wood logs)	
Fixed cooling system	
Secondary heating fuel:	wood logs

SAP 2009 OVERHEATING ASSESSMENT FOR New Build (As Designed) BRE SAP Worksheet 9.90
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

Overheating Calculation Input Data

Dwelling type	MidTerrace House
Number of storeys	4
Cross ventilation possible	Yes
Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	1933.40 (P1)
Transmission heat loss coefficient	311.67 (37)
Summer heat loss coefficient	2245.07 (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)
North	1.000	1.00	1.000	1.000 (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)
Horizontal	1.000	1.00	1.000	1.000 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	20.9100	85.3441	0.6300	0.7000	0.9000	637.4576
East	12.7300	117.7842	0.6300	0.7000	0.9000	535.5981
South	41.0900	110.5233	0.6300	0.7000	0.9000	1622.2343
West	11.7500	117.7842	0.6300	0.7000	0.9000	494.3659
Horizontal	10.2900	204.0000	0.6300	0.7000	1.0000	714.1342
					total:	4053.5835

	Jun	Jul	Aug	
Solar gains	4247	4054	3659	(P3)
Internal gains	822	791	805	
Total summer gains	5069	4844	4463	(P5)
Summer gain/loss ratio	2.26	2.16	1.99	(P6)
Summer external temperature	15.40	17.80	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	18.96	21.26	21.09	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

SAP 2009 IMPROVEMENTS
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

0006-Kemplay-Road

Current energy efficiency rating: C 80
Current environmental impact rating: B 83

(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
L	Not considered
M	Not considered
N Solar water heating	SAP increase too small
O	Not considered
P	Not considered
Q	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic (PV) panels	Recommended
V Wind turbine	SAP increase too small

Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic (PV) panels	+ 3.9	-£ 233	-908 kg (21.7%)

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.7	-£ 40	-240 kg (5.7%)
V Wind turbine	+ 0.1	-£ 8	-33 kg (1.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Lower cost measures				
(none)				
Sub Total	£0	0.00 kg/m²		
Higher cost measures				
(none)				
Sub Total	£0	0.00 kg/m²		

Potential energy efficiency rating: C 80
Potential environmental impact rating: B 83

Further improvements to achieve even higher standards

Solar photovoltaic	£233	3.18 kg/m²	B 84	B 87
Total Savings	£233	3.18 kg/m²		

Enhanced energy efficiency rating: B 84
Enhanced environmental impact rating: B 87

Fuel prices for cost data on this page from database revision number 341 TEST (31 Jul 2013)
Recommendation texts revision number 4.6 (10 Dec 2012)

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

	Current	Potential	Enhanced
Electricity	£538	£538	£538
Mains gas	£506	£506	£506
Wood	£175	£175	£175
Space heating	£970	£970	£970
Space cooling	£18	£18	£18
Water heating	£110	£110	£110
Lighting	£119	£119	£119
Generated (PV)	-£0	-£0	-£233
Total cost	£1219	£1219	£986
Carbon dioxide emissions	4.2 tonnes	4.2 tonnes	3.3 tonnes
Primary energy	92 kWh/m^2	92 kWh/m^2	75 kWh/m^2

MES Energy Services
Newark Beacon, Cafferata Way
Newark
Nottingham
01636 653055

Full SAP Calculation Printout

Property Reference: 0006-Kemplay-Road
Survey Reference: Be Lean
Property: Kemplay Road, London, NW3

Issued on Date: 08.Aug.2013
Prop Type Ref: TAG Architects

SAP Rating:	81 B	**CO2 Emissions (t/year):**	3.97	**DER:** 14.45 Pass	**Reduction:** 5.2%	**FEE:** 56.7	**ZC8:**	0.00
Environmental:	84 B	**General Requirements Compliance:**	Pass	**TER:** 15.24		**HLP:** 1.47	**Energy cost:**	£ 1159

CfSH Results	**Version:** CfSH November 2010	**ENE1 Credits:** 0.6	**ENE2 Credits:** 0.0	**ENE7 Credits:** 0		**CfSH Level:**	3

Surveyor: Matthew Crowther, Tel: 01636 653005 Surveyor ID: 8440-0006
Address: Cafferata Way, Newark, Nottinghamshire, NG24 2TN
Client:

Software Version: Elmhurst Energy Systems SAP2009 Calculator (Design System) version 4.01r01
SAP version: SAP 2009, Regs Region: England and Wales (Part L1A 2010), Calculation Type: New Dwelling As Designed

CALCULATION DETAILS for survey reference no 'Be Lean'
SAP2009 - 9.81 input data (DesignData) -

SAP2009 Input Data

FullRefNo:	Be Lean
Sap Version:	SAP 2009
Regs Region:	England & Wales
Region:	Thames Valley
Calculation Type:	New Build (As Designed)
DwellingOrientation:	North
Property Type:	House, Mid-Terrace
Storeys:	4
Date Built:	2013
Sheltered Sides:	3
Sunlight Shade:	Average or unknown
Measurements	Perimeter, Floor Area, Storey Height
Basement:	28.92, 42.66, 2.8
1st Storey:	42.73, 111.94, 2.53
2nd Storey:	40.44, 79.72, 2.65
3rd Storey:	30.92, 51.27, 2.31
4th Storey:	0, 0, 0
Living Area:	75.35 m2, fraction: 26.4%
Thermal Mass:	Simple calculation
Thermal Mass Simple:	Low
Thermal MassValue:	100
External Walls	Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Basement Wall	84.18, 84.18, 190, , Other, , Solid, 0, 0.22, Gross
External Wall	144.02, 233.77, 0, , Other, , Cavity, 0, 0.25, Gross
Room in Roof	14.51, 14.51, 0, , Other, , TimberFrame, 0, 0.12, Gross
Party Walls	Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall	51.05, 0, , Other, , FilledWithEdge, 0, 0
External Roofs	Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
Flat Roof	80.44, 89.26, 9, PlasterInsulatedFlatRoof, , , 0.16
Sloped Roof	21.65, 23.12, 9, PlasterInsulatedSlope, , , 0.16
Room in Roof	14.72, 14.72, 0, Other, , , 0.12
Heat Loss Floors	Area, Kappa, Construction, Element, Type, UValueFinal, ShelterFactor
Basement Floor	42.66, 0, Other, , GroundSolid, 0, 0.18
Ground Floor	77.75, 0, Other, , GroundSolid, 0, 0.2
Description	Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
Window/Glazed Door	Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
Solid Door	Manufacturer, Solid Door, , , , , , ,
Roof Lights	Manufacturer, Roof Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
Openings	Opening Type, Location, Orientation, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
Opening 1	Solid Door, External Wall, North, , , , 0, 0, 0, 3.27,
Opening 2	Window, External Wall, North, None, 0, , 0, 0, 0, 20.91,
Opening 3	Window, External Wall, East, None, 0, , 0, 0, 0, 12.73,
Opening 4	Window, External Wall, South, None, 0, , 0, 0, 0, 41.09,
Opening 5	Window, External Wall, West, None, 0, , 0, 0, 0, 11.75,
Opening 6	Roof Window, Sloped Roof, North, None, , , 0, 0, 0, 1.47,
Opening 7	Roof Window, Flat Roof, Horizontal, None, , , 0, 0, 0, 8.82,
Conservatory:	None
Draught Proofing:	100
Draught Lobby:	No
Thermal Bridges	User Input, ACDs Assumed
Y	0.08
Pressure Test:	True
Designed q50:	5.1
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:	1
Open Flues Other:	0
Open Flues Total:	1
Intermittent Fans:	8
Passive Vents:	0
Flueless Gas Fires:	0
Cooling System	
Cooled Area	130.99
Data Source	SAP table
Type	Split or Multi-Split
Class	A
Control	Modulating
Light Fittings:	20
LEL Fittings:	15

```
Percentage of LEL Fittings:   75
External Lights Fitted:       Yes
External LELs Fitted:         Yes
Electricity Tariff:           Standard
Main Heating 1
    Description
    Percentage                54
    MHS                       Mains gas BGB Post 98 Regular condens. with auto ign.
    SAP Code                  102
    Boiler Efficiency Type    Sedbuk 2009
    Efficiency                89
    Model Name                TBC
    Manufacturer              TBC
    MHS Controls              CBI Time and temperature zone control
    Delayed Start Stat        No
    Ctrl SAP Code             2110
    Burner Control            Modulating
    Boiler Compensator        None
    Flue Type                 Balanced
    Fan Assisted Flue         Yes
    Pumped                    Pump in heated space
    Heat Emitter              Underfloor
    Under Floor Heating       Yes - Pipes in thin screed
Main Heating 2
    Description
    Percentage                46
    MHS                       Electricity PEH Heat pump air-to-air
    SAP Code                  524
    Boiler Efficiency Type    SAP Table
    Efficiency                250
    MHS Controls              CWD Time and temperature zone control
    Delayed Start Stat        No
    Ctrl SAP Code             2506
Smoke Control Area             Unknown
Community Heating              None
Secondary Heating
    SHS                       RWJ - Wood Logs RWJ Open fire in grate
    SAP Code                  631
    Hetas Approved System     True
    Efficiency                37
Water Heating
    Type                      MainHeating1
    WHS                       HWP From main heating 1
    Low Water Usage           Yes
    SAP Code                  901
    Hot Water Cylinder
    Cylinder Type             HotWaterCylinder
    Cylinder Insulation Type  Foam
    Insulation Thickness      80 mm
    Cylinder Volume           300.00
    Cylinder Stat             Yes
    Pipes Insulated           Yes
    Cylinder in Heated Space  Yes
    Separate Time Control     Yes
Flue Gas Heat Recovery System None
Waste Water Heat Recovery      none
PV Unit                        None
Wind Turbine                   None
Terrain Type:                  Urban
Small Scale Hydro              None
Special Features               None
```

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF FABRIC ENERGY EFFICIENCY
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

---

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480 (1a) - (3a)	
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082 (1b) - (3b)	
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580 (1c) - (3c)	
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479	(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	+	1	+	0	=	1 * 20	=	20.0000	(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) =	60.0000 / (5) =	0.0819	(8)
Pressure test		Yes	
Measured/design q50		5.1000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3369	(18)
Number of sides on which dwelling is 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) =	0.2864	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.3866	0.3651	0.3651	0.3222	0.2935	0.2792	0.2649	0.2649	0.3007	0.3222	0.3437	0.3651	(22b)
Effective ach	0.5747	0.5667	0.5667	0.5519	0.5431	0.5390	0.5351	0.5351	0.5452	0.5519	0.5591	0.5667	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		238.4581			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area) 46.3976 (36)
Total fabric heat loss (33) + (36) = 284.8557 (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	138.9001	136.9488	136.9488	133.3809	131.2501	130.2590	129.3174	129.3174	131.7642	133.3809	135.1091	136.9488	(38)
(39)m	423.7557	421.8045	421.8045	418.2366	416.1057	415.1147	414.1731	414.1731	416.6199	418.2366	419.9648	421.8045	(39)
									Average = Sum(39)m / 12 =			418.4828	(39)
(40)m	1.4838	1.4770	1.4770	1.4645	1.4570	1.4535	1.4502	1.4502	1.4588	1.4645	1.4705	1.4770	(40)
									Average = Sum(40)m / 12 =			1.4653	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N 3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 108.1384 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)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:													
(57)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	(57)
Primary circuit loss (annual) from Table 3												0.0000	(58)
(59)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	(59)
(65)m	37.5753	32.8636	33.9123	29.5655	28.3688	24.4801	22.6845	26.0307	26.3416	30.6986	33.5100	36.3896	(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	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	(66)
(67)m	39.8048	35.3543	28.7520	21.7671	16.2712	13.7368	14.8431	19.2936	25.8959	32.8808	38.3767	40.9111	(67)
(68)m	446.4885	451.1217	439.4463	414.5908	383.2151	353.7264	334.0261	329.3930	341.0684	365.9239	397.2996	426.7883	(68)
(69)m	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	(69)
(70)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	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	50.5044	48.9041	45.5810	41.0632	38.1301	34.0002	30.4899	34.9876	36.5856	41.2616	46.5416	48.9108	(72)
(73)m	606.4957	605.0780	583.4773	547.1191	507.3144	471.1614	449.0571	453.3721	473.2478	509.7643	551.9159	586.3081	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457	(74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133	(76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691	(78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614	(80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754	(82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199	(83)
(84)m	1515.2606	2193.5046	2788.9303	3457.1257	3892.1918	3996.9487	3868.0598	3494.7788	2972.1545	2342.8651	1648.5572	1358.3280	(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	18.7208	18.8074	18.8074	18.9679	19.0650	19.1105	19.1540	19.1540	19.0415	18.9679	18.8898	18.8074	
alpha	2.2481	2.2538	2.2538	2.2645	2.2710	2.2740	2.2769	2.2769	2.2694	2.2645	2.2593	2.2538	
(86)m	0.9746	0.9450	0.8959	0.8165	0.6923	0.5453	0.3985	0.4326	0.6721	0.8649	0.9587	0.9786	(86)
(87)m	17.9075	18.3724	19.0384	19.6905	20.3354	20.7299	20.9112	20.8945	20.5514	19.7365	18.5794	17.9309	(87)
(88)m	19.7033	19.7085	19.7085	19.7178	19.7234	19.7261	19.7285	19.7285	19.7221	19.7178	19.7133	19.7085	(88)
(89)m	0.9702	0.9358	0.8782	0.7859	0.6395	0.4644	0.2887	0.3162	0.5948	0.8338	0.9503	0.9747	(89)
(90)m	16.9152	17.3757	18.0252	18.6511	19.2432	19.5722	19.6974	19.6908	19.4446	18.7159	17.5892	16.9425	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	17.1770	17.6387	18.2925	18.9253	19.5314	19.8776	20.0177	20.0084	19.7366	18.9852	17.8505	17.2033	(92)
Temperature adjustment												0.0000	
(93)m	17.1770	17.6387	18.2925	18.9253	19.5314	19.8776	20.0177	20.0084	19.7366	18.9852	17.8505	17.2033	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9576	0.9158	0.8536	0.7636	0.6307	0.4748	0.3150	0.3435	0.5958	0.8117	0.9334	0.9635	(94)
(95)m	1450.9745	2008.7828	2380.6562	2639.7548	2454.7215	1897.6306	1218.5119	1200.4318	1770.8688	1901.6493	1538.7710	1308.8090	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5371.9584	5331.0416	4847.5889	4276.6057	3258.6740	2190.8295	1291.2518	1287.4189	2265.0030	3423.3338	4556.8200	5189.5957	(97)
(98)m	2917.2120	2232.5579	1835.3979	1178.5326	598.1406	0.0000	0.0000	0.0000	0.0000	1132.1332	2172.9953	2887.3053	(98)

Space heating (October to May) (kWh/year) 14954.2749 (98)
Space heating requirement in kWh/m2/year (98) / (4) = 52.3627 (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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	3569.9860	2567.8733	2567.8733	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.7989	0.8689	0.8501	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	2851.9759	2231.1307	2182.8992	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	4962.0232	4738.7840	4352.4198	0.0000	0.0000	0.0000	0.0000	(103)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1519.2340	1865.6941	1614.1233	0.0000	0.0000	0.0000	0.0000	(104)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	99.4420	13.8185	16.3804	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1519.2340	1865.6941	1614.1233	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	379.8085	466.4235	403.5308	0.0000	0.0000	0.0000	0.0000	(107)
									Total = Sum(107)6..8 =			1249.7629	(107)

Space cooling requirement in kWh/m2/year (107) / (4) = 4.3761 (108)

8f. Fabric Energy Efficiency

Fabric Energy Efficiency (99) + (108) = 56.7388
Fabric Energy Efficiency rounded 56.7 (109)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF DATA FOR RENEWABLE HEAT INCENTIVE (RHI)
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600	(1a)	x 2.8000	(2a) =	119.4480	(1a) - (3a)
Ground floor	111.9400	(1b)	x 2.5300	(2b) =	283.2082	(1b) - (3b)
First floor	79.7200	(1c)	x 2.6500	(2c) =	211.2580	(1c) - (3c)
Second floor	51.2700	(1d)	x 2.3100	(2d) =	118.4337	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		732.3479	(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	+	1	+	0	=	1 * 20 =	20.0000	(6b)
Number of intermittent fans							8 * 10 =	80.0000	(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) =	100.0000 / (5) =	0.1365 (8)
Pressure test		Yes
Measured/design q50		5.1000
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915 (18)
Number of sides on which dwelling is sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		238.4581			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area) 46.3976 (36)
Total fabric heat loss (33) + (36) = 284.8557 (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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	425.9718	423.7812	423.7812	419.7755	417.3832	416.2706	415.2135	415.2135	417.9605	419.7755	421.7158	423.7812	(39)
									Average = Sum(39)m / 12 =			420.0520	(39)
(40)m	1.4916	1.4839	1.4839	1.4699	1.4615	1.4576	1.4539	1.4539	1.4635	1.4699	1.4766	1.4839	(40)
									Average = Sum(40)m / 12 =			1.4708	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N 3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 108.1384 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:
b) If manufacturer declared cylinder loss factor is not known :
Cylinder volume (litres) including any solar storage within same cylinder 300.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0115 (51)
Volume factor from Table 2a 0.7368 (52)
Temperature factor from Table 2b 0.5400 (53)
Enter (49) or (54) in (55) 1.3784 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)
Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
								Total per year (kWh/year) = Sum(64)m =				2568.6082	(64)
RHI water heating demand												2569	(64)
(65)m	117.4377	104.3901	111.7062	103.0131	103.0323	95.0560	94.1380	99.3739	97.9686	106.6778	109.1850	115.5825	(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	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	(66)
(67)m	124.3899	110.4820	89.8500	68.0223	50.8474	42.9275	46.3847	60.2926	80.9246	102.7524	119.9272	127.8471	(67)
(68)m	666.4008	673.3160	655.8900	618.7922	571.9628	527.9499	498.5465	491.6313	509.0573	546.1551	592.9845	636.9974	(68)
(69)m	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	(69)
(70)m	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	157.8464	155.3424	150.1427	143.0737	138.4843	132.0222	126.5295	133.5671	136.0675	143.3841	151.6458	155.3529	(72)
(73)m	1121.6343	1112.1376	1068.8799	1002.8853	934.2918	875.8968	844.4579	858.4882	899.0467	965.2888	1037.5546	1093.1946	(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	20.9100	11.6736	0.6300	0.7000	0.7700	74.5983	(74)
East	12.7300	21.7895	0.6300	0.7000	0.7700	84.7712	(76)
South	41.0900	49.8711	0.6300	0.7000	0.7700	626.2638	(78)
West	11.7500	21.7895	0.6300	0.7000	0.7700	78.2452	(80)
Horizontal	10.2900	29.0000	0.6300	0.7000	1.0000	108.3299	(82)

(83)m	972.2084	1553.2515	2241.4738	2899.5718	3389.8706	3749.2269	3578.4110	3225.2609	2588.1426	1891.7704	1243.2165	811.0012	(83)
(84)m	2093.8427	2665.3891	3310.3538	3902.4571	4324.1623	4625.1237	4422.8689	4083.7491	3487.1892	2857.0592	2280.7711	1904.1958	(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	18.6234	18.7197	18.7197	18.8983	19.0066	19.0575	19.1060	19.1060	18.9804	18.8983	18.8114	18.7197	
alpha	2.2416	2.2480	2.2480	2.2599	2.2671	2.2705	2.2737	2.2737	2.2654	2.2599	2.2541	2.2480	
(86)m	0.9491	0.9174	0.8534	0.7684	0.6186	0.4450	0.2865	0.3078	0.5677	0.7957	0.9186	0.9553	(86)
(87)m	18.6201	18.9359	19.5107	20.0044	20.5304	20.8029	20.9064	20.9015	20.6990	20.1214	19.2075	18.6323	(87)
(88)m	19.6976	19.7033	19.7033	19.7138	19.7201	19.7230	19.7258	19.7258	19.7186	19.7138	19.7087	19.7033	(88)
(89)m	0.9404	0.9039	0.8295	0.7315	0.5572	0.3599	0.1777	0.1919	0.4779	0.7516	0.9030	0.9473	(89)
(90)m	16.5946	17.0469	17.8575	18.5388	19.2249	19.5333	19.6232	19.6215	19.4367	18.7228	17.4471	16.6171	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	17.1290	17.5453	18.2937	18.9255	19.5693	19.8683	19.9618	19.9592	19.7697	19.0918	17.9115	17.1488	(92)
Temperature adjustment												0.0000	
(93)m	17.1290	17.5453	18.2937	18.9255	19.5693	19.8683	19.9618	19.9592	19.7697	19.0918	17.9115	17.1488	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9158	0.8738	0.7972	0.7052	0.5493	0.3701	0.1986	0.2140	0.4818	0.7258	0.8735	0.9244	(94)
(95)m	1917.5914	2329.0564	2638.9337	2752.0286	2375.1940	1711.9102	878.4596	874.1173	1680.1579	2073.6050	1992.2095	1760.2516	(95)
(96)m	5.1000	5.5000	7.4000	9.3000	12.6000	15.4000	17.8000	17.8000	15.1000	11.6000	7.6000	5.5000	(96)
(97)m	5124.0342	5104.5628	4616.5424	4040.5524	2908.8816	1860.0021	897.6065	896.5429	1951.7617	3144.8672	4348.5400	4936.5436	(97)
(98)m	2385.5934	1865.1403	1471.3409	927.7372	397.0635	0.0000	0.0000	0.0000	0.0000	797.0191	1696.5580	2363.1613	(98)

Space heating (October to May) (kWh/year) 11903.6136 (98)
RHI space heating demand 11904 (98)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF ENERGY RATINGS
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

---

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480 (1a) - (3a)	
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082 (1b) - (3b)	
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580 (1c) - (3c)	
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479	(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	+	1	+	0	=	1 * 20 =	20.0000	(6b)
Number of intermittent fans							8 * 10 =	80.0000	(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) =	100.0000 / (5) =	0.1365	(8)
Pressure test		Yes	
Measured/design q50		5.1000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915	(18)
Number of sides on which dwelling is sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		238.4581			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (User defined value 0.080 * total exposed area)	46.3976	(36)
Total fabric heat loss (33) + (36) =	284.8557	(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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	425.9718	423.7812	423.7812	419.7755	417.3832	416.2706	415.2135	415.2135	417.9605	419.7755	421.7158	423.7812	(39)
									Average = Sum(39)m / 12 =			420.0520	(39)
(40)m	1.4916	1.4839	1.4839	1.4699	1.4615	1.4576	1.4539	1.4539	1.4635	1.4699	1.4766	1.4839	(40)
									Average = Sum(40)m / 12 =			1.4708	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.1384 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:		
b) If manufacturer declared cylinder loss factor is not known :		
Cylinder volume (litres) including any solar storage within same cylinder	300.0000	(50)
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115	(51)
Volume factor from Table 2a	0.7368	(52)
Temperature factor from Table 2b	0.5400	(53)
Enter (49) or (54) in (55)	1.3784	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)

Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
								Total per year (kWh/year) = Sum(64)m =				2568.6082	(64)
(65)m	117.4377	104.3901	111.7062	103.0131	103.0323	95.0560	94.1380	99.3739	97.9686	106.6778	109.1850	115.5825	(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	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	(66)
(67)m	124.3899	110.4820	89.8500	68.0223	50.8474	42.9275	46.3847	60.2926	80.9246	102.7524	119.9272	127.8471	(67)
(68)m	666.4008	673.3160	655.8900	618.7922	571.9628	527.9499	498.5465	491.6313	509.0573	546.1551	592.9845	636.9974	(68)
(69)m	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	(69)
(70)m	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	157.8464	155.3424	150.1427	143.0737	138.4843	132.0222	126.5295	133.5671	136.0675	143.3841	151.6458	155.3529	(72)
(73)m	1121.6343	1112.1376	1068.8799	1002.8853	934.2918	875.8968	844.4579	858.4882	899.0467	965.2888	1037.5546	1093.1946	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457	(74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133	(76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691	(78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614	(80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754	(82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199	(83)
(84)m	2030.3993	2700.5642	3274.3330	3912.8919	4319.1692	4401.6841	4263.4606	3899.8949	3397.9533	2798.3897	2134.1960	1865.2145	(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	18.6234	18.7197	18.7197	18.8983	19.0066	19.0575	19.1060	19.1060	18.9804	18.8983	18.8114	18.7197	
alpha	2.2416	2.2480	2.2480	2.2599	2.2671	2.2705	2.2737	2.2737	2.2654	2.2599	2.2541	2.2480	
(86)m	0.9552	0.9200	0.8653	0.7825	0.6561	0.5105	0.3680	0.3965	0.6244	0.8234	0.9331	0.9600	(86)
(87)m	18.4733	18.8523	19.3913	19.9125	20.4246	20.7325	20.8712	20.8602	20.6051	19.9728	19.0341	18.4952	(87)
(88)m	19.6976	19.7033	19.7033	19.7138	19.7201	19.7230	19.7258	19.7258	19.7186	19.7138	19.7087	19.7033	(88)
(89)m	0.9478	0.9074	0.8438	0.7488	0.6019	0.4313	0.2644	0.2869	0.5457	0.7864	0.9205	0.9531	(89)
(90)m	16.3820	16.9257	17.6890	18.4127	19.0922	19.4625	19.6000	19.5938	19.3321	18.5213	17.1994	16.4181	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	16.9337	17.4340	18.1381	18.8084	19.4438	19.7975	19.9354	19.9279	19.6680	18.9043	17.6835	16.9661	(92)
Temperature adjustment												0.0000	
(93)m	16.9337	17.4340	18.1381	18.8084	19.4438	19.7975	19.9354	19.9279	19.6680	18.9043	17.6835	16.9661	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9248	0.8775	0.8112	0.7208	0.5889	0.4363	0.2823	0.3053	0.5423	0.7577	0.8929	0.9316	(94)
(95)m	1877.6127	2369.8665	2655.9852	2820.5101	2543.4663	1920.4187	1203.7121	1190.6534	1842.5578	2120.3744	1905.6450	1737.6229	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5296.4189	5269.2879	4804.8779	4243.2665	3232.1130	2163.5866	1260.3328	1257.2365	2243.5954	3401.9742	4505.3967	5113.3885	(97)
(98)m	2543.5918	1948.4112	1598.7762	1024.3846	512.3532	0.0000	0.0000	0.0000	0.0000	953.5102	1871.8212	2511.5695	(98)
Space heating (October to May) (kWh/year)												12964.4180	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	45.3952	(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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	3579.9268	2574.3237	2574.3237	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.8037	0.8726	0.8549	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	2877.0994	2246.3884	2200.9004	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	5068.6307	4844.1006	4463.0578	0.0000	0.0000	0.0000	0.0000	(103)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1577.9025	1932.6978	1683.0451	0.0000	0.0000	0.0000	0.0000	(104)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	89.7171	11.6021	13.6582	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1577.9025	1932.6978	1683.0451	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area / (4) =			0.4587	(105)
(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	180.9320	221.6150	192.9883	0.0000	0.0000	0.0000	0.0000	(107)
									Total = Sum(107)6..8 =			595.5352	(107)
Space cooling requirement in kWh/m2/year											(107) / (4) =	2.0853	(108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Fraction of main heating from main system 2	0.4600	(203)
Fraction of total heating from main system 1	0.4860	(204)
Fraction of total heating from main system 2	0.4140	(205)
Efficiency of main space heating system 1 (in %)	90.0000	(206)
Efficiency of main space heating system 2 (in %)	250.0000	(207)
Efficiency of secondary/supplementary heating system, %	37.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.3200	(209)
Space heating:		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	2543.5918	1948.4112	1598.7762	1024.3846	512.3532	0.0000	0.0000	0.0000	0.0000	953.5102	1871.8212	2511.5695	(98)
(211)m	1373.5396	1052.1421	863.3391	553.1677	276.6707	0.0000	0.0000	0.0000	0.0000	514.8955	1010.7835	1356.2476	(211)
(213)m	421.2188	322.6569	264.7573	169.6381	84.8457	0.0000	0.0000	0.0000	0.0000	157.9013	309.9736	415.9159	(213)
(215)m	687.4572	526.5976	432.1017	276.8607	138.4738	0.0000	0.0000	0.0000	0.0000	257.7055	505.8976	678.8026	(215)

Annual totals kWh/year

Space heating fuel used, main system 1	7000.7857	(211)
Space heating fuel used, main system 2	2146.9076	(213)
Space heating fuel used, secondary	3503.8968	(215)

Water heating

(64)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
Efficiency of water heater												79.3000	(216)
(217)m	88.0017	87.7604	87.2840	86.5351	84.8081	79.3000	79.3000	79.3000	79.3000	86.2782	87.6253	88.0177	(217)
(219)m	284.2321	251.6652	266.8202	242.7587	243.8502	234.7293	227.0551	246.9129	245.7759	252.4025	260.9219	277.8413	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	41.8824	51.2998	44.6732	0.0000	0.0000	0.0000	0.0000	(221)

Water heating fuel used	3034.9652	(219)
Space cooling fuel used	137.8554	(221)

Electricity for pumps, fans and electric keep-hot (Table 4f):

warm air heating system fans	439.4087	(230b)
central heating pump	130.0000	(230c)
boiler with a fan-assisted flue	45.0000	(230e)
Total electricity for the above, kWh/year	614.4087	(231)
Electricity for lighting (calculated in Appendix L)	878.7060	(232)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	7000.7857	3.1000	217.0244	(240)
Space heating - main system 2	2146.9076	11.4600	246.0356	(241)
Space heating - secondary	3503.8968	3.4200	119.8333	(242)
Water heating cost (other fuel)	3034.9652	3.1000	94.0839	(247)
Space cooling	137.8554	11.4600	15.7982	(248)
Pumps and fans for heating	614.4087	11.4600	70.4112	(249)
Energy for lighting	878.7060	11.4600	100.6997	(250)
Additional standing charges			106.0000	(251)
Total energy cost			969.8863	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4700	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.3789	(257)
SAP value		80.7645	
SAP rating (Section 12)		81	(258)
SAP band		B	

10a. Fuel costs - using BEDF prices (341)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	7000.7857	3.6400	254.8286	(240)
Space heating - main system 2	2146.9076	13.5900	291.7647	(241)
Space heating - secondary	3503.8968	4.6000	161.1793	(242)
Water heating cost (other fuel)	3034.9652	3.6400	110.4727	(247)
Space cooling	137.8554	13.5900	18.7345	(248)
Pumps and fans for heating	614.4087	13.5900	83.4981	(249)
Energy for lighting	878.7060	13.5900	119.4161	(250)
Additional standing charges			119.0000	(251)
Total energy cost			1158.8942	(255)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7000.7857	0.1980	1386.1556	(261)
Space heating - main system 2	2146.9076	0.5170	1109.9512	(262)
Space heating - secondary	3503.8968	0.0080	28.0312	(263)
Water heating cost (other fuel)	3034.9652	0.1980	600.9231	(264)
Space and water heating			3125.0611	(265)
Space cooling	137.8554	0.5170	71.2712	(266)
Pumps and fans	614.4087	0.5170	317.6493	(267)
Energy for lighting	878.7060	0.5170	454.2910	(268)
Total CO2, kg/year			3968.2727	(272)
CO2 emissions per m2			13.8900	(273)
EI value			83.9152	
EI rating			84	(274)
EI band			B	

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	7000.7857	1.0200	7140.8014	(261)
Space heating - main system 2	2146.9076	2.9200	6268.9702	(262)
Space heating - secondary	3503.8968	1.0500	3679.0916	(263)
Water heating cost (other fuel)	3034.9652	1.0200	3095.6645	(264)
Space and water heating			20184.5278	(265)
Space cooling	137.8554	2.9200	402.5377	(266)
Pumps and fans	614.4087	2.9200	1794.0735	(267)
Energy for lighting	878.7060	2.9200	2565.8216	(268)
Primary energy kWh/year			24946.9606	(272)
Primary energy kWh/m2/year			87.3524	(273)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480 (1a) - (3a)	
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082 (1b) - (3b)	
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580 (1c) - (3c)	
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479	(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	+	1	+	0	=	1 * 20 =	20.0000	(6b)
Number of intermittent fans							8 * 10 =	80.0000	(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) =	100.0000 / (5) =	0.1365 (8)
Pressure test		Yes
Measured/design q50		5.1000
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915 (18)
Number of sides on which dwelling is sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		238.4581			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area)		46.3976 (36)
Total fabric heat loss	(33) + (36) =	284.8557 (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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	425.9718	423.7812	423.7812	419.7755	417.3832	416.2706	415.2135	415.2135	417.9605	419.7755	421.7158	423.7812	(39)
									Average = Sum(39)m / 12 =			420.0520	(39)
(40)m	1.4916	1.4839	1.4839	1.4699	1.4615	1.4576	1.4539	1.4539	1.4635	1.4699	1.4766	1.4839	(40)
									Average = Sum(40)m / 12 =			1.4708	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N		3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		108.1384 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:

b) If manufacturer declared cylinder loss factor is not known :		
Cylinder volume (litres) including any solar storage within same cylinder		300.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.0115 (51)
Volume factor from Table 2a		0.7368 (52)
Temperature factor from Table 2b		0.5400 (53)
Enter (49) or (54) in (55)		1.3784 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)
Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(62)
(63)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	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Water heat.	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)

												Total per year (kWh/year) = Sum(64)m =	2568.6082 (64)
(65)m	117.4377	104.3901	111.7062	103.0131	103.0323	95.0560	94.1380	99.3739	97.9686	106.6778	109.1850	115.5825	(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	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	(66)
(67)m	49.7560	44.1928	35.9400	27.2089	20.3390	17.1710	18.5539	24.1170	32.3699	41.1010	47.9709	51.1388	(67)
(68)m	446.4885	451.1217	439.4463	414.5908	383.2151	353.7264	334.0261	329.3930	341.0684	365.9239	397.2996	426.7883	(68)
(69)m	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	(69)
(70)m	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	157.8464	155.3424	150.1427	143.0737	138.4843	132.0222	126.5295	133.5671	136.0675	143.3841	151.6458	155.3529	(72)
(73)m	777.7297	774.2958	749.1678	708.5122	665.6772	626.5584	602.7484	610.7160	633.1446	674.0478	720.5551	756.9188	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457	(74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133	(76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691	(78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614	(80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754	(82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199	(83)
(84)m	1686.4947	2362.7223	2954.6209	3618.5188	4050.5547	4152.3457	4021.7511	3652.1226	3132.0513	2507.1487	1817.1964	1528.9388	(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	18.6234	18.7197	18.7197	18.8983	19.0066	19.0575	19.1060	19.1060	18.9804	18.8983	18.8114	18.7197	
alpha	2.2416	2.2480	2.2480	2.2599	2.2671	2.2705	2.2737	2.2737	2.2654	2.2599	2.2541	2.2480	
(86)m	0.9687	0.9370	0.8858	0.8047	0.6790	0.5320	0.3865	0.4183	0.6541	0.8502	0.9503	0.9729	(86)
(87)m	18.3253	18.7210	19.2866	19.8395	20.3838	20.7139	20.8641	20.8511	20.5694	19.8887	18.9055	18.3481	(87)
(88)m	19.6976	19.7033	19.7033	19.7138	19.7201	19.7230	19.7258	19.7258	19.7186	19.7138	19.7087	19.7033	(88)
(89)m	0.9633	0.9267	0.8668	0.7729	0.6256	0.4515	0.2790	0.3044	0.5760	0.8169	0.9405	0.9680	(89)
(90)m	16.1697	16.7404	17.5456	18.3179	19.0452	19.4455	19.5960	19.5886	19.2961	18.4125	17.0177	16.2068	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	16.7384	17.2630	18.0049	18.7194	19.3984	19.7802	19.9306	19.9217	19.6321	18.8020	17.5158	16.7717	(92)
Temperature adjustment												0.0000	
(93)m	16.7384	17.2630	18.0049	18.7194	19.3984	19.7802	19.9306	19.9217	19.6321	18.8020	17.5158	16.7717	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9447	0.8995	0.8345	0.7435	0.6105	0.4554	0.2972	0.3231	0.5700	0.7870	0.9164	0.9511	(94)
(95)m	1593.1788	2125.3200	2465.7379	2690.4516	2472.8668	1891.1060	1195.3666	1179.8375	1785.3311	1973.0122	1665.2975	1454.2207	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5213.2215	5196.8272	4748.4467	4205.8876	3213.1905	2156.3519	1258.3561	1254.6583	2228.6017	3359.0352	4434.6590	5031.0186	(97)
(98)m	2693.3117	2064.0528	1698.3353	1091.1139	550.8008	0.0000	0.0000	0.0000	0.0000	1031.2011	1993.9403	2661.1376	(98)
Space heating (October to May) (kWh/year)												13783.8936	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	48.2646	(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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	3579.9268	2574.3237	2574.3237	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.8037	0.8726	0.8549	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	2877.0994	2246.3884	2200.9004	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	5068.6307	4844.1006	4463.0578	0.0000	0.0000	0.0000	0.0000	(103)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1577.9025	1932.6978	1683.0451	0.0000	0.0000	0.0000	0.0000	(104)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	89.7171	11.6021	13.6582	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1577.9025	1932.6978	1683.0451	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area / (4) =			0.4587	(105)
(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	180.9320	221.6150	192.9883	0.0000	0.0000	0.0000	0.0000	(107)
										Total = Sum(107)6..8 =		595.5352	(107)
Space cooling requirement in kWh/m2/year											(107) / (4) =	2.0853	(108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Fraction of main heating from main system 2	0.4600	(203)
Fraction of total heating from main system 1	0.4860	(204)
Fraction of total heating from main system 2	0.4140	(205)
Efficiency of main space heating system 1 (in %)	90.0000	(206)
Efficiency of main space heating system 2 (in %)	250.0000	(207)
Efficiency of secondary/supplementary heating system, %	37.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.3200	(209)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	2693.3117	2064.0528	1698.3353	1091.1139	550.8008	0.0000	0.0000	0.0000	0.0000	1031.2011	1993.9403	2661.1376	(98)
(211)m	1454.3883	1114.5885	917.1011	589.2015	297.4324	0.0000	0.0000	0.0000	0.0000	556.8486	1076.7277	1437.0143	(211)
(213)m	446.0124	341.8072	281.2443	180.6885	91.2126	0.0000	0.0000	0.0000	0.0000	170.7669	330.1965	440.6844	(213)
(215)m	727.9221	557.8521	459.0096	294.8956	148.8651	0.0000	0.0000	0.0000	0.0000	278.7030	538.9028	719.2264	(215)
Annual totals kWh/year													

Space heating fuel used, main system 1												7443.3025	(211)
Space heating fuel used, main system 2												2282.6128	(213)
Space heating fuel used, secondary												3725.3766	(215)
Water heating													
(64)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
Efficiency of water heater												79.3000	(216)
(217)m	88.0930	87.8608	87.4046	86.6813	85.0012	79.3000	79.3000	79.3000	79.3000	86.4660	87.7400	88.1095	(217)
(219)m	283.9375	251.3777	266.4520	242.3493	243.2962	234.7293	227.0551	246.9129	245.7759	251.8544	260.5807	277.5521	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	41.8824	51.2998	44.6732	0.0000	0.0000	0.0000	0.0000	(221)
Water heating fuel used												3031.8730	(219)
Space cooling fuel used												137.8554	(221)
Electricity for pumps, fans and electric keep-hot (Table 4f):													
warm air heating system fans												439.4087	(230b)
central heating pump												130.0000	(230c)
boiler with a fan-assisted flue												45.0000	(230e)
Total electricity for the above, kWh/year												614.4087	(231)
Electricity for lighting (calculated in Appendix L)												878.7060	(232)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7443.3025	0.1980	1473.7739	(261)
Space heating - main system 2	2282.6128	0.5170	1180.1108	(262)
Space heating - secondary	3725.3766	0.0080	29.8030	(263)
Water heating cost (other fuel)	3031.8730	0.1980	600.3109	(264)
Space and water heating			3283.9986	(265)
Space cooling	137.8554	0.5170	71.2712	(266)
Pumps and fans	614.4087	0.5170	317.6493	(267)
Energy for lighting	878.7060	0.5170	454.2910	(268)
Total CO2, kg/year			4127.2101	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.4500	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES			
DER		14.4500	ZC1
Total Floor Area	TFA	285.5900	
Assumed number of occupants	N	3.1132	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5290	
CO2 emissions from appliances, equation (L14)		9.4428	ZC2
CO2 emissions from cooking, equation (L16)		0.6783	ZC3
Total CO2 emissions		24.5711	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		24.5711	ZC8

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF TARGET EMISSIONS
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480 (1a) - (3a)	
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082 (1b) - (3b)	
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580 (1c) - (3c)	
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)
									Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =							30.0000 / (5)	=	0.0410	(8)
Pressure test									Yes	
Measured/design q50									10.0000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)									0.5410	(18)
Number of sides on which dwelling is 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)	=	0.4598	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.6208	0.5863	0.5863	0.5173	0.4713	0.4483	0.4253	0.4253	0.4828	0.5173	0.5518	0.5863	(22b)
Effective ach	0.6927	0.6719	0.6719	0.6338	0.6111	0.6005	0.5905	0.5905	0.6166	0.6338	0.6522	0.6719	(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	
Doors			1.8500	2.0000	3.7000			(26)
Windows (Uw = 2.00)			69.5475	1.8519	128.7917			(27)

Basement Floor			42.6600	0.2500	10.6650	(28a)
Ground Floor			77.7500	0.2500	19.4375	(28a)
Basement Wall	332.4600	71.3975	261.0625	0.3500	91.3719	(29a)
Flat Roof	127.1000		127.1000	0.1600	20.3360	(30)
Total net area of external elements Aum(A, m2)			579.9700			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		274.3020	(33)
Party Wall			51.0500	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
Thermal bridges (User defined value 0.110 * total exposed area) 63.7967 (36)
Total fabric heat loss (33) + (36) = 338.0987 (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	167.4007	162.3707	162.3707	153.1730	147.6800	145.1250	142.6979	142.6979	149.0053	153.1730	157.6282	162.3707	(38)
(39)m	505.4994	500.4695	500.4695	491.2718	485.7787	483.2238	480.7966	480.7966	487.1041	491.2718	495.7269	500.4695	(39)
									Average = Sum(39)m / 12 =			491.9065	(39)
(40)m	1.7700	1.7524	1.7524	1.7202	1.7010	1.6920	1.6835	1.6835	1.7056	1.7202	1.7358	1.7524	(40)
									Average = Sum(40)m / 12 =			1.7224	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N 3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 113.8299 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	125.2129	120.6597	116.1065	111.5533	107.0001	102.4469	102.4469	107.0001	111.5533	116.1065	120.6597	125.2129	(44)
(45)m	186.1314	162.7917	167.9864	146.4546	140.5267	121.2639	112.3688	128.9448	130.4849	152.0675	165.9936	180.2583	(45)
Energy content (annual)										Total = Sum(45)m =		1795.2726	(45)
(46)m	27.9197	24.4188	25.1980	21.9682	21.0790	18.1896	16.8553	19.3417	19.5727	22.8101	24.8990	27.0387	(46)

Water storage loss:
b) If manufacturer declared cylinder loss factor is not known :
Cylinder volume (litres) including any solar storage within same cylinder 150.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0191 (51)
Volume factor from Table 2a 0.9283 (52)
Temperature factor from Table 2b 0.5400 (53)
Enter (49) or (54) in (55) 1.4364 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(57)
Primary circuit loss (annual) from Table 3												610.0000	(58)
(59)m	51.8082	46.7945	51.8082	50.1370	51.8082	50.1370	51.8082	51.8082	50.1370	51.8082	50.1370	51.8082	(59)
(62)m	282.4678	249.8052	264.3228	239.6834	236.8631	214.4927	208.7052	225.2813	223.7136	248.4039	259.2224	276.5947	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	282.4678	249.8052	264.3228	239.6834	236.8631	214.4927	208.7052	225.2813	223.7136	248.4039	259.2224	276.5947	(64)
								Total per year (kWh/year) = Sum(64)m =				2929.5561	(64)
(65)m	138.9578	123.7391	132.9246	123.2792	123.7943	114.9033	114.4318	119.9433	117.9692	127.6316	129.7759	137.0050	(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	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	(66)
(67)m	67.6681	60.1022	48.8784	37.0041	27.6610	23.3526	25.2333	32.7992	44.0230	55.8973	65.2404	69.5488	(67)
(68)m	446.4885	451.1217	439.4463	414.5908	383.2151	353.7264	334.0261	329.3930	341.0684	365.9239	397.2996	426.7883	(68)
(69)m	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	(69)
(70)m	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	186.7712	184.1355	178.6621	171.2211	166.3901	159.5879	153.8061	161.2141	163.8462	171.5478	180.2443	184.1465	(72)
(73)m	780.6259	775.0574	746.6848	702.5139	656.9642	616.3648	592.7635	603.1042	628.6355	673.0670	722.4823	760.1816	(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	
East	69.5475	19.8726	0.7200	0.7000	0.7700	482.7244	(76)

(83)m	482.7244	935.6570	1495.4811	2220.4346	2701.6367	2819.0202	2736.1785	2381.3561	1787.9087	1139.4543	600.1517	398.2000	(83)
(84)m	1263.3502	1710.7144	2242.1659	2922.9485	3358.6009	3435.3850	3328.9420	2984.4603	2416.5443	1812.5213	1322.6340	1158.3816	(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	39.2338	39.6281	39.6281	40.3700	40.8265	41.0423	41.2495	41.2495	40.7154	40.3700	40.0072	39.6281	
alpha	3.6156	3.6419	3.6419	3.6913	3.7218	3.7362	3.7500	3.7500	3.7144	3.6913	3.6671	3.6419	
(86)m	0.9991	0.9972	0.9897	0.9634	0.8870	0.7456	0.5552	0.6055	0.8878	0.9849	0.9981	0.9993	(86)
(87)m	18.9084	19.1326	19.5516	20.0388	20.5402	20.8410	20.9632	20.9508	20.6661	20.0390	19.3300	18.9553	(87)
(88)m	19.4963	19.5086	19.5086	19.5313	19.5450	19.5513	19.5574	19.5574	19.5417	19.5313	19.5203	19.5086	(88)
(89)m	0.9987	0.9960	0.9854	0.9475	0.8349	0.6297	0.3772	0.4178	0.8090	0.9756	0.9973	0.9990	(89)
(90)m	17.6292	17.8618	18.2786	18.7711	19.2441	19.4827	19.5508	19.5481	19.3630	18.7802	18.0680	17.6850	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	17.9667	18.1971	18.6144	19.1056	19.5861	19.8411	19.9234	19.9182	19.7068	19.1123	18.4010	18.0201	(92)
Temperature adjustment												0.0000	
(93)m	17.9667	18.1971	18.6144	19.1056	19.5861	19.8411	19.9234	19.9182	19.7068	19.1123	18.4010	18.0201	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9982	0.9946	0.9816	0.9413	0.8367	0.6560	0.4255	0.4689	0.8204	0.9716	0.9963	0.9985	(94)
(95)m	1261.0173	1701.4418	2200.9766	2751.5158	2810.2301	2253.7504	1416.3054	1399.5589	1982.5000	1761.1131	1317.7009	1156.6610	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)

(97)m	6807.4065	6604.7532	5912.7688	5111.9727	3830.8807	2532.6058	1453.6643	1451.1440	2633.6768	4083.6177	5651.7641	6566.2302	(97)
(98)m	4126.5136	3295.0253	2761.5734	1699.5289	759.3640	0.0000	0.0000	0.0000	0.0000	1727.9434	3120.5255	4024.7195	(98)
Space heating (October to May) (kWh/year)												21515.1937	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	75.3359	(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)	0.1000 (201)
Fraction of space heat from main system(s)	0.9000 (202)
Efficiency of main space heating system 1 (in %)	78.9000 (206)
Efficiency of secondary/supplementary heating system, %	100.0000 (208)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	4126.5136	3295.0253	2761.5734	1699.5289	759.3640	0.0000	0.0000	0.0000	0.0000	1727.9434	3120.5255	4024.7195	(98)
(211)m	4707.0498	3758.5840	3150.0837	1938.6262	866.1947	0.0000	0.0000	0.0000	0.0000	1971.0381	3559.5348	4590.9348	(211)
(215)m	412.6514	329.5025	276.1573	169.9529	75.9364	0.0000	0.0000	0.0000	0.0000	172.7943	312.0526	402.4720	(215)

Annual totals kWh/year	
Space heating fuel used, main system 1	24542.0460 (211)
Space heating fuel used, secondary	2151.5194 (215)

Water heating

(64)m	282.4678	249.8052	264.3228	239.6834	236.8631	214.4927	208.7052	225.2813	223.7136	248.4039	259.2224	276.5947	(64)
Efficiency of water heater												68.8000	(216)
(217)m	78.0897	78.0103	77.8021	77.3615	76.0274	68.8000	68.8000	68.8000	68.8000	77.3363	77.9332	78.0868	(217)
(219)m	361.7221	320.2210	339.7375	309.8227	311.5497	311.7626	303.3506	327.4437	325.1652	321.1995	332.6210	354.2146	(219)

Water heating fuel used	3918.8101 (219)
Electricity for pumps, fans and electric keep-hot (Table 4f):	
central heating pump	130.0000 (230c)
boiler with a fan-assisted flue	45.0000 (230e)
Total electricity for the above, kWh/year	175.0000 (231)
Electricity for lighting (calculated in Appendix L)	1195.0402 (232)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	24542.0460	0.1940	4761.1569	(261)
Space heating - secondary	2151.5194	0.4220	907.9412	(263)
Water heating cost (other fuel)	3918.8101	0.1940	760.2492	(264)
Space and water heating			6429.3473	(265)
Pumps and fans	175.0000	0.4220	73.8500	(267)
Energy for lighting	1195.0402	0.4220	504.3070	(268)
Total CO2, kg/year			7007.5042	(272)
Emissions per m2 for space and water heating			22.7711	(272a)
Emissions per m2 for lighting			1.7658	(272b)
Target Carbon Dioxide Emission Rate (TER)			15.2400	(273)

= [(22.7711 * 1.00 * 1.0206) + (1.7658 * 1.2251)] * 0.60

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF STANDARD ENE7 CO2
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480 (1a) - (3a)	
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082 (1b) - (3b)	
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580 (1c) - (3c)	
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479 (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	+	1	+	0	=	1 * 20 =	20.0000	(6b)
Number of intermittent fans							8 * 10 =	80.0000	(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) =	100.0000 / (5) =	0.1365 (8)
Pressure test		Yes
Measured/design q50		5.1000
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915 (18)
Number of sides on which dwelling is sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		238.4581			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area) 46.3976 (36)
Total fabric heat loss (33) + (36) = 284.8557 (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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	425.9718	423.7812	423.7812	419.7755	417.3832	416.2706	415.2135	415.2135	417.9605	419.7755	421.7158	423.7812	(39)
									Average = Sum(39)m / 12 =			420.0520	(39)
(40)m	1.4916	1.4839	1.4839	1.4699	1.4615	1.4576	1.4539	1.4539	1.4635	1.4699	1.4766	1.4839	(40)
									Average = Sum(40)m / 12 =			1.4708	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N 3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 108.1384 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of
not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:
b) If manufacturer declared cylinder loss factor is not known :
Cylinder volume (litres) including any solar storage within same cylinder 150.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0191 (51)
Volume factor from Table 2a 0.9283 (52)
Temperature factor from Table 2b 0.5400 (53)
Enter (49) or (54) in (55) 1.4364 (55)

(57)m	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(57)
Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	251.9283	222.4875	234.6906	211.8127	208.6039	187.8815	181.8539	197.6011	196.6415	219.5677	230.3747	246.3489	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	251.9283	222.4875	234.6906	211.8127	208.6039	187.8815	181.8539	197.6011	196.6415	219.5677	230.3747	246.3489	(64)
								Total per year (kWh/year) = Sum(64)m =				2589.7925	(64)
(65)m	118.8771	105.6902	113.1455	104.4060	104.4717	96.4489	95.5773	100.8133	99.3616	108.1172	110.5779	117.0219	(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	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	(66)
(67)m	49.7560	44.1928	35.9400	27.2089	20.3390	17.1710	18.5539	24.1170	32.3699	41.1010	47.9709	51.1388	(67)
(68)m	446.4885	451.1217	439.4463	414.5908	383.2151	353.7264	334.0261	329.3930	341.0684	365.9239	397.2996	426.7883	(68)
(69)m	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	(69)
(70)m	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	159.7810	157.2771	152.0773	145.0084	140.4190	133.9568	128.4641	135.5017	138.0022	145.3188	153.5804	157.2875	(72)
(73)m	735.7235	732.2895	707.1616	666.5060	623.6710	584.5522	560.7421	568.7097	591.1384	632.0416	678.5488	714.9126	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457	(74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133	(76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691	(78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614	(80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754	(82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199	(83)
(84)m	1644.4884	2320.7161	2912.6147	3576.5126	4008.5484	4110.3395	3979.7449	3610.1164	3090.0450	2465.1425	1775.1902	1486.9325	(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	18.6234	18.7197	18.7197	18.8983	19.0066	19.0575	19.1060	19.1060	18.9804	18.8983	18.8114	18.7197	
alpha	2.2416	2.2480	2.2480	2.2599	2.2671	2.2705	2.2737	2.2737	2.2654	2.2599	2.2541	2.2480	
(86)m	0.9702	0.9391	0.8885	0.8079	0.6827	0.5357	0.3899	0.4222	0.6590	0.8540	0.9525	0.9744	(86)

(87)m	17.9609	18.4201	19.0768	19.7196	20.3534	20.7388	20.9147	20.8992	20.5688	19.7743	18.6323	17.9867	(87)
(88)m	19.6976	19.7033	19.7033	19.7138	19.7201	19.7230	19.7258	19.7258	19.7186	19.7138	19.7087	19.7033	(88)
(89)m	0.9650	0.9290	0.8697	0.7764	0.6294	0.4551	0.2816	0.3075	0.5810	0.8213	0.9430	0.9697	(89)
(90)m	16.9640	17.4184	18.0576	18.6740	19.2546	19.5749	19.6961	19.6901	19.4537	18.7467	17.6376	16.9943	(90)
Living area fraction										fLA = Living area / (4) =		0.2638	(91)
(92)m	17.2270	17.6827	18.3265	18.9498	19.5445	19.8820	20.0176	20.0091	19.7479	19.0178	17.9000	17.2561	(92)
Temperature adjustment												0.0000	
(93)m	17.2270	17.6827	18.3265	18.9498	19.5445	19.8820	20.0176	20.0091	19.7479	19.0178	17.9000	17.2561	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9509	0.9080	0.8448	0.7544	0.6213	0.4659	0.3078	0.3346	0.5830	0.7993	0.9247	0.9570	(94)
(95)m	1563.7769	2107.1232	2460.5422	2698.2611	2490.4238	1915.0188	1224.7692	1208.0546	1801.5824	1970.5079	1641.5358	1423.0295	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5421.3562	5374.6710	4884.7287	4302.6345	3274.1623	2198.7398	1294.4845	1290.9419	2277.0140	3449.6508	4596.7213	5236.2863	(97)
(98)m	2870.0390	2195.7921	1803.5948	1155.1489	583.1014	0.0000	0.0000	0.0000	0.0000	1100.4823	2127.7336	2837.0630	(98)
Space heating (October to May) (kWh/year)												14672.9551	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	51.3777	(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)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Fraction of main heating from main system 2	0.4600	(203)
Fraction of total heating from main system 1	0.4860	(204)
Fraction of total heating from main system 2	0.4140	(205)
Efficiency of main space heating system 1 (in %)	88.9000	(206)
Efficiency of main space heating system 2 (in %)	88.9000	(207)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	2870.0390	2195.7921	1803.5948	1155.1489	583.1014	0.0000	0.0000	0.0000	0.0000	1100.4823	2127.7336	2837.0630	(98)
(211)m	1568.9977	1200.3993	985.9922	631.4987	318.7709	0.0000	0.0000	0.0000	0.0000	601.6135	1163.1929	1550.9703	(211)
(213)m	1336.5536	1022.5624	839.9193	537.9433	271.5456	0.0000	0.0000	0.0000	0.0000	512.4856	990.8680	1321.1969	(213)
(215)m	287.0039	219.5792	180.3595	115.5149	58.3101	0.0000	0.0000	0.0000	0.0000	110.0482	212.7734	283.7063	(215)

Annual totals kWh/year

Space heating fuel used, main system 1	8021.4355	(211)
Space heating fuel used, main system 2	6833.0747	(213)
Space heating fuel used, secondary	1467.2955	(215)

Water heating

(64)m	251.9283	222.4875	234.6906	211.8127	208.6039	187.8815	181.8539	197.6011	196.6415	219.5677	230.3747	246.3489	(64)
Efficiency of water heater												78.8000	(216)
(217)m	87.1903	86.9768	86.5569	85.8845	84.3177	78.8000	78.8000	78.8000	78.8000	85.7029	86.8714	87.2057	(217)
(219)m	288.9406	255.8012	271.1402	246.6252	247.4022	238.4283	230.7791	250.7629	249.5450	256.1963	265.1907	282.4918	(219)

Water heating fuel used	3083.3033	(219)

Electricity for pumps, fans and electric keep-hot (Table 4f):		
central heating pump	130.0000	(230c)
boiler with a fan-assisted flue	90.0000	(230e)
Total electricity for the above, kWh/year	220.0000	(231)
Electricity for lighting (calculated in Appendix L)	878.7060	(232)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	8021.4355	0.1980	1588.2442	(261)
Space heating - main system 2	6833.0747	0.1980	1352.9488	(262)
Space heating - secondary	1467.2955	0.5170	758.5918	(263)
Water heating cost (other fuel)	3083.3033	0.1980	610.4941	(264)
Space and water heating			4310.2789	(265)
Pumps and fans	220.0000	0.5170	113.7400	(267)
Energy for lighting	878.7060	0.5170	454.2910	(268)
Total CO2, kg/year			4878.3099	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.0800	(273)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600	(1a)	x 2.8000	(2a) =	119.4480	(1a) - (3a)
Ground floor	111.9400	(1b)	x 2.5300	(2b) =	283.2082	(1b) - (3b)
First floor	79.7200	(1c)	x 2.6500	(2c) =	211.2580	(1c) - (3c)
Second floor	51.2700	(1d)	x 2.3100	(2d) =	118.4337	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	732.3479	(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	+ 1	+ 0	= 1 * 20 =	20.0000	(6b)
Number of intermittent fans				8 * 10 =	80.0000	(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) =	100.0000 / (5) =	0.1365	(8)
Pressure test		Yes	
Measured/design q50		5.1000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915	(18)
Number of sides on which dwelling is sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		238.4581			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (User defined value 0.080 * total exposed area)	46.3976	(36)
Total fabric heat loss (33) + (36) =	284.8557	(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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	425.9718	423.7812	423.7812	419.7755	417.3832	416.2706	415.2135	415.2135	417.9605	419.7755	421.7158	423.7812	(39)
									Average = Sum(39)m / 12 =			420.0520	(39)
(40)m	1.4916	1.4839	1.4839	1.4699	1.4615	1.4576	1.4539	1.4539	1.4635	1.4699	1.4766	1.4839	(40)
									Average = Sum(40)m / 12 =			1.4708	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	3.1132	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.1384	(43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:		
b) If manufacturer declared cylinder loss factor is not known :		
Cylinder volume (litres) including any solar storage within same cylinder	300.0000	(50)
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115	(51)
Volume factor from Table 2a	0.7368	(52)
Temperature factor from Table 2b	0.5400	(53)
Enter (49) or (54) in (55)	1.3784	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)
Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
								Total per year (kWh/year) = Sum(64)m =				2568.6082	(64)
(65)m	117.4377	104.3901	111.7062	103.0131	103.0323	95.0560	94.1380	99.3739	97.9686	106.6778	109.1850	115.5825	(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	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	(66)
(67)m	124.3899	110.4820	89.8500	68.0223	50.8474	42.9275	46.3847	60.2926	80.9246	102.7524	119.9272	127.8471	(67)
(68)m	666.4008	673.3160	655.8900	618.7922	571.9628	527.9499	498.5465	491.6313	509.0573	546.1551	592.9845	636.9974	(68)
(69)m	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	(69)
(70)m	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	157.8464	155.3424	150.1427	143.0737	138.4843	132.0222	126.5295	133.5671	136.0675	143.3841	151.6458	155.3529	(72)
(73)m	1121.6343	1112.1376	1068.8799	1002.8853	934.2918	875.8968	844.4579	858.4882	899.0467	965.2888	1037.5546	1093.1946	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457 (74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133 (76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691 (78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614 (80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754 (82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199 (83)
(84)m	2030.3993	2700.5642	3274.3330	3912.8919	4319.1692	4401.6841	4263.4606	3899.8949	3397.9533	2798.3897	2134.1960	1865.2145 (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	18.6234	18.7197	18.7197	18.8983	19.0066	19.0575	19.1060	19.1060	18.9804	18.8983	18.8114	18.7197	
alpha	2.2416	2.2480	2.2480	2.2599	2.2671	2.2705	2.2737	2.2737	2.2654	2.2599	2.2541	2.2480	
(86)m	0.9552	0.9200	0.8653	0.7825	0.6561	0.5105	0.3680	0.3965	0.6244	0.8234	0.9331	0.9600	(86)
(87)m	18.4733	18.8523	19.3913	19.9125	20.4246	20.7325	20.8712	20.8602	20.6051	19.9728	19.0341	18.4952	(87)
(88)m	19.6976	19.7033	19.7033	19.7138	19.7201	19.7230	19.7258	19.7258	19.7186	19.7138	19.7087	19.7033	(88)
(89)m	0.9478	0.9074	0.8438	0.7488	0.6019	0.4313	0.2644	0.2869	0.5457	0.7864	0.9205	0.9531	(89)
(90)m	16.3820	16.9257	17.6890	18.4127	19.0922	19.4625	19.6000	19.5938	19.3321	18.5213	17.1994	16.4181	(90)

Living area fraction fLA = Living area / (4) = 0.2638 (91)

(92)m	16.9337	17.4340	18.1381	18.8084	19.4438	19.7975	19.9354	19.9279	19.6680	18.9043	17.6835	16.9661	(92)

Temperature adjustment 0.0000

(93)m	16.9337	17.4340	18.1381	18.8084	19.4438	19.7975	19.9354	19.9279	19.6680	18.9043	17.6835	16.9661	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9248	0.8775	0.8112	0.7208	0.5889	0.4363	0.2823	0.3053	0.5423	0.7577	0.8929	0.9316	(94)
(95)m	1877.6127	2369.8665	2655.9852	2820.5101	2543.4663	1920.4187	1203.7121	1190.6534	1842.5578	2120.3744	1905.6450	1737.6229	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5296.4189	5269.2879	4804.8779	4243.2665	3232.1130	2163.5866	1260.3328	1257.2365	2243.5954	3401.9742	4505.3967	5113.3885	(97)
(98)m	2543.5918	1948.4112	1598.7762	1024.3846	512.3532	0.0000	0.0000	0.0000	0.0000	953.5102	1871.8212	2511.5695	(98)

Space heating (October to May) (kWh/year) 12964.4180 (98)

Space heating requirement in kWh/m2/year (98) / (4) = 45.3952 (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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	3579.9268	2574.3237	2574.3237	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.8037	0.8726	0.8549	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	2877.0994	2246.3884	2200.9004	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	5068.6307	4844.1006	4463.0578	0.0000	0.0000	0.0000	0.0000	(103)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1577.9025	1932.6978	1683.0451	0.0000	0.0000	0.0000	0.0000	(104)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	89.7171	11.6021	13.6582	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1577.9025	1932.6978	1683.0451	0.0000	0.0000	0.0000	0.0000	(104)

Cooled fraction fC = cooled area / (4) = 0.4587 (105)

(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	180.9320	221.6150	192.9883	0.0000	0.0000	0.0000	0.0000	(107)

Total = Sum(107)6..8 = 595.5352 (107)

Space cooling requirement in kWh/m2/year (107) / (4) = 2.0853 (108)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.1000 (201)
Fraction of space heat from main system(s) 0.9000 (202)
Fraction of main heating from main system 2 0.4600 (203)
Fraction of total heating from main system 1 0.4860 (204)
Fraction of total heating from main system 2 0.4140 (205)
Efficiency of main space heating system 1 (in %) 90.0000 (206)
Efficiency of main space heating system 2 (in %) 250.0000 (207)
Efficiency of secondary/supplementary heating system, % 37.0000 (208)
Cooling System Energy Efficiency Ratio (see Table 10c) 4.3200 (209)
Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	2543.5918	1948.4112	1598.7762	1024.3846	512.3532	0.0000	0.0000	0.0000	0.0000	953.5102	1871.8212	2511.5695	(98)
(211)m	1373.5396	1052.1421	863.3391	553.1677	276.6707	0.0000	0.0000	0.0000	0.0000	514.8955	1010.7835	1356.2476	(211)
(213)m	421.2188	322.6569	264.7573	169.6381	84.8457	0.0000	0.0000	0.0000	0.0000	157.9013	309.9736	415.9159	(213)
(215)m	687.4572	526.5976	432.1017	276.8607	138.4738	0.0000	0.0000	0.0000	0.0000	257.7055	505.8976	678.8026	(215)

Annual totals kWh/year
Space heating fuel used, main system 1 7000.7857 (211)
Space heating fuel used, main system 2 2146.9076 (213)
Space heating fuel used, secondary 3503.8968 (215)

Water heating

(64)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)

Efficiency of water heater 79.3000 (216)

(217)m	88.0017	87.7604	87.2840	86.5351	84.8081	79.3000	79.3000	79.3000	79.3000	86.2782	87.6253	88.0177	(217)
(219)m	284.2321	251.6652	266.8202	242.7587	243.8502	234.7293	227.0551	246.9129	245.7759	252.4025	260.9219	277.8413	(219)

Space cooling fuel requirement

(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	41.8824	51.2998	44.6732	0.0000	0.0000	0.0000	0.0000	(221)

Water heating fuel used 3034.9652 (219)
Space cooling fuel used 137.8554 (221)

Electricity for pumps, fans and electric keep-hot (Table 4f):
warm air heating system fans 439.4087 (230b)
central heating pump 130.0000 (230c)
boiler with a fan-assisted flue 45.0000 (230e)
Total electricity for the above, kWh/year 614.4087 (231)
Electricity for lighting (calculated in Appendix L) 878.7060 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 2.50 * 1073 * 0.80) -1716.8000 (233)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	7000.7857	3.1000	217.0244	(240)
Space heating - main system 2	2146.9076	11.4600	246.0356	(241)
Space heating - secondary	3503.8968	3.4200	119.8333	(242)
Water heating cost (other fuel)	3034.9652	3.1000	94.0839	(247)
Space cooling	137.8554	11.4600	15.7982	(248)
Pumps and fans for heating	614.4087	11.4600	70.4112	(249)
Energy for lighting	878.7060	11.4600	100.6997	(250)
Additional standing charges			106.0000	(251)
Energy saving/generation technologies				
PV Unit	-1716.8000	11.4600	-196.7453	(252)
Total energy cost			773.1411	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4700	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0992	(257)
SAP value		84.6665	
SAP rating (Section 12)		85	(258)
SAP band		B	

10a. Fuel costs - using BEDF prices (341)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	7000.7857	3.6400	254.8286	(240)
Space heating - main system 2	2146.9076	13.5900	291.7647	(241)
Space heating - secondary	3503.8968	4.6000	161.1793	(242)
Water heating cost (other fuel)	3034.9652	3.6400	110.4727	(247)
Space cooling	137.8554	13.5900	18.7345	(248)
Pumps and fans for heating	614.4087	13.5900	83.4981	(249)
Energy for lighting	878.7060	13.5900	119.4161	(250)
Additional standing charges			119.0000	(251)
Energy saving/generation technologies				
PV Unit	-1716.8000	13.5900	-233.3131	(252)
Total energy cost			925.5811	(255)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7000.7857	0.1980	1386.1556	(261)
Space heating - main system 2	2146.9076	0.5170	1109.9512	(262)
Space heating - secondary	3503.8968	0.0080	28.0312	(263)
Water heating cost (other fuel)	3034.9652	0.1980	600.9231	(264)
Space and water heating			3125.0611	(265)
Space cooling	137.8554	0.5170	71.2712	(266)
Pumps and fans	614.4087	0.5170	317.6493	(267)
Energy for lighting	878.7060	0.5170	454.2910	(268)
Energy saving/generation technologies				
PV Unit	-1716.8000	0.5290	-908.1872	(269)
Total CO2, kg/year			3060.0855	(272)
CO2 emissions per m2			10.7100	(273)
EI value			87.5964	
EI rating			88	(274)
EI band			B	

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	7000.7857	1.0200	7140.8014	(261)
Space heating - main system 2	2146.9076	2.9200	6268.9702	(262)
Space heating - secondary	3503.8968	1.0500	3679.0916	(263)
Water heating cost (other fuel)	3034.9652	1.0200	3095.6645	(264)
Space and water heating			20184.5278	(265)
Space cooling	137.8554	2.9200	402.5377	(266)
Pumps and fans	614.4087	2.9200	1794.0735	(267)
Energy for lighting	878.7060	2.9200	2565.8216	(268)
Energy saving/generation technologies				
PV Unit	-1716.8000	2.9200	-5013.0560	(269)
Primary energy kWh/year			19933.9046	(272)
Primary energy kWh/m2/year			69.7990	(273)

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2010 Edition
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

New Build (As Designed)

1 TER and DER
Fuels for main heating:Mains gas, Electricity
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.24 kg/m^2
Dwelling Carbon Dioxide Emission Rate (DER) 14.45 kg/m^{2}OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.25 (max. 0.70)	OK

Floor	0.19 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.15 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.49 (max. 2.00)	1.50 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.080

---

3 Air permeability

Air permeability at 50 pascals:	5.10 (design value)	
Maximum	10.0	OK

---

4 Heating efficiency

Main heating system 1:	Boiler system with radiators or underfloor - Mains gas	
Data from manufacturer		
TBC TBC		
Efficiency: 89.0% SEDBUK2009		
Minimum: 88.0%	OK	
Main heating system 2:	Heat pump with warm air distribution - Electric	
Secondary heating system:	Room heaters - Wood Logs	
RWJ Open fire in grate		
Efficiency: 37%		
Minimum: 37%	OK	

---

5 Cylinder insulation

Hot water storage	Nominal cylinder loss: 2.55 kWh/day	
Permitted by DBSCG 2.86	OK	
Primary pipework insulated:	Yes	OK

---

6 Controls

Space heating controls 1:	Time and temperature zone control	OK
Space heating controls 2:	Time and temperature zone control	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
Boiler interlock	Yes	OK

---

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

Minimum	75%	OK

---

8 Mechanical ventilation
Not applicable

---

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing North:	22.38 m^2, No overhang	
Windows facing East:	12.73 m^2, No overhang	
Windows facing South:	41.09 m^2, No overhang	
Windows facing West:	11.75 m^2, No overhang	
Windows facing Horizontal:	8.82 m^2, No overhang	
Ventilation rate:	8.00	
Blinds/curtains:	None	

---

10 Key features

External wall U-value	0.12 W/m^2K
Roof U-value	0.12 W/m^2K
Floor U-value	0.18 W/m^2K
Door U-value	1.20 W/m^2K
Party wall U-value	0.00 W/m^2K
Secondary heating (wood logs)	
Fixed cooling system	
Secondary heating fuel:	wood logs

SAP 2009 OVERHEATING ASSESSMENT FOR New Build (As Designed) BRE SAP Worksheet 9.90
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

Overheating Calculation Input Data

Dwelling type	MidTerrace House
Number of storeys	4
Cross ventilation possible	Yes
Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	1933.40 (P1)
Transmission heat loss coefficient	284.86 (37)
Summer heat loss coefficient	2218.25 (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)
North	1.000	1.00	1.000	1.000 (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)
Horizontal	1.000	1.00	1.000	1.000 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	20.9100	85.3441	0.6300	0.7000	0.9000	637.4576
East	12.7300	117.7842	0.6300	0.7000	0.9000	535.5981
South	41.0900	110.5233	0.6300	0.7000	0.9000	1622.2343
West	11.7500	117.7842	0.6300	0.7000	0.9000	494.3659
Horizontal	10.2900	204.0000	0.6300	0.7000	1.0000	714.1342
					total:	4053.5835

	Jun	Jul	Aug	
Solar gains	4247	4054	3659	(P3)
Internal gains	822	791	805	
Total summer gains	5069	4844	4463	(P5)
Summer gain/loss ratio	2.28	2.18	2.01	(P6)
Summer external temperature	15.40	17.80	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	18.98	21.28	21.11	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

SAP 2009 IMPROVEMENTS
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

0006-Kemplay-Road

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

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
L	Not considered
M	Not considered
N Solar water heating	SAP increase too small
O	Not considered
P	Not considered
Q	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic (PV) panels	Recommended
V Wind turbine	SAP increase too small

Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic (PV) panels	+ 3.9	-£ 233	-908 kg (22.9%)

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.7	-£ 41	-240 kg (6.1%)
V Wind turbine	+ 0.1	-£ 8	-33 kg (1.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Lower cost measures				
(none)				
Sub Total	£0	0.00 kg/m²		
Higher cost measures				
(none)				
Sub Total	£0	0.00 kg/m²		

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

Further improvements to achieve even higher standards

Solar photovoltaic	£233	3.18 kg/m²	B 85	B 88
Total Savings	£233	3.18 kg/m²		

Enhanced energy efficiency rating: B 85
Enhanced environmental impact rating: B 88

Fuel prices for cost data on this page from database revision number 341 TEST (31 Jul 2013)
Recommendation texts revision number 4.6 (10 Dec 2012)

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

	Current	Potential	Enhanced
Electricity	£513	£513	£513
Mains gas	£484	£484	£484
Wood	£161	£161	£161
Space heating	£910	£910	£910
Space cooling	£19	£19	£19
Water heating	£110	£110	£110
Lighting	£119	£119	£119
Generated (PV)	-£0	-£0	-£233
Total cost	£1158	£1158	£925
Carbon dioxide emissions	4.0 tonnes	4.0 tonnes	3.1 tonnes
Primary energy	87 kWh/m^2	87 kWh/m^2	70 kWh/m^2

MES Energy Services
Newark Beacon, Cafferata Way
Newark
Nottingham
01636 653055

Full SAP Calculation Printout

Property Reference: 0006-Kemplay-Road
Survey Reference: Be Clean
Property: Kemplay Road, London, NW3

Issued on Date: 08.Aug.2013
Prop Type Ref: TAG Architects

SAP Rating:	82 B	**CO2 Emissions (t/year):**	3.79	**DER:** 13.78 Pass	**Reduction:** 9.6%	**FEE:** 56.7	**ZC8:**	0.00
Environmental:	85 B	**General Requirements Compliance:**	Pass	**TER:** 15.24		**HLP:** 1.47	**Energy cost:**	£ 1114

CfSH Results	**Version:** CfSH November 2010	**ENE1 Credits:** 1.2	**ENE2 Credits:** 0.0	**ENE7 Credits:** 0		**CfSH Level:**	3

Surveyor: Matthew Crowther, Tel: 01636 653005 Surveyor ID: 8440-0006
Address: Cafferata Way, Newark, Nottinghamshire, NG24 2TN
Client:

Software Version: Elmhurst Energy Systems SAP2009 Calculator (Design System) version 4.01r01
SAP version: SAP 2009, Regs Region: England and Wales (Part L1A 2010), Calculation Type: New Dwelling As Designed

CALCULATION DETAILS for survey reference no 'Be Clean'
SAP2009 - 9.81 input data (DesignData) -

SAP2009 Input Data

FullRefNo:	Be Clean
Sap Version:	SAP 2009
Regs Region:	England & Wales
Region:	Thames Valley
Calculation Type:	New Build (As Designed)
DwellingOrientation:	North
Property Type:	House, Mid-Terrace
Storeys:	4
Date Built:	2013
Sheltered Sides:	3
Sunlight Shade:	Average or unknown
Measurements	Perimeter, Floor Area, Storey Height
Basement:	28.92, 42.66, 2.8
1st Storey:	42.73, 111.94, 2.53
2nd Storey:	40.44, 79.72, 2.65
3rd Storey:	30.92, 51.27, 2.31
4th Storey:	0, 0, 0
Living Area:	75.35 m2, fraction: 26.4%
Thermal Mass:	Simple calculation
Thermal Mass Simple:	Low
Thermal MassValue:	100
External Walls	Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Basement Wall	84.18, 84.18, 190, , Other, , Solid, 0, 0.22, Gross
External Wall	144.02, 233.77, 0, , Other, , Cavity, 0, 0.25, Gross
Room in Roof	14.51, 14.51, 0, , Other, , TimberFrame, 0, 0.12, Gross
Party Walls	Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall	51.05, 0, , Other, , FilledWithEdge, 0, 0
External Roofs	Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
Flat Roof	80.44, 89.26, 9, PlasterInsulatedFlatRoof, , , 0.16
Sloped Roof	21.65, 23.12, 9, PlasterInsulatedSlope, , , 0.16
Room in Roof	14.72, 14.72, 0, Other, , , 0.12
Heat Loss Floors	Area, Kappa, Construction, Element, Type, UValueFinal, ShelterFactor
Basement Floor	42.66, 0, Other, , GroundSolid, 0, 0.18
Ground Floor	77.75, 0, Other, , GroundSolid, 0, 0.2
Description	Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
Window/Glazed Door	Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
Solid Door	Manufacturer, Solid Door, , , , , , ,
Roof Lights	Manufacturer, Roof Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
Openings	Opening Type, Location, Orientation, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
Opening 1	Solid Door, External Wall, North, , , , 0, 0, 0, 3.27,
Opening 2	Window, External Wall, North, None, 0, , 0, 0, 0, 20.91,
Opening 3	Window, External Wall, East, None, 0, , 0, 0, 0, 12.73,
Opening 4	Window, External Wall, South, None, 0, , 0, 0, 0, 41.09,
Opening 5	Window, External Wall, West, None, 0, , 0, 0, 0, 11.75,
Opening 6	Roof Window, Sloped Roof, North, None, , , 0, 0, 0, 1.47,
Opening 7	Roof Window, Flat Roof, Horizontal, None, , , 0, 0, 0, 8.82,
Conservatory:	None
Draught Proofing:	100
Draught Lobby:	No
Thermal Bridges	User Input, ACDs Assumed
Y	0.08
Pressure Test:	True
Designed q50:	5.1
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:	1
Open Flues Other:	0
Open Flues Total:	1
Intermittent Fans:	8
Passive Vents:	0
Flueless Gas Fires:	0
Cooling System	
Cooled Area	130.99
Data Source	SAP table
Type	Split or Multi-Split
Class	A
Control	Modulating
Light Fittings:	20
LEL Fittings:	20

Percentage of LEL Fittings:	100
External Lights Fitted:	Yes
External LELs Fitted:	Yes
Electricity Tariff:	Standard
Main Heating 1	
Description	
Percentage	54
MHS	Mains gas BGB Post 98 Regular condens. with auto ign.
SAP Code	102
Boiler Efficiency Type	Sedbuk 2009
Efficiency	89
Model Name	TBC
Manufacturer	TBC
MHS Controls	CBI Time and temperature zone control
Delayed Start Stat	Yes
Ctrl SAP Code	2110
Burner Control	Modulating
Boiler Compensator	WeatherCompensator
Flue Type	Balanced
Fan Assisted Flue	Yes
Pumped	Pump in heated space
Heat Emitter	Underfloor
Under Floor Heating	Yes - Pipes in thin screed
Main Heating 2	
Description	
Percentage	46
MHS	Electricity PEH Heat pump air-to-air
SAP Code	524
Boiler Efficiency Type	SAP Table
Efficiency	250
MHS Controls	CWD Time and temperature zone control
Delayed Start Stat	Yes
Ctrl SAP Code	2506
Smoke Control Area	Unknown
Community Heating	None
Secondary Heating	
SHS	RWJ - Wood Logs RWJ Open fire in grate
SAP Code	631
Hetas Approved System	True
Efficiency	37
Water Heating	
Type	MainHeating1
WHS	HWP From main heating 1
Low Water Usage	Yes
SAP Code	901
Hot Water Cylinder	
Cylinder Type	HotWaterCylinder
Cylinder Insulation Type	Foam
Insulation Thickness	80 mm
Cylinder Volume	300.00
Cylinder Stat	Yes
Pipes Insulated	Yes
Cylinder in Heated Space	Yes
Separate Time Control	Yes
Flue Gas Heat Recovery System	None
Waste Water Heat Recovery	none
PV Unit	None
Wind Turbine	None
Terrain Type:	Urban
Small Scale Hydro	None
Special Features	None

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF FABRIC ENERGY EFFICIENCY
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480 (1a) - (3a)	
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082 (1b) - (3b)	
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580 (1c) - (3c)	
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479	(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	+	1	+	0	=	1 * 20	=	20.0000	(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) =	60.0000 / (5) =	0.0819	(8)
Pressure test		Yes	
Measured/design q50		5.1000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3369	(18)
Number of sides on which dwelling is 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) =	0.2864	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.3866	0.3651	0.3651	0.3222	0.2935	0.2792	0.2649	0.2649	0.3007	0.3222	0.3437	0.3651	(22b)
Effective ach	0.5747	0.5667	0.5667	0.5519	0.5431	0.5390	0.5351	0.5351	0.5452	0.5519	0.5591	0.5667	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		238.4581			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area) 46.3976 (36)
Total fabric heat loss (33) + (36) = 284.8557 (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	138.9001	136.9488	136.9488	133.3809	131.2501	130.2590	129.3174	129.3174	131.7642	133.3809	135.1091	136.9488	(38)
(39)m	423.7557	421.8045	421.8045	418.2366	416.1057	415.1147	414.1731	414.1731	416.6199	418.2366	419.9648	421.8045	(39)
									Average = Sum(39)m / 12 =			418.4828	(39)
(40)m	1.4838	1.4770	1.4770	1.4645	1.4570	1.4535	1.4502	1.4502	1.4588	1.4645	1.4705	1.4770	(40)
									Average = Sum(40)m / 12 =			1.4653	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N 3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 108.1384 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)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:													
(57)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	(57)
Primary circuit loss (annual) from Table 3												0.0000	(58)
(59)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	(59)
(65)m	37.5753	32.8636	33.9123	29.5655	28.3688	24.4801	22.6845	26.0307	26.3416	30.6986	33.5100	36.3896	(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	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	(66)
(67)m	39.8048	35.3543	28.7520	21.7671	16.2712	13.7368	14.8431	19.2936	25.8959	32.8808	38.3767	40.9111	(67)
(68)m	446.4885	451.1217	439.4463	414.5908	383.2151	353.7264	334.0261	329.3930	341.0684	365.9239	397.2996	426.7883	(68)
(69)m	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	(69)
(70)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	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	50.5044	48.9041	45.5810	41.0632	38.1301	34.0002	30.4899	34.9876	36.5856	41.2616	46.5416	48.9108	(72)
(73)m	606.4957	605.0780	583.4773	547.1191	507.3144	471.1614	449.0571	453.3721	473.2478	509.7643	551.9159	586.3081	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457	(74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133	(76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691	(78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614	(80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754	(82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199	(83)
(84)m	1515.2606	2193.5046	2788.9303	3457.1257	3892.1918	3996.9487	3868.0598	3494.7788	2972.1545	2342.8651	1648.5572	1358.3280	(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	18.7208	18.8074	18.8074	18.9679	19.0650	19.1105	19.1540	19.1540	19.0415	18.9679	18.8898	18.8074	
alpha	2.2481	2.2538	2.2538	2.2645	2.2710	2.2740	2.2769	2.2769	2.2694	2.2645	2.2593	2.2538	
(86)m	0.9746	0.9450	0.8959	0.8165	0.6923	0.5453	0.3985	0.4326	0.6721	0.8649	0.9587	0.9786	(86)
(87)m	17.9075	18.3724	19.0384	19.6905	20.3354	20.7299	20.9112	20.8945	20.5514	19.7365	18.5794	17.9309	(87)
(88)m	19.7033	19.7085	19.7085	19.7178	19.7234	19.7261	19.7285	19.7285	19.7221	19.7178	19.7133	19.7085	(88)
(89)m	0.9702	0.9358	0.8782	0.7859	0.6395	0.4644	0.2887	0.3162	0.5948	0.8338	0.9503	0.9747	(89)
(90)m	16.9152	17.3757	18.0252	18.6511	19.2432	19.5722	19.6974	19.6908	19.4446	18.7159	17.5892	16.9425	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	17.1770	17.6387	18.2925	18.9253	19.5314	19.8776	20.0177	20.0084	19.7366	18.9852	17.8505	17.2033	(92)
Temperature adjustment												0.0000	
(93)m	17.1770	17.6387	18.2925	18.9253	19.5314	19.8776	20.0177	20.0084	19.7366	18.9852	17.8505	17.2033	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9576	0.9158	0.8536	0.7636	0.6307	0.4748	0.3150	0.3435	0.5958	0.8117	0.9334	0.9635	(94)
(95)m	1450.9745	2008.7828	2380.6562	2639.7548	2454.7215	1897.6306	1218.5119	1200.4318	1770.8688	1901.6493	1538.7710	1308.8090	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5371.9584	5331.0416	4847.5889	4276.6057	3258.6740	2190.8295	1291.2518	1287.4189	2265.0030	3423.3338	4556.8200	5189.5957	(97)
(98)m	2917.2120	2232.5579	1835.3979	1178.5326	598.1406	0.0000	0.0000	0.0000	0.0000	1132.1332	2172.9953	2887.3053	(98)

Space heating (October to May) (kWh/year) 14954.2749 (98)
Space heating requirement in kWh/m2/year (98) / (4) = 52.3627 (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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	3569.9860	2567.8733	2567.8733	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.7989	0.8689	0.8501	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	2851.9759	2231.1307	2182.8992	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	4962.0232	4738.7840	4352.4198	0.0000	0.0000	0.0000	0.0000	(103)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1519.2340	1865.6941	1614.1233	0.0000	0.0000	0.0000	0.0000	(104)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	99.4420	13.8185	16.3804	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1519.2340	1865.6941	1614.1233	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	379.8085	466.4235	403.5308	0.0000	0.0000	0.0000	0.0000	(107)
									Total = Sum(107)6..8 =			1249.7629	(107)

Space cooling requirement in kWh/m2/year (107) / (4) = 4.3761 (108)

8f. Fabric Energy Efficiency

Fabric Energy Efficiency (99) + (108) = 56.7388
Fabric Energy Efficiency rounded 56.7 (109)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF DATA FOR RENEWABLE HEAT INCENTIVE (RHI)
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600	(1a)	x 2.8000	(2a) =	119.4480	(1a) - (3a)
Ground floor	111.9400	(1b)	x 2.5300	(2b) =	283.2082	(1b) - (3b)
First floor	79.7200	(1c)	x 2.6500	(2c) =	211.2580	(1c) - (3c)
Second floor	51.2700	(1d)	x 2.3100	(2d) =	118.4337	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		732.3479	(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	+	1	+	0	=	1 * 20 =	20.0000	(6b)
Number of intermittent fans							8 * 10 =	80.0000	(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) =	100.0000 / (5) =	0.1365 (8)
Pressure test		Yes
Measured/design q50		5.1000
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915 (18)
Number of sides on which dwelling is sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		238.4581			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area) 46.3976 (36)
Total fabric heat loss (33) + (36) = 284.8557 (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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	425.9718	423.7812	423.7812	419.7755	417.3832	416.2706	415.2135	415.2135	417.9605	419.7755	421.7158	423.7812	(39)
									Average = Sum(39)m / 12 =			420.0520	(39)
(40)m	1.4916	1.4839	1.4839	1.4699	1.4615	1.4576	1.4539	1.4539	1.4635	1.4699	1.4766	1.4839	(40)
									Average = Sum(40)m / 12 =			1.4708	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N 3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 108.1384 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:
b) If manufacturer declared cylinder loss factor is not known :
Cylinder volume (litres) including any solar storage within same cylinder 300.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0115 (51)
Volume factor from Table 2a 0.7368 (52)
Temperature factor from Table 2b 0.5400 (53)
Enter (49) or (54) in (55) 1.3784 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)
Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
								Total per year (kWh/year) = Sum(64)m =				2568.6082	(64)
RHI water heating demand												2569	(64)
(65)m	117.4377	104.3901	111.7062	103.0131	103.0323	95.0560	94.1380	99.3739	97.9686	106.6778	109.1850	115.5825	(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	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	(66)
(67)m	99.5119	88.3856	71.8800	54.4178	40.6779	34.3420	37.1078	48.2341	64.7397	82.2019	95.9418	102.2777	(67)
(68)m	666.4008	673.3160	655.8900	618.7922	571.9628	527.9499	498.5465	491.6313	509.0573	546.1551	592.9845	636.9974	(68)
(69)m	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	(69)
(70)m	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	157.8464	155.3424	150.1427	143.0737	138.4843	132.0222	126.5295	133.5671	136.0675	143.3841	151.6458	155.3529	(72)
(73)m	1096.7563	1090.0412	1050.9099	989.2809	924.1223	867.3112	835.1810	846.4297	882.8617	944.7384	1013.5692	1067.6252	(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	20.9100	11.6736	0.6300	0.7000	0.7700	74.5983	(74)
East	12.7300	21.7895	0.6300	0.7000	0.7700	84.7712	(76)
South	41.0900	49.8711	0.6300	0.7000	0.7700	626.2638	(78)
West	11.7500	21.7895	0.6300	0.7000	0.7700	78.2452	(80)
Horizontal	10.2900	29.0000	0.6300	0.7000	1.0000	108.3299	(82)

(83)m	972.2084	1553.2515	2241.4738	2899.5718	3389.8706	3749.2269	3578.4110	3225.2609	2588.1426	1891.7704	1243.2165	811.0012	(83)
(84)m	2068.9647	2643.2927	3292.3837	3888.8527	4313.9929	4616.5382	4413.5920	4071.6906	3471.0043	2836.5087	2256.7857	1878.6264	(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	18.6234	18.7197	18.7197	18.8983	19.0066	19.0575	19.1060	19.1060	18.9804	18.8983	18.8114	18.7197	
alpha	2.2416	2.2480	2.2480	2.2599	2.2671	2.2705	2.2737	2.2737	2.2654	2.2599	2.2541	2.2480	
(86)m	0.9503	0.9185	0.8546	0.7694	0.6194	0.4456	0.2870	0.3086	0.5694	0.7977	0.9201	0.9564	(86)
(87)m	18.6098	18.9276	19.5052	20.0013	20.5291	20.8025	20.9063	20.9013	20.6974	20.1162	19.1984	18.6215	(87)
(88)m	19.6976	19.7033	19.7033	19.7138	19.7201	19.7230	19.7258	19.7258	19.7186	19.7138	19.7087	19.7033	(88)
(89)m	0.9417	0.9053	0.8309	0.7327	0.5581	0.3604	0.1781	0.1925	0.4795	0.7538	0.9047	0.9486	(89)
(90)m	16.5800	17.0352	17.8501	18.5349	19.2235	19.5329	19.6232	19.6215	19.4353	18.7164	17.4344	16.6017	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	17.1155	17.5345	18.2868	18.9218	19.5680	19.8679	19.9617	19.9591	19.7683	19.0857	17.8999	17.1346	(92)
Temperature adjustment												-0.1500	
(93)m	16.9655	17.3845	18.1368	18.7718	19.4180	19.7179	19.8117	19.8091	19.6183	18.9357	17.7499	16.9846	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9156	0.8728	0.7946	0.7009	0.5420	0.3601	0.1858	0.2004	0.4717	0.7212	0.8724	0.9243	(94)
(95)m	1894.2816	2307.0068	2616.2049	2725.6546	2338.2586	1662.3272	819.8529	816.0764	1637.1786	2045.6544	1968.8528	1736.4438	(95)
(96)m	5.1000	5.5000	7.4000	9.3000	12.6000	15.4000	17.8000	17.8000	15.1000	11.6000	7.6000	5.5000	(96)
(97)m	5054.3793	5036.4366	4550.0544	3976.0312	2845.7213	1797.4180	835.2984	834.2184	1888.4686	3079.3469	4280.3532	4866.9495	(97)
(98)m	2351.1127	1834.1769	1438.7840	900.2712	377.5522	0.0000	0.0000	0.0000	0.0000	769.0672	1664.2803	2329.0963	(98)

Space heating (October to May) (kWh/year) 11664.3407 (98)
RHI space heating demand 11664 (98)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF ENERGY RATINGS
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

---

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480 (1a) - (3a)	
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082 (1b) - (3b)	
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580 (1c) - (3c)	
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479	(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	+	1	+	0	=	1 * 20 =	20.0000	(6b)
Number of intermittent fans							8 * 10 =	80.0000	(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) =	100.0000 / (5) =	0.1365	(8)
Pressure test		Yes	
Measured/design q50		5.1000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915	(18)
Number of sides on which dwelling is sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		238.4581			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area)		46.3976 (36)
Total fabric heat loss	(33) + (36) =	284.8557 (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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	425.9718	423.7812	423.7812	419.7755	417.3832	416.2706	415.2135	415.2135	417.9605	419.7755	421.7158	423.7812	(39)
									Average = Sum(39)m / 12 =			420.0520	(39)
(40)m	1.4916	1.4839	1.4839	1.4699	1.4615	1.4576	1.4539	1.4539	1.4635	1.4699	1.4766	1.4839	(40)
									Average = Sum(40)m / 12 =			1.4708	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

---

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.1384 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:		
b) If manufacturer declared cylinder loss factor is not known :		
Cylinder volume (litres) including any solar storage within same cylinder		300.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.0115 (51)
Volume factor from Table 2a		0.7368 (52)
Temperature factor from Table 2b		0.5400 (53)
Enter (49) or (54) in (55)		1.3784 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)

Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
								Total per year (kWh/year) = Sum(64)m =				2568.6082	(64)
(65)m	117.4377	104.3901	111.7062	103.0131	103.0323	95.0560	94.1380	99.3739	97.9686	106.6778	109.1850	115.5825	(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	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	(66)
(67)m	99.5119	88.3856	71.8800	54.4178	40.6779	34.3420	37.1078	48.2341	64.7397	82.2019	95.9418	102.2777	(67)
(68)m	666.4008	673.3160	655.8900	618.7922	571.9628	527.9499	498.5465	491.6313	509.0573	546.1551	592.9845	636.9974	(68)
(69)m	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	(69)
(70)m	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	157.8464	155.3424	150.1427	143.0737	138.4843	132.0222	126.5295	133.5671	136.0675	143.3841	151.6458	155.3529	(72)
(73)m	1096.7563	1090.0412	1050.9099	989.2809	924.1223	867.3112	835.1810	846.4297	882.8617	944.7384	1013.5692	1067.6252	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457	(74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133	(76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691	(78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614	(80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754	(82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199	(83)
(84)m	2005.5213	2678.4678	3256.3630	3899.2875	4308.9997	4393.0986	4254.1837	3887.8364	3381.7684	2777.8392	2110.2105	1839.6451	(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	18.6234	18.7197	18.7197	18.8983	19.0066	19.0575	19.1060	19.1060	18.9804	18.8983	18.8114	18.7197	
alpha	2.2416	2.2480	2.2480	2.2599	2.2671	2.2705	2.2737	2.2737	2.2654	2.2599	2.2541	2.2480	
(86)m	0.9563	0.9212	0.8664	0.7835	0.6570	0.5112	0.3687	0.3975	0.6262	0.8252	0.9345	0.9611	(86)
(87)m	18.4628	18.8439	19.3856	19.9093	20.4231	20.7319	20.8710	20.8598	20.6031	19.9671	19.0246	18.4842	(87)
(88)m	19.6976	19.7033	19.7033	19.7138	19.7201	19.7230	19.7258	19.7258	19.7186	19.7138	19.7087	19.7033	(88)
(89)m	0.9489	0.9087	0.8451	0.7499	0.6028	0.4320	0.2650	0.2877	0.5475	0.7885	0.9221	0.9543	(89)
(90)m	16.3669	16.9139	17.6812	18.4085	19.0905	19.4619	19.5998	19.5936	19.3301	18.5140	17.1861	16.4024	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	16.9199	17.4231	18.1309	18.8045	19.4421	19.7970	19.9352	19.9276	19.6659	18.8974	17.6712	16.9516	(92)
Temperature adjustment												-0.1500	
(93)m	16.7699	17.2731	17.9809	18.6545	19.2921	19.6470	19.7852	19.7776	19.5159	18.7474	17.5212	16.8016	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9246	0.8766	0.8089	0.7169	0.5824	0.4269	0.2701	0.2925	0.5334	0.7539	0.8922	0.9316	(94)
(95)m	1854.3567	2347.9226	2633.9882	2795.2245	2509.5858	1875.3500	1148.9641	1137.0285	1803.8101	2094.2260	1882.7133	1713.8205	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5226.6367	5201.1140	4738.2504	4178.6444	3168.8254	2100.9119	1197.9804	1194.8387	2180.0507	3336.1239	4436.9390	5043.6900	(97)
(98)m	2508.9763	1917.3446	1565.5711	996.0623	490.4743	0.0000	0.0000	0.0000	0.0000	923.9720	1839.0425	2477.4229	(98)
Space heating (October to May) (kWh/year)												12718.8660	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	44.5354	(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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	3579.9268	2574.3237	2574.3237	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.8032	0.8722	0.8543	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	2875.4184	2245.3736	2199.3240	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	5060.0452	4834.8236	4450.9993	0.0000	0.0000	0.0000	0.0000	(103)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1572.9313	1926.5508	1675.2464	0.0000	0.0000	0.0000	0.0000	(104)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	81.7215	9.3426	11.0274	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1572.9313	1926.5508	1675.2464	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area / (4) =			0.4587	(105)
(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	180.3619	220.9101	192.0940	0.0000	0.0000	0.0000	0.0000	(107)
									Total = Sum(107)6..8 =			593.3661	(107)
Space cooling requirement in kWh/m2/year											(107) / (4) =	2.0777	(108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Fraction of main heating from main system 2	0.4600	(203)
Fraction of total heating from main system 1	0.4860	(204)
Fraction of total heating from main system 2	0.4140	(205)
Efficiency of main space heating system 1 (in %)	93.0000	(206)
Efficiency of main space heating system 2 (in %)	250.0000	(207)
Efficiency of secondary/supplementary heating system, %	37.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.3200	(209)
Space heating:		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	2508.9763	1917.3446	1565.5711	996.0623	490.4743	0.0000	0.0000	0.0000	0.0000	923.9720	1839.0425	2477.4229	(98)
(211)m	1311.1425	1001.9672	818.1372	520.5229	256.3124	0.0000	0.0000	0.0000	0.0000	482.8499	961.0480	1294.6532	(211)
(213)m	415.4865	317.5123	259.2586	164.9479	81.2225	0.0000	0.0000	0.0000	0.0000	153.0098	304.5454	410.2612	(213)
(215)m	678.1017	518.2012	423.1273	269.2060	132.5606	0.0000	0.0000	0.0000	0.0000	249.7222	497.0385	669.5737	(215)

Annual totals kWh/year

Space heating fuel used, main system 1	6646.6332	(211)
Space heating fuel used, main system 2	2106.2442	(213)
Space heating fuel used, secondary	3437.5313	(215)

Water heating

(64)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
Efficiency of water heater												79.3000	(216)
(217)m	87.9794	87.7318	87.2413	86.4691	84.6914	79.3000	79.3000	79.3000	79.3000	86.2015	87.5925	87.9955	(217)
(219)m	284.3043	251.7472	266.9509	242.9440	244.1862	234.7293	227.0551	246.9129	245.7759	252.6272	261.0196	277.9115	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	41.7505	51.1366	44.4662	0.0000	0.0000	0.0000	0.0000	(221)

Water heating fuel used	3036.1641	(219)
Space cooling fuel used	137.3533	(221)

Electricity for pumps, fans and electric keep-hot (Table 4f):

warm air heating system fans	439.4087	(230b)
central heating pump	130.0000	(230c)
boiler with a fan-assisted flue	45.0000	(230e)
Total electricity for the above, kWh/year	614.4087	(231)
Electricity for lighting (calculated in Appendix L)	702.9648	(232)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6646.6332	3.1000	206.0456	(240)
Space heating - main system 2	2106.2442	11.4600	241.3756	(241)
Space heating - secondary	3437.5313	3.4200	117.5636	(242)
Water heating cost (other fuel)	3036.1641	3.1000	94.1211	(247)
Space cooling	137.3533	11.4600	15.7407	(248)
Pumps and fans for heating	614.4087	11.4600	70.4112	(249)
Energy for lighting	702.9648	11.4600	80.5598	(250)
Additional standing charges			106.0000	(251)
Total energy cost			931.8176	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4700	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.3248	(257)
SAP value		81.5195	
SAP rating (Section 12)		82	(258)
SAP band		B	

10a. Fuel costs - using BEDF prices (341)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6646.6332	3.6400	241.9374	(240)
Space heating - main system 2	2106.2442	13.5900	286.2386	(241)
Space heating - secondary	3437.5313	4.6000	158.1264	(242)
Water heating cost (other fuel)	3036.1641	3.6400	110.5164	(247)
Space cooling	137.3533	13.5900	18.6663	(248)
Pumps and fans for heating	614.4087	13.5900	83.4981	(249)
Energy for lighting	702.9648	13.5900	95.5329	(250)
Additional standing charges			119.0000	(251)
Total energy cost			1113.5162	(255)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6646.6332	0.1980	1316.0334	(261)
Space heating - main system 2	2106.2442	0.5170	1088.9283	(262)
Space heating - secondary	3437.5313	0.0080	27.5003	(263)
Water heating cost (other fuel)	3036.1641	0.1980	601.1605	(264)
Space and water heating			3033.6224	(265)
Space cooling	137.3533	0.5170	71.0116	(266)
Pumps and fans	614.4087	0.5170	317.6493	(267)
Energy for lighting	702.9648	0.5170	363.4328	(268)
Total CO2, kg/year			3785.7161	(272)
CO2 emissions per m2			13.2600	(273)
EI value			84.6551	
EI rating			85	(274)
EI band			B	

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	6646.6332	1.0200	6779.5659	(261)
Space heating - main system 2	2106.2442	2.9200	6150.2331	(262)
Space heating - secondary	3437.5313	1.0500	3609.4079	(263)
Water heating cost (other fuel)	3036.1641	1.0200	3096.8873	(264)
Space and water heating			19636.0942	(265)
Space cooling	137.3533	2.9200	401.0715	(266)
Pumps and fans	614.4087	2.9200	1794.0735	(267)
Energy for lighting	702.9648	2.9200	2052.6573	(268)
Primary energy kWh/year			23883.8965	(272)
Primary energy kWh/m2/year			83.6300	(273)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480 (1a) - (3a)	
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082 (1b) - (3b)	
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580 (1c) - (3c)	
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479	(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	+	1	+	0	=	1 * 20	=	20.0000	(6b)
Number of intermittent fans							8 * 10	=	80.0000	(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) =	100.0000 / (5) =	0.1365	(8)
Pressure test		Yes	
Measured/design q50		5.1000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915	(18)
Number of sides on which dwelling is sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		238.4581			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (User defined value 0.080 * total exposed area)	46.3976	(36)
Total fabric heat loss (33) + (36) =	284.8557	(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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	425.9718	423.7812	423.7812	419.7755	417.3832	416.2706	415.2135	415.2135	417.9605	419.7755	421.7158	423.7812	(39)
									Average = Sum(39)m / 12 =			420.0520	(39)
(40)m	1.4916	1.4839	1.4839	1.4699	1.4615	1.4576	1.4539	1.4539	1.4635	1.4699	1.4766	1.4839	(40)
									Average = Sum(40)m / 12 =			1.4708	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.1384 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:		
b) If manufacturer declared cylinder loss factor is not known :		
Cylinder volume (litres) including any solar storage within same cylinder	300.0000	(50)
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115	(51)
Volume factor from Table 2a	0.7368	(52)
Temperature factor from Table 2b	0.5400	(53)
Enter (49) or (54) in (55)	1.3784	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)
Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(62)
(63)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	(63)
									Solar input (sum of months) = Sum(63)m =			0.0000	(63)
Water heat.	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)

												Total per year (kWh/year) = Sum(64)m =	2568.6082 (64)
(65)m	117.4377	104.3901	111.7062	103.0131	103.0323	95.0560	94.1380	99.3739	97.9686	106.6778	109.1850	115.5825	(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	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	(66)
(67)m	39.8048	35.3543	28.7520	21.7671	16.2712	13.7368	14.8431	19.2936	25.8959	32.8808	38.3767	40.9111	(67)
(68)m	446.4885	451.1217	439.4463	414.5908	383.2151	353.7264	334.0261	329.3930	341.0684	365.9239	397.2996	426.7883	(68)
(69)m	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	(69)
(70)m	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	157.8464	155.3424	150.1427	143.0737	138.4843	132.0222	126.5295	133.5671	136.0675	143.3841	151.6458	155.3529	(72)
(73)m	767.7785	765.4572	741.9798	703.0704	661.6094	623.1242	599.0376	605.8925	626.6706	665.8276	710.9609	746.6911	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457	(74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133	(76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691	(78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614	(80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754	(82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199	(83)
(84)m	1676.5435	2353.8837	2947.4329	3613.0770	4046.4869	4148.9115	4018.0403	3647.2992	3125.5773	2498.9285	1807.6022	1518.7110	(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	18.6234	18.7197	18.7197	18.8983	19.0066	19.0575	19.1060	19.1060	18.9804	18.8983	18.8114	18.7197	
alpha	2.2416	2.2480	2.2480	2.2599	2.2671	2.2705	2.2737	2.2737	2.2654	2.2599	2.2541	2.2480	
(86)m	0.9691	0.9375	0.8863	0.8052	0.6794	0.5323	0.3868	0.4188	0.6548	0.8509	0.9508	0.9733	(86)
(87)m	18.3210	18.7175	19.2841	19.8381	20.3832	20.7136	20.8640	20.8509	20.5685	19.8863	18.9015	18.3436	(87)
(88)m	19.6976	19.7033	19.7033	19.7138	19.7201	19.7230	19.7258	19.7258	19.7186	19.7138	19.7087	19.7033	(88)
(89)m	0.9637	0.9272	0.8673	0.7734	0.6260	0.4518	0.2792	0.3047	0.5768	0.8177	0.9411	0.9684	(89)
(90)m	16.1634	16.7354	17.5423	18.3161	19.0445	19.4453	19.5960	19.5885	19.2952	18.4092	17.0120	16.2002	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	16.7326	17.2584	18.0018	18.7177	19.3977	19.7799	19.9305	19.9216	19.6311	18.7989	17.5105	16.7657	(92)
Temperature adjustment												-0.1500	
(93)m	16.5826	17.1084	17.8518	18.5677	19.2477	19.6299	19.7805	19.7716	19.4811	18.6489	17.3605	16.6157	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9440	0.8980	0.8317	0.7391	0.6036	0.4454	0.2841	0.3091	0.5601	0.7823	0.9150	0.9505	(94)
(95)m	1582.5892	2113.7822	2451.4860	2670.4060	2442.2872	1848.0137	1141.5915	1127.5008	1750.6828	1954.8581	1653.9569	1443.5778	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5146.8614	5131.3065	4683.5619	4142.1988	3150.2805	2093.8050	1196.0413	1192.3216	2165.5140	3294.7907	4369.1938	4964.8894	(97)
(98)m	2651.8185	2027.7763	1660.6645	1059.6909	526.7470	0.0000	0.0000	0.0000	0.0000	996.9098	1954.9706	2619.8558	(98)
Space heating (October to May) (kWh/year)												13498.4333	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	47.2651	(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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	3579.9268	2574.3237	2574.3237	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.8032	0.8722	0.8543	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	2875.4184	2245.3736	2199.3240	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	5060.0452	4834.8236	4450.9993	0.0000	0.0000	0.0000	0.0000	(103)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1572.9313	1926.5508	1675.2464	0.0000	0.0000	0.0000	0.0000	(104)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	81.7215	9.3426	11.0274	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1572.9313	1926.5508	1675.2464	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area / (4) =			0.4587	(105)
(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	180.3619	220.9101	192.0940	0.0000	0.0000	0.0000	0.0000	(107)
										Total = Sum(107)6..8 =		593.3661	(107)
Space cooling requirement in kWh/m2/year											(107) / (4) =	2.0777	(108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000 (201)
Fraction of space heat from main system(s)	0.9000 (202)
Fraction of main heating from main system 2	0.4600 (203)
Fraction of total heating from main system 1	0.4860 (204)
Fraction of total heating from main system 2	0.4140 (205)
Efficiency of main space heating system 1 (in %)	93.0000 (206)
Efficiency of main space heating system 2 (in %)	250.0000 (207)
Efficiency of secondary/supplementary heating system, %	37.0000 (208)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.3200 (209)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	2651.8185	2027.7763	1660.6645	1059.6909	526.7470	0.0000	0.0000	0.0000	0.0000	996.9098	1954.9706	2619.8558	(98)
(211)m	1385.7890	1059.6766	867.8311	553.7739	275.2678	0.0000	0.0000	0.0000	0.0000	520.9658	1021.6298	1369.0859	(211)
(213)m	439.1411	335.7998	275.0060	175.4848	87.2293	0.0000	0.0000	0.0000	0.0000	165.0883	323.7431	433.8481	(213)
(215)m	716.7077	548.0476	448.8282	286.4029	142.3641	0.0000	0.0000	0.0000	0.0000	269.4351	528.3704	708.0691	(215)
Annual totals kWh/year													

Space heating fuel used, main system 1												7054.0200	(211)
Space heating fuel used, main system 2												2235.3406	(213)
Space heating fuel used, secondary												3648.2252	(215)
Water heating													
(64)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
Efficiency of water heater												79.3000	(216)
(217)m	88.0686	87.8303	87.3603	86.6141	84.8821	79.3000	79.3000	79.3000	79.3000	86.3855	87.7046	88.0850	(217)
(219)m	284.0164	251.4650	266.5873	242.5375	243.6375	234.7293	227.0551	246.9129	245.7759	252.0890	260.6858	277.6292	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	41.7505	51.1366	44.4662	0.0000	0.0000	0.0000	0.0000	(221)
Water heating fuel used												3033.1209	(219)
Space cooling fuel used												137.3533	(221)
Electricity for pumps, fans and electric keep-hot (Table 4f):													
warm air heating system fans												439.4087	(230b)
central heating pump												130.0000	(230c)
boiler with a fan-assisted flue												45.0000	(230e)
Total electricity for the above, kWh/year												614.4087	(231)
Electricity for lighting (calculated in Appendix L)												702.9648	(232)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7054.0200	0.1980	1396.6960	(261)
Space heating - main system 2	2235.3406	0.5170	1155.6711	(262)
Space heating - secondary	3648.2252	0.0080	29.1858	(263)
Water heating cost (other fuel)	3033.1209	0.1980	600.5579	(264)
Space and water heating			3182.1108	(265)
Space cooling	137.3533	0.5170	71.0116	(266)
Pumps and fans	614.4087	0.5170	317.6493	(267)
Energy for lighting	702.9648	0.5170	363.4328	(268)
Total CO2, kg/year			3934.2045	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.7800	(273)

---

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

DER		13.7800	ZC1
Total Floor Area	TFA	285.5900	
Assumed number of occupants	N	3.1132	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5290	
CO2 emissions from appliances, equation (L14)		9.4428	ZC2
CO2 emissions from cooking, equation (L16)		0.6783	ZC3
Total CO2 emissions		23.9011	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		23.9011	ZC8

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF TARGET EMISSIONS
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

---

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480 (1a) - (3a)	
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082 (1b) - (3b)	
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580 (1c) - (3c)	
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479	(5)

---

2. Ventilation rate

---

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0410	(8)
Pressure test		Yes	
Measured/design q50		10.0000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.5410	(18)
Number of sides on which dwelling is 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) =	0.4598	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.6208	0.5863	0.5863	0.5173	0.4713	0.4483	0.4253	0.4253	0.4828	0.5173	0.5518	0.5863	(22b)
Effective ach	0.6927	0.6719	0.6719	0.6338	0.6111	0.6005	0.5905	0.5905	0.6166	0.6338	0.6522	0.6719	(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	
Doors			1.8500	2.0000	3.7000			(26)
Windows (Uw = 2.00)			69.5475	1.8519	128.7917			(27)

Basement Floor			42.6600	0.2500	10.6650	(28a)
Ground Floor			77.7500	0.2500	19.4375	(28a)
Basement Wall	332.4600	71.3975	261.0625	0.3500	91.3719	(29a)
Flat Roof	127.1000		127.1000	0.1600	20.3360	(30)
Total net area of external elements Aum(A, m2)			579.9700			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		274.3020	(33)
Party Wall			51.0500	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
Thermal bridges (User defined value 0.110 * total exposed area) 63.7967 (36)
Total fabric heat loss (33) + (36) = 338.0987 (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	167.4007	162.3707	162.3707	153.1730	147.6800	145.1250	142.6979	142.6979	149.0053	153.1730	157.6282	162.3707	(38)
(39)m	505.4994	500.4695	500.4695	491.2718	485.7787	483.2238	480.7966	480.7966	487.1041	491.2718	495.7269	500.4695	(39)
									Average = Sum(39)m / 12 =			491.9065	(39)
(40)m	1.7700	1.7524	1.7524	1.7202	1.7010	1.6920	1.6835	1.6835	1.7056	1.7202	1.7358	1.7524	(40)
									Average = Sum(40)m / 12 =			1.7224	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N 3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 113.8299 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	125.2129	120.6597	116.1065	111.5533	107.0001	102.4469	102.4469	107.0001	111.5533	116.1065	120.6597	125.2129	(44)
(45)m	186.1314	162.7917	167.9864	146.4546	140.5267	121.2639	112.3688	128.9448	130.4849	152.0675	165.9936	180.2583	(45)
Energy content (annual)										Total = Sum(45)m =		1795.2726	(45)
(46)m	27.9197	24.4188	25.1980	21.9682	21.0790	18.1896	16.8553	19.3417	19.5727	22.8101	24.8990	27.0387	(46)

Water storage loss:
b) If manufacturer declared cylinder loss factor is not known :
Cylinder volume (litres) including any solar storage within same cylinder 150.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0191 (51)
Volume factor from Table 2a 0.9283 (52)
Temperature factor from Table 2b 0.5400 (53)
Enter (49) or (54) in (55) 1.4364 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(57)
Primary circuit loss (annual) from Table 3												610.0000	(58)
(59)m	51.8082	46.7945	51.8082	50.1370	51.8082	50.1370	51.8082	51.8082	50.1370	51.8082	50.1370	51.8082	(59)
(62)m	282.4678	249.8052	264.3228	239.6834	236.8631	214.4927	208.7052	225.2813	223.7136	248.4039	259.2224	276.5947	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	282.4678	249.8052	264.3228	239.6834	236.8631	214.4927	208.7052	225.2813	223.7136	248.4039	259.2224	276.5947	(64)
								Total per year (kWh/year) = Sum(64)m =				2929.5561	(64)
(65)m	138.9578	123.7391	132.9246	123.2792	123.7943	114.9033	114.4318	119.9433	117.9692	127.6316	129.7759	137.0050	(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	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	(66)
(67)m	67.6681	60.1022	48.8784	37.0041	27.6610	23.3526	25.2333	32.7992	44.0230	55.8973	65.2404	69.5488	(67)
(68)m	446.4885	451.1217	439.4463	414.5908	383.2151	353.7264	334.0261	329.3930	341.0684	365.9239	397.2996	426.7883	(68)
(69)m	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	(69)
(70)m	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	186.7712	184.1355	178.6621	171.2211	166.3901	159.5879	153.8061	161.2141	163.8462	171.5478	180.2443	184.1465	(72)
(73)m	780.6259	775.0574	746.6848	702.5139	656.9642	616.3648	592.7635	603.1042	628.6355	673.0670	722.4823	760.1816	(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	
East	69.5475	19.8726	0.7200	0.7000	0.7700	482.7244	(76)

(83)m	482.7244	935.6570	1495.4811	2220.4346	2701.6367	2819.0202	2736.1785	2381.3561	1787.9087	1139.4543	600.1517	398.2000	(83)
(84)m	1263.3502	1710.7144	2242.1659	2922.9485	3358.6009	3435.3850	3328.9420	2984.4603	2416.5443	1812.5213	1322.6340	1158.3816	(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	39.2338	39.6281	39.6281	40.3700	40.8265	41.0423	41.2495	41.2495	40.7154	40.3700	40.0072	39.6281	
alpha	3.6156	3.6419	3.6419	3.6913	3.7218	3.7362	3.7500	3.7500	3.7144	3.6913	3.6671	3.6419	
(86)m	0.9991	0.9972	0.9897	0.9634	0.8870	0.7456	0.5552	0.6055	0.8878	0.9849	0.9981	0.9993	(86)
(87)m	18.9084	19.1326	19.5516	20.0388	20.5402	20.8410	20.9632	20.9508	20.6661	20.0390	19.3300	18.9553	(87)
(88)m	19.4963	19.5086	19.5086	19.5313	19.5450	19.5513	19.5574	19.5574	19.5417	19.5313	19.5203	19.5086	(88)
(89)m	0.9987	0.9960	0.9854	0.9475	0.8349	0.6297	0.3772	0.4178	0.8090	0.9756	0.9973	0.9990	(89)
(90)m	17.6292	17.8618	18.2786	18.7711	19.2441	19.4827	19.5508	19.5481	19.3630	18.7802	18.0680	17.6850	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	17.9667	18.1971	18.6144	19.1056	19.5861	19.8411	19.9234	19.9182	19.7068	19.1123	18.4010	18.0201	(92)
Temperature adjustment												0.0000	
(93)m	17.9667	18.1971	18.6144	19.1056	19.5861	19.8411	19.9234	19.9182	19.7068	19.1123	18.4010	18.0201	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9982	0.9946	0.9816	0.9413	0.8367	0.6560	0.4255	0.4689	0.8204	0.9716	0.9963	0.9985	(94)
(95)m	1261.0173	1701.4418	2200.9766	2751.5158	2810.2301	2253.7504	1416.3054	1399.5589	1982.5000	1761.1131	1317.7009	1156.6610	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)

(97)m	6807.4065	6604.7532	5912.7688	5111.9727	3830.8807	2532.6058	1453.6643	1451.1440	2633.6768	4083.6177	5651.7641	6566.2302	(97)
(98)m	4126.5136	3295.0253	2761.5734	1699.5289	759.3640	0.0000	0.0000	0.0000	0.0000	1727.9434	3120.5255	4024.7195	(98)
Space heating (October to May) (kWh/year)												21515.1937	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	75.3359	(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)	0.1000 (201)
Fraction of space heat from main system(s)	0.9000 (202)
Efficiency of main space heating system 1 (in %)	78.9000 (206)
Efficiency of secondary/supplementary heating system, %	100.0000 (208)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	4126.5136	3295.0253	2761.5734	1699.5289	759.3640	0.0000	0.0000	0.0000	0.0000	1727.9434	3120.5255	4024.7195	(98)
(211)m	4707.0498	3758.5840	3150.0837	1938.6262	866.1947	0.0000	0.0000	0.0000	0.0000	1971.0381	3559.5348	4590.9348	(211)
(215)m	412.6514	329.5025	276.1573	169.9529	75.9364	0.0000	0.0000	0.0000	0.0000	172.7943	312.0526	402.4720	(215)

Annual totals kWh/year	
Space heating fuel used, main system 1	24542.0460 (211)
Space heating fuel used, secondary	2151.5194 (215)

Water heating

(64)m	282.4678	249.8052	264.3228	239.6834	236.8631	214.4927	208.7052	225.2813	223.7136	248.4039	259.2224	276.5947	(64)
Efficiency of water heater												68.8000	(216)
(217)m	78.0897	78.0103	77.8021	77.3615	76.0274	68.8000	68.8000	68.8000	68.8000	77.3363	77.9332	78.0868	(217)
(219)m	361.7221	320.2210	339.7375	309.8227	311.5497	311.7626	303.3506	327.4437	325.1652	321.1995	332.6210	354.2146	(219)

Water heating fuel used	3918.8101 (219)
Electricity for pumps, fans and electric keep-hot (Table 4f):	
central heating pump	130.0000 (230c)
boiler with a fan-assisted flue	45.0000 (230e)
Total electricity for the above, kWh/year	175.0000 (231)
Electricity for lighting (calculated in Appendix L)	1195.0402 (232)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	24542.0460	0.1940	4761.1569	(261)
Space heating - secondary	2151.5194	0.4220	907.9412	(263)
Water heating cost (other fuel)	3918.8101	0.1940	760.2492	(264)
Space and water heating			6429.3473	(265)
Pumps and fans	175.0000	0.4220	73.8500	(267)
Energy for lighting	1195.0402	0.4220	504.3070	(268)
Total CO2, kg/year			7007.5042	(272)
Emissions per m2 for space and water heating			22.7711	(272a)
Emissions per m2 for lighting			1.7658	(272b)
Target Carbon Dioxide Emission Rate (TER)			15.2400	(273)

= [(22.7711 * 1.00 * 1.0206) + (1.7658 * 1.2251)] * 0.60

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF STANDARD ENE7 CO2
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480 (1a) - (3a)	
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082 (1b) - (3b)	
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580 (1c) - (3c)	
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900				(4)	
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479 (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	+	1	+	0	=	1 * 20 =	20.0000	(6b)
Number of intermittent fans							8 * 10 =	80.0000	(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) =	100.0000 / (5) =	0.1365 (8)
Pressure test		Yes
Measured/design q50		5.1000
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915 (18)
Number of sides on which dwelling is sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		238.4581			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area) 46.3976 (36)
Total fabric heat loss (33) + (36) = 284.8557 (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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	425.9718	423.7812	423.7812	419.7755	417.3832	416.2706	415.2135	415.2135	417.9605	419.7755	421.7158	423.7812	(39)
									Average = Sum(39)m / 12 =			420.0520	(39)
(40)m	1.4916	1.4839	1.4839	1.4699	1.4615	1.4576	1.4539	1.4539	1.4635	1.4699	1.4766	1.4839	(40)
									Average = Sum(40)m / 12 =			1.4708	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N 3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 108.1384 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of
not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:
b) If manufacturer declared cylinder loss factor is not known :
Cylinder volume (litres) including any solar storage within same cylinder 150.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0191 (51)
Volume factor from Table 2a 0.9283 (52)
Temperature factor from Table 2b 0.5400 (53)
Enter (49) or (54) in (55) 1.4364 (55)

(57)m	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(57)
Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	251.9283	222.4875	234.6906	211.8127	208.6039	187.8815	181.8539	197.6011	196.6415	219.5677	230.3747	246.3489	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	251.9283	222.4875	234.6906	211.8127	208.6039	187.8815	181.8539	197.6011	196.6415	219.5677	230.3747	246.3489	(64)
								Total per year (kWh/year) = Sum(64)m =				2589.7925	(64)
(65)m	118.8771	105.6902	113.1455	104.4060	104.4717	96.4489	95.5773	100.8133	99.3616	108.1172	110.5779	117.0219	(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	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	(66)
(67)m	39.8048	35.3543	28.7520	21.7671	16.2712	13.7368	14.8431	19.2936	25.8959	32.8808	38.3767	40.9111	(67)
(68)m	446.4885	451.1217	439.4463	414.5908	383.2151	353.7264	334.0261	329.3930	341.0684	365.9239	397.2996	426.7883	(68)
(69)m	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	(69)
(70)m	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	159.7810	157.2771	152.0773	145.0084	140.4190	133.9568	128.4641	135.5017	138.0022	145.3188	153.5804	157.2875	(72)
(73)m	725.7723	723.4510	699.9736	661.0642	619.6032	581.1180	557.0314	563.8863	584.6644	623.8214	668.9547	704.6848	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457	(74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133	(76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691	(78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614	(80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754	(82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199	(83)
(84)m	1634.5372	2311.8775	2905.4267	3571.0708	4004.4806	4106.9053	3976.0341	3605.2930	3083.5710	2456.9223	1765.5960	1476.7048	(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	18.6234	18.7197	18.7197	18.8983	19.0066	19.0575	19.1060	19.1060	18.9804	18.8983	18.8114	18.7197	
alpha	2.2416	2.2480	2.2480	2.2599	2.2671	2.2705	2.2737	2.2737	2.2654	2.2599	2.2541	2.2480	
(86)m	0.9706	0.9395	0.8889	0.8084	0.6830	0.5360	0.3902	0.4227	0.6597	0.8548	0.9529	0.9747	(86)

(87)m	17.9558	18.4160	19.0740	19.7179	20.3527	20.7384	20.9146	20.8990	20.5677	19.7714	18.6276	17.9814	(87)
(88)m	19.6976	19.7033	19.7033	19.7138	19.7201	19.7230	19.7258	19.7258	19.7186	19.7138	19.7087	19.7033	(88)
(89)m	0.9654	0.9295	0.8703	0.7769	0.6298	0.4554	0.2819	0.3079	0.5818	0.8221	0.9436	0.9701	(89)
(90)m	16.9590	17.4144	18.0550	18.6725	19.2540	19.5747	19.6961	19.6900	19.4529	18.7441	17.6331	16.9890	(90)
Living area fraction										fLA = Living area / (4) =		0.2638	(91)
(92)m	17.2220	17.6786	18.3238	18.9483	19.5439	19.8818	20.0176	20.0090	19.7471	19.0152	17.8955	17.2509	(92)
Temperature adjustment												0.0000	
(93)m	17.2220	17.6786	18.3238	18.9483	19.5439	19.8818	20.0176	20.0090	19.7471	19.0152	17.8955	17.2509	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9514	0.9085	0.8453	0.7549	0.6216	0.4662	0.3080	0.3350	0.5837	0.8002	0.9254	0.9576	(94)
(95)m	1555.1639	2100.3723	2455.9957	2695.6950	2489.2714	1914.5735	1224.6205	1207.8083	1800.0315	1966.0051	1633.8423	1414.0209	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5419.2185	5372.9717	4883.5772	4301.9992	3273.8929	2198.6428	1294.4530	1290.8896	2276.6573	3448.5241	4594.8002	5234.0646	(97)
(98)m	2874.8566	2199.1868	1806.1206	1156.5390	583.7584	0.0000	0.0000	0.0000	0.0000	1102.9941	2131.8897	2842.1125	(98)
Space heating (October to May) (kWh/year)												14697.4577	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	51.4635	(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)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Fraction of main heating from main system 2	0.4600	(203)
Fraction of total heating from main system 1	0.4860	(204)
Fraction of total heating from main system 2	0.4140	(205)
Efficiency of main space heating system 1 (in %)	88.9000	(206)
Efficiency of main space heating system 2 (in %)	88.9000	(207)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating:		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	2874.8566	2199.1868	1806.1206	1156.5390	583.7584	0.0000	0.0000	0.0000	0.0000	1102.9941	2131.8897	2842.1125	(98)
(211)m	1571.6314	1202.2551	987.3730	632.2587	319.1300	0.0000	0.0000	0.0000	0.0000	602.9867	1165.4650	1553.7308	(211)
(213)m	1338.7971	1024.1432	841.0955	538.5907	271.8515	0.0000	0.0000	0.0000	0.0000	513.6553	992.8035	1323.5485	(213)
(215)m	287.4857	219.9187	180.6121	115.6539	58.3758	0.0000	0.0000	0.0000	0.0000	110.2994	213.1890	284.2113	(215)

Annual totals kWh/year		
Space heating fuel used, main system 1	8034.8307	(211)
Space heating fuel used, main system 2	6844.4854	(213)
Space heating fuel used, secondary	1469.7458	(215)
Water heating		

(64)m	251.9283	222.4875	234.6906	211.8127	208.6039	187.8815	181.8539	197.6011	196.6415	219.5677	230.3747	246.3489	(64)
Efficiency of water heater												78.8000	(216)
(217)m	87.1927	86.9792	86.5594	85.8870	84.3206	78.8000	78.8000	78.8000	78.8000	85.7079	86.8745	87.2082	(217)
(219)m	288.9327	255.7941	271.1323	246.6179	247.3939	238.4283	230.7791	250.7629	249.5450	256.1814	265.1810	282.4837	(219)

Water heating fuel used	3083.2323	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):		
central heating pump	130.0000	(230c)
boiler with a fan-assisted flue	90.0000	(230e)
Total electricity for the above, kWh/year	220.0000	(231)
Electricity for lighting (calculated in Appendix L)	702.9648	(232)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	8034.8307	0.1980	1590.8965	(261)
Space heating - main system 2	6844.4854	0.1980	1355.2081	(262)
Space heating - secondary	1469.7458	0.5170	759.8586	(263)
Water heating cost (other fuel)	3083.2323	0.1980	610.4800	(264)
Space and water heating			4316.4431	(265)
Pumps and fans	220.0000	0.5170	113.7400	(267)
Energy for lighting	702.9648	0.5170	363.4328	(268)
Total CO2, kg/year			4793.6159	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.7800	(273)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600	(1a)	x 2.8000	(2a) =	119.4480	(1a) - (3a)
Ground floor	111.9400	(1b)	x 2.5300	(2b) =	283.2082	(1b) - (3b)
First floor	79.7200	(1c)	x 2.6500	(2c) =	211.2580	(1c) - (3c)
Second floor	51.2700	(1d)	x 2.3100	(2d) =	118.4337	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	732.3479	(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	+ 1	+ 0	= 1 * 20 =	20.0000	(6b)
Number of intermittent fans				8 * 10 =	80.0000	(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) =	100.0000 / (5) =	0.1365	(8)
Pressure test		Yes	
Measured/design q50		5.1000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915	(18)
Number of sides on which dwelling is sheltered		3	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		238.4581			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (User defined value 0.080 * total exposed area)	46.3976	(36)
Total fabric heat loss (33) + (36) =	284.8557	(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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	425.9718	423.7812	423.7812	419.7755	417.3832	416.2706	415.2135	415.2135	417.9605	419.7755	421.7158	423.7812	(39)
									Average = Sum(39)m / 12 =			420.0520	(39)
(40)m	1.4916	1.4839	1.4839	1.4699	1.4615	1.4576	1.4539	1.4539	1.4635	1.4699	1.4766	1.4839	(40)
									Average = Sum(40)m / 12 =			1.4708	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	3.1132	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.1384	(43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)		

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:		
b) If manufacturer declared cylinder loss factor is not known :		
Cylinder volume (litres) including any solar storage within same cylinder	300.0000	(50)
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115	(51)
Volume factor from Table 2a	0.7368	(52)
Temperature factor from Table 2b	0.5400	(53)
Enter (49) or (54) in (55)	1.3784	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)
Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
								Total per year (kWh/year) = Sum(64)m =				2568.6082	(64)
(65)m	117.4377	104.3901	111.7062	103.0131	103.0323	95.0560	94.1380	99.3739	97.9686	106.6778	109.1850	115.5825	(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	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	(66)
(67)m	99.5119	88.3856	71.8800	54.4178	40.6779	34.3420	37.1078	48.2341	64.7397	82.2019	95.9418	102.2777	(67)
(68)m	666.4008	673.3160	655.8900	618.7922	571.9628	527.9499	498.5465	491.6313	509.0573	546.1551	592.9845	636.9974	(68)
(69)m	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	(69)
(70)m	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	157.8464	155.3424	150.1427	143.0737	138.4843	132.0222	126.5295	133.5671	136.0675	143.3841	151.6458	155.3529	(72)
(73)m	1096.7563	1090.0412	1050.9099	989.2809	924.1223	867.3112	835.1810	846.4297	882.8617	944.7384	1013.5692	1067.6252	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457 (74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133 (76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691 (78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614 (80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754 (82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199 (83)
(84)m	2005.5213	2678.4678	3256.3630	3899.2875	4308.9997	4393.0986	4254.1837	3887.8364	3381.7684	2777.8392	2110.2105	1839.6451 (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	18.6234	18.7197	18.7197	18.8983	19.0066	19.0575	19.1060	19.1060	18.9804	18.8983	18.8114	18.7197	
alpha	2.2416	2.2480	2.2480	2.2599	2.2671	2.2705	2.2737	2.2737	2.2654	2.2599	2.2541	2.2480	
(86)m	0.9563	0.9212	0.8664	0.7835	0.6570	0.5112	0.3687	0.3975	0.6262	0.8252	0.9345	0.9611	(86)
(87)m	18.4628	18.8439	19.3856	19.9093	20.4231	20.7319	20.8710	20.8598	20.6031	19.9671	19.0246	18.4842	(87)
(88)m	19.6976	19.7033	19.7033	19.7138	19.7201	19.7230	19.7258	19.7258	19.7186	19.7138	19.7087	19.7033	(88)
(89)m	0.9489	0.9087	0.8451	0.7499	0.6028	0.4320	0.2650	0.2877	0.5475	0.7885	0.9221	0.9543	(89)
(90)m	16.3669	16.9139	17.6812	18.4085	19.0905	19.4619	19.5998	19.5936	19.3301	18.5140	17.1861	16.4024	(90)
Living area fraction										fLA = Living area / (4) =		0.2638	(91)
(92)m	16.9199	17.4231	18.1309	18.8045	19.4421	19.7970	19.9352	19.9276	19.6659	18.8974	17.6712	16.9516	(92)
Temperature adjustment												-0.1500	
(93)m	16.7699	17.2731	17.9809	18.6545	19.2921	19.6470	19.7852	19.7776	19.5159	18.7474	17.5212	16.8016	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9246	0.8766	0.8089	0.7169	0.5824	0.4269	0.2701	0.2925	0.5334	0.7539	0.8922	0.9316	(94)
(95)m	1854.3567	2347.9226	2633.9882	2795.2245	2509.5858	1875.3500	1148.9641	1137.0285	1803.8101	2094.2260	1882.7133	1713.8205	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5226.6367	5201.1140	4738.2504	4178.6444	3168.8254	2100.9119	1197.9804	1194.8387	2180.0507	3336.1239	4436.9390	5043.6900	(97)
(98)m	2508.9763	1917.3446	1565.5711	996.0623	490.4743	0.0000	0.0000	0.0000	0.0000	923.9720	1839.0425	2477.4229	(98)
Space heating (October to May) (kWh/year)												12718.8660	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	44.5354	(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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	3579.9268	2574.3237	2574.3237	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.8032	0.8722	0.8543	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	2875.4184	2245.3736	2199.3240	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	5060.0452	4834.8236	4450.9993	0.0000	0.0000	0.0000	0.0000	(103)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1572.9313	1926.5508	1675.2464	0.0000	0.0000	0.0000	0.0000	(104)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	81.7215	9.3426	11.0274	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1572.9313	1926.5508	1675.2464	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		0.4587	(105)
(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	180.3619	220.9101	192.0940	0.0000	0.0000	0.0000	0.0000	(107)
										Total = Sum(107)6..8 =		593.3661	(107)
Space cooling requirement in kWh/m2/year											(107) / (4) =	2.0777	(108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000 (201)
Fraction of space heat from main system(s)	0.9000 (202)
Fraction of main heating from main system 2	0.4600 (203)
Fraction of total heating from main system 1	0.4860 (204)
Fraction of total heating from main system 2	0.4140 (205)
Efficiency of main space heating system 1 (in %)	93.0000 (206)
Efficiency of main space heating system 2 (in %)	250.0000 (207)
Efficiency of secondary/supplementary heating system, %	37.0000 (208)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.3200 (209)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	2508.9763	1917.3446	1565.5711	996.0623	490.4743	0.0000	0.0000	0.0000	0.0000	923.9720	1839.0425	2477.4229	(98)
(211)m	1311.1425	1001.9672	818.1372	520.5229	256.3124	0.0000	0.0000	0.0000	0.0000	482.8499	961.0480	1294.6532	(211)
(213)m	415.4865	317.5123	259.2586	164.9479	81.2225	0.0000	0.0000	0.0000	0.0000	153.0098	304.5454	410.2612	(213)
(215)m	678.1017	518.2012	423.1273	269.2060	132.5606	0.0000	0.0000	0.0000	0.0000	249.7222	497.0385	669.5737	(215)

Annual totals kWh/year	
Space heating fuel used, main system 1	6646.6332 (211)
Space heating fuel used, main system 2	2106.2442 (213)
Space heating fuel used, secondary	3437.5313 (215)
Water heating	

(64)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
Efficiency of water heater												79.3000	(216)
(217)m	87.9794	87.7318	87.2413	86.4691	84.6914	79.3000	79.3000	79.3000	79.3000	86.2015	87.5925	87.9955	(217)
(219)m	284.3043	251.7472	266.9509	242.9440	244.1862	234.7293	227.0551	246.9129	245.7759	252.6272	261.0196	277.9115	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	41.7505	51.1366	44.4662	0.0000	0.0000	0.0000	0.0000	(221)

Water heating fuel used	3036.1641 (219)
Space cooling fuel used	137.3533 (221)
Electricity for pumps, fans and electric keep-hot (Table 4f):	
warm air heating system fans	439.4087 (230b)
central heating pump	130.0000 (230c)
boiler with a fan-assisted flue	45.0000 (230e)
Total electricity for the above, kWh/year	614.4087 (231)
Electricity for lighting (calculated in Appendix L)	702.9648 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV Unit 0 (0.80 * 2.50 * 1073 * 0.80)	-1716.8000 (233)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6646.6332	3.1000	206.0456	(240)
Space heating - main system 2	2106.2442	11.4600	241.3756	(241)
Space heating - secondary	3437.5313	3.4200	117.5636	(242)
Water heating cost (other fuel)	3036.1641	3.1000	94.1211	(247)
Space cooling	137.3533	11.4600	15.7407	(248)
Pumps and fans for heating	614.4087	11.4600	70.4112	(249)
Energy for lighting	702.9648	11.4600	80.5598	(250)
Additional standing charges			106.0000	(251)
Energy saving/generation technologies				
PV Unit	-1716.8000	11.4600	-196.7453	(252)
Total energy cost			735.0723	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4700	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0451	(257)
SAP value		85.4215	
SAP rating (Section 12)		85	(258)
SAP band		B	

10a. Fuel costs - using BEDF prices (341)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6646.6332	3.6400	241.9374	(240)
Space heating - main system 2	2106.2442	13.5900	286.2386	(241)
Space heating - secondary	3437.5313	4.6000	158.1264	(242)
Water heating cost (other fuel)	3036.1641	3.6400	110.5164	(247)
Space cooling	137.3533	13.5900	18.6663	(248)
Pumps and fans for heating	614.4087	13.5900	83.4981	(249)
Energy for lighting	702.9648	13.5900	95.5329	(250)
Additional standing charges			119.0000	(251)
Energy saving/generation technologies				
PV Unit	-1716.8000	13.5900	-233.3131	(252)
Total energy cost			880.2031	(255)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6646.6332	0.1980	1316.0334	(261)
Space heating - main system 2	2106.2442	0.5170	1088.9283	(262)
Space heating - secondary	3437.5313	0.0080	27.5003	(263)
Water heating cost (other fuel)	3036.1641	0.1980	601.1605	(264)
Space and water heating			3033.6224	(265)
Space cooling	137.3533	0.5170	71.0116	(266)
Pumps and fans	614.4087	0.5170	317.6493	(267)
Energy for lighting	702.9648	0.5170	363.4328	(268)
Energy saving/generation technologies				
PV Unit	-1716.8000	0.5290	-908.1872	(269)
Total CO2, kg/year			2877.5289	(272)
CO2 emissions per m2			10.0800	(273)
EI value			88.3363	
EI rating			88	(274)
EI band			B	

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	6646.6332	1.0200	6779.5659	(261)
Space heating - main system 2	2106.2442	2.9200	6150.2331	(262)
Space heating - secondary	3437.5313	1.0500	3609.4079	(263)
Water heating cost (other fuel)	3036.1641	1.0200	3096.8873	(264)
Space and water heating			19636.0942	(265)
Space cooling	137.3533	2.9200	401.0715	(266)
Pumps and fans	614.4087	2.9200	1794.0735	(267)
Energy for lighting	702.9648	2.9200	2052.6573	(268)
Energy saving/generation technologies				
PV Unit	-1716.8000	2.9200	-5013.0560	(269)
Primary energy kWh/year			18870.8405	(272)
Primary energy kWh/m2/year			66.0767	(273)

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2010 Edition
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

New Build (As Designed)

1 TER and DER
Fuels for main heating:Mains gas, Electricity
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.24 kg/m^2
Dwelling Carbon Dioxide Emission Rate (DER) 13.78 kg/m^{2}OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.25 (max. 0.70)	OK

Floor	0.19 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.15 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.49 (max. 2.00)	1.50 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.080

---

3 Air permeability

Air permeability at 50 pascals:	5.10 (design value)	
Maximum	10.0	OK

---

4 Heating efficiency

Main heating system 1:	Boiler system with radiators or underfloor - Mains gas	
Data from manufacturer		
TBC TBC		
Efficiency: 89.0% SEDBUK2009		
Minimum: 88.0%	OK	
Main heating system 2:	Heat pump with warm air distribution - Electric	
Secondary heating system:	Room heaters - Wood Logs	
RWJ Open fire in grate		
Efficiency: 37%		
Minimum: 37%	OK	

---

5 Cylinder insulation

Hot water storage	Nominal cylinder loss: 2.55 kWh/day	
Permitted by DBSCG 2.86	OK	
Primary pipework insulated:	Yes	OK

---

6 Controls

Space heating controls 1:	Time and temperature zone control	OK
Space heating controls 2:	Time and temperature zone control	OK
Hot water controls:	Cylinderstat	OK
	Independent timer for DHW	OK
Boiler interlock	Yes	OK

---

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

Minimum	75%	OK

---

8 Mechanical ventilation
Not applicable

---

9 Summertime temperature

Overheating risk (Thames Valley):	Slight	OK
Based on:		
Overshading:	Average	
Windows facing North:	22.38 m^2, No overhang	
Windows facing East:	12.73 m^2, No overhang	
Windows facing South:	41.09 m^2, No overhang	
Windows facing West:	11.75 m^2, No overhang	
Windows facing Horizontal:	8.82 m^2, No overhang	
Ventilation rate:	8.00	
Blinds/curtains:	None	

---

10 Key features

External wall U-value	0.12 W/m^2K
Roof U-value	0.12 W/m^2K
Floor U-value	0.18 W/m^2K
Door U-value	1.20 W/m^2K
Party wall U-value	0.00 W/m^2K
Secondary heating (wood logs)	
Fixed cooling system	
Secondary heating fuel:	wood logs

SAP 2009 OVERHEATING ASSESSMENT FOR New Build (As Designed) BRE SAP Worksheet 9.90
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

Overheating Calculation Input Data

Dwelling type	MidTerrace House
Number of storeys	4
Cross ventilation possible	Yes
Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	1933.40 (P1)
Transmission heat loss coefficient	284.86 (37)
Summer heat loss coefficient	2218.25 (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)
North	1.000	1.00	1.000	1.000 (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)
Horizontal	1.000	1.00	1.000	1.000 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	20.9100	85.3441	0.6300	0.7000	0.9000	637.4576
East	12.7300	117.7842	0.6300	0.7000	0.9000	535.5981
South	41.0900	110.5233	0.6300	0.7000	0.9000	1622.2343
West	11.7500	117.7842	0.6300	0.7000	0.9000	494.3659
Horizontal	10.2900	204.0000	0.6300	0.7000	1.0000	714.1342
					total:	4053.5835

	Jun	Jul	Aug	
Solar gains	4247	4054	3659	(P3)
Internal gains	813	781	792	
Total summer gains	5060	4835	4451	(P5)
Summer gain/loss ratio	2.28	2.18	2.01	(P6)
Summer external temperature	15.40	17.80	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	18.98	21.28	21.11	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

SAP 2009 IMPROVEMENTS
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

0006-Kemplay-Road

Current energy efficiency rating: B 82
Current environmental impact rating: B 85

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
L	Not considered
M	Not considered
N Solar water heating	SAP increase too small
O	Not considered
P	Not considered
Q	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic (PV) panels	Recommended
V Wind turbine	SAP increase too small

Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic (PV) panels	+ 3.9	-£ 233	-908 kg (24.0%)

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.7	-£ 41	-241 kg (6.4%)
V Wind turbine	+ 0.1	-£ 8	-33 kg (1.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Lower cost measures				
(none)				
Sub Total	£0	0.00 kg/m²		
Higher cost measures				
(none)				
Sub Total	£0	0.00 kg/m²		

Potential energy efficiency rating: B 82
Potential environmental impact rating: B 85

Further improvements to achieve even higher standards

Solar photovoltaic	£233	3.18 kg/m²	B 85	B 88
Total Savings	£233	3.18 kg/m²		

Enhanced energy efficiency rating: B 85
Enhanced environmental impact rating: B 88

Fuel prices for cost data on this page from database revision number 341 TEST (31 Jul 2013)
Recommendation texts revision number 4.6 (10 Dec 2012)

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

	Current	Potential	Enhanced
Electricity	£484	£484	£484
Mains gas	£471	£471	£471
Wood	£158	£158	£158
Space heating	£889	£889	£889
Space cooling	£19	£19	£19
Water heating	£111	£111	£111
Lighting	£96	£96	£96
Generated (PV)	-£0	-£0	-£233
Total cost	£1113	£1113	£880
Carbon dioxide emissions	3.8 tonnes	3.8 tonnes	2.9 tonnes
Primary energy	84 kWh/m^2	84 kWh/m^2	66 kWh/m^2

MES Energy Services
Newark Beacon, Cafferata Way
Newark
Nottingham
01636 653055

Full SAP Calculation Printout

Property Reference: 0006-Kemplay-Road
Survey Reference: Be Green
Property: Kemplay Road, London, NW3

Issued on Date: 08.Aug.2013
Prop Type Ref: TAG Architects

SAP Rating:	87 B	**CO2 Emissions (t/year):**	2.42	**DER:** 9.01 Pass	**Reduction:** 40.9%	**FEE:** 56.7	**ZC8:**	0.00
Environmental:	90 B	**General Requirements Compliance:**	Pass	**TER:** 15.24		**HLP:** 1.47	**Energy cost:**	£ 764

CfSH Results	**Version:** CfSH November 2010	**ENE1 Credits:** 4.4	**ENE2 Credits:** 0.0	**ENE7 Credits:** 2	**CfSH Level:** 4		

Surveyor: Matthew Crowther, Tel: 01636 653005 Surveyor ID: 8440-0006
Address: Cafferata Way, Newark, Nottinghamshire, NG24 2TN
Client:

Software Version: Elmhurst Energy Systems SAP2009 Calculator (Design System) version 4.01r01
SAP version: SAP 2009, Regs Region: England and Wales (Part L1A 2010), Calculation Type: New Dwelling As Designed

CALCULATION DETAILS for survey reference no 'Be Green'
SAP2009 - 9.81 input data (DesignData) -

SAP2009 Input Data

FullRefNo:	Be Green
Sap Version:	SAP 2009
Regs Region:	England & Wales
Region:	Thames Valley
Calculation Type:	New Build (As Designed)
DwellingOrientation:	North
Property Type:	House, Mid-Terrace
Storeys:	4
Date Built:	2013
Sheltered Sides:	3
Sunlight Shade:	Average or unknown
Measurements	Perimeter, Floor Area, Storey Height
Basement:	28.92, 42.66, 2.8
1st Storey:	42.73, 111.94, 2.53
2nd Storey:	40.44, 79.72, 2.65
3rd Storey:	30.92, 51.27, 2.31
4th Storey:	0, 0, 0
Living Area:	75.35 m2, fraction: 26.4%
Thermal Mass:	Simple calculation
Thermal Mass Simple:	Low
Thermal MassValue:	100
External Walls	Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Basement Wall	84.18, 84.18, 190, , Other, , Solid, 0, 0.22, Gross
External Wall	144.02, 233.77, 0, , Other, , Cavity, 0, 0.25, Gross
Room in Roof	14.51, 14.51, 0, , Other, , TimberFrame, 0, 0.12, Gross
Party Walls	Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
Party Wall	51.05, 0, , Other, , FilledWithEdge, 0, 0
External Roofs	Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
Flat Roof	80.44, 89.26, 9, PlasterInsulatedFlatRoof, , , 0.16
Sloped Roof	21.65, 23.12, 9, PlasterInsulatedSlope, , , 0.16
Room in Roof	14.72, 14.72, 0, Other, , , 0.12
Heat Loss Floors	Area, Kappa, Construction, Element, Type, UValueFinal, ShelterFactor
Basement Floor	42.66, 0, Other, , GroundSolid, 0, 0.18
Ground Floor	77.75, 0, Other, , GroundSolid, 0, 0.2
Description	Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
Window/Glazed Door	Manufacturer, Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
Solid Door	Manufacturer, Solid Door, , , , , , ,
Roof Lights	Manufacturer, Roof Window, Double Low-E Soft 0.1, , , 0.63, , 0.7,
Openings	Opening Type, Location, Orientation, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
Opening 1	Solid Door, External Wall, North, , , , 0, 0, 0, 3.27,
Opening 2	Window, External Wall, North, None, 0, , 0, 0, 0, 20.91,
Opening 3	Window, External Wall, East, None, 0, , 0, 0, 0, 12.73,
Opening 4	Window, External Wall, South, None, 0, , 0, 0, 0, 41.09,
Opening 5	Window, External Wall, West, None, 0, , 0, 0, 0, 11.75,
Opening 6	Roof Window, Sloped Roof, North, None, , , 0, 0, 0, 1.47,
Opening 7	Roof Window, Flat Roof, Horizontal, None, , , 0, 0, 0, 8.82,
Conservatory:	None
Draught Proofing:	100
Draught Lobby:	No
Thermal Bridges	User Input, ACDs Assumed
Y	0.08
Pressure Test:	True
Designed q50:	5.1
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:	1
Open Flues Other:	0
Open Flues Total:	1
Intermittent Fans:	8
Passive Vents:	0
Flueless Gas Fires:	0
Cooling System	
Cooled Area	130.99
Data Source	SAP table
Type	Split or Multi-Split
Class	A
Control	Modulating
Light Fittings:	20
LEL Fittings:	20

```
Percentage of LEL Fittings:   100
External Lights Fitted:       Yes
External LELs Fitted:         Yes
Electricity Tariff:           Standard
Main Heating 1
    Description
    Percentage                54
    MHS                       Mains gas BGB Post 98 Regular condens. with auto ign.
    SAP Code                  102
    Boiler Efficiency Type    Sedbuk 2009
    Efficiency                89
    Model Name                TBC
    Manufacturer              TBC
    MHS Controls              CBI Time and temperature zone control
    Delayed Start Stat        Yes
    Ctrl SAP Code             2110
    Burner Control            Modulating
    Boiler Compensator        WeatherCompensator
    Flue Type                 Balanced
    Fan Assisted Flue         Yes
    Pumped                    Pump in heated space
    Heat Emitter              Underfloor
    Under Floor Heating       Yes - Pipes in thin screed
Main Heating 2
    Description
    Percentage                46
    MHS                       Electricity PEH Heat pump air-to-air
    SAP Code                  524
    Boiler Efficiency Type    SAP Table
    Efficiency                250
    MHS Controls              CWD Time and temperature zone control
    Delayed Start Stat        Yes
    Ctrl SAP Code             2506
Smoke Control Area             Unknown
Community Heating              None
Secondary Heating
    SHS                       RWJ - Wood Logs RWJ Open fire in grate
    SAP Code                  631
    Hetas Approved System     True
    Efficiency                37
Water Heating
    Type                      MainHeating1
    WHS                       HWP From main heating 1
    Low Water Usage           Yes
    SAP Code                  901
    Hot Water Cylinder
    Cylinder Type             HotWaterCylinder
    Cylinder Insulation Type  Foam
    Insulation Thickness      80 mm
    Cylinder Volume           300.00
    Cylinder Stat             Yes
    Pipes Insulated           Yes
    Cylinder in Heated Space  Yes
    Separate Time Control     Yes
Flue Gas Heat Recovery System None
Waste Water Heat Recovery      none
PV Unit
    Type                      One Dwelling
    PVUnit 1                  Cells Peak = 3, Orientation = South, Elevation = _30, Overshading = NoneOrLittle
Wind Turbine                   None
Terrain Type:                  Urban
Small Scale Hydro              None
Special Features               None
```

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF FABRIC ENERGY EFFICIENCY
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

---

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480 (1a) - (3a)	
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082 (1b) - (3b)	
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580 (1c) - (3c)	
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479	(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	+	1	+	0	=	1 * 20 =	20.0000	(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) =	60.0000 / (5) =	0.0819	(8)
Pressure test		Yes	
Measured/design q50		5.1000	
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3369	(18)
Number of sides on which dwelling is 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) =	0.2864	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)

(22b)m	0.3866	0.3651	0.3651	0.3222	0.2935	0.2792	0.2649	0.2649	0.3007	0.3222	0.3437	0.3651	(22b)
Effective ach	0.5747	0.5667	0.5667	0.5519	0.5431	0.5390	0.5351	0.5351	0.5452	0.5519	0.5591	0.5667	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		238.4581			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area)		46.3976 (36)
Total fabric heat loss	(33) + (36) =	284.8557 (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	138.9001	136.9488	136.9488	133.3809	131.2501	130.2590	129.3174	129.3174	131.7642	133.3809	135.1091	136.9488	(38)
(39)m	423.7557	421.8045	421.8045	418.2366	416.1057	415.1147	414.1731	414.1731	416.6199	418.2366	419.9648	421.8045	(39)
									Average = Sum(39)m / 12 =			418.4828	(39)
(40)m	1.4838	1.4770	1.4770	1.4645	1.4570	1.4535	1.4502	1.4502	1.4588	1.4645	1.4705	1.4770	(40)
									Average = Sum(40)m / 12 =			1.4653	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.1384 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)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:													
(57)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	(57)
Primary circuit loss (annual) from Table 3												0.0000	(58)
(59)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	(59)
(65)m	37.5753	32.8636	33.9123	29.5655	28.3688	24.4801	22.6845	26.0307	26.3416	30.6986	33.5100	36.3896	(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	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	(66)
(67)m	39.8048	35.3543	28.7520	21.7671	16.2712	13.7368	14.8431	19.2936	25.8959	32.8808	38.3767	40.9111	(67)
(68)m	446.4885	451.1217	439.4463	414.5908	383.2151	353.7264	334.0261	329.3930	341.0684	365.9239	397.2996	426.7883	(68)
(69)m	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	(69)
(70)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	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	50.5044	48.9041	45.5810	41.0632	38.1301	34.0002	30.4899	34.9876	36.5856	41.2616	46.5416	48.9108	(72)
(73)m	606.4957	605.0780	583.4773	547.1191	507.3144	471.1614	449.0571	453.3721	473.2478	509.7643	551.9159	586.3081	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457	(74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133	(76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691	(78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614	(80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754	(82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199	(83)
(84)m	1515.2606	2193.5046	2788.9303	3457.1257	3892.1918	3996.9487	3868.0598	3494.7788	2972.1545	2342.8651	1648.5572	1358.3280	(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	18.7208	18.8074	18.8074	18.9679	19.0650	19.1105	19.1540	19.1540	19.0415	18.9679	18.8898	18.8074	
alpha	2.2481	2.2538	2.2538	2.2645	2.2710	2.2740	2.2769	2.2769	2.2694	2.2645	2.2593	2.2538	
(86)m	0.9746	0.9450	0.8959	0.8165	0.6923	0.5453	0.3985	0.4326	0.6721	0.8649	0.9587	0.9786	(86)
(87)m	17.9075	18.3724	19.0384	19.6905	20.3354	20.7299	20.9112	20.8945	20.5514	19.7365	18.5794	17.9309	(87)
(88)m	19.7033	19.7085	19.7085	19.7178	19.7234	19.7261	19.7285	19.7285	19.7221	19.7178	19.7133	19.7085	(88)
(89)m	0.9702	0.9358	0.8782	0.7859	0.6395	0.4644	0.2887	0.3162	0.5948	0.8338	0.9503	0.9747	(89)
(90)m	16.9152	17.3757	18.0252	18.6511	19.2432	19.5722	19.6974	19.6908	19.4446	18.7159	17.5892	16.9425	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	17.1770	17.6387	18.2925	18.9253	19.5314	19.8776	20.0177	20.0084	19.7366	18.9852	17.8505	17.2033	(92)
Temperature adjustment												0.0000	
(93)m	17.1770	17.6387	18.2925	18.9253	19.5314	19.8776	20.0177	20.0084	19.7366	18.9852	17.8505	17.2033	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9576	0.9158	0.8536	0.7636	0.6307	0.4748	0.3150	0.3435	0.5958	0.8117	0.9334	0.9635	(94)
(95)m	1450.9745	2008.7828	2380.6562	2639.7548	2454.7215	1897.6306	1218.5119	1200.4318	1770.8688	1901.6493	1538.7710	1308.8090	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5371.9584	5331.0416	4847.5889	4276.6057	3258.6740	2190.8295	1291.2518	1287.4189	2265.0030	3423.3338	4556.8200	5189.5957	(97)
(98)m	2917.2120	2232.5579	1835.3979	1178.5326	598.1406	0.0000	0.0000	0.0000	0.0000	1132.1332	2172.9953	2887.3053	(98)

Space heating (October to May) (kWh/year) 14954.2749 (98)
Space heating requirement in kWh/m2/year (98) / (4) = 52.3627 (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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	3569.9860	2567.8733	2567.8733	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.7989	0.8689	0.8501	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	2851.9759	2231.1307	2182.8992	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	4962.0232	4738.7840	4352.4198	0.0000	0.0000	0.0000	0.0000	(103)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1519.2340	1865.6941	1614.1233	0.0000	0.0000	0.0000	0.0000	(104)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	99.4420	13.8185	16.3804	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1519.2340	1865.6941	1614.1233	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	379.8085	466.4235	403.5308	0.0000	0.0000	0.0000	0.0000	(107)
										Total = Sum(107)6..8 =		1249.7629	(107)

Space cooling requirement in kWh/m2/year (107) / (4) = 4.3761 (108)

8f. Fabric Energy Efficiency

Fabric Energy Efficiency (99) + (108) = 56.7388
Fabric Energy Efficiency rounded 56.7 (109)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF DATA FOR RENEWABLE HEAT INCENTIVE (RHI)
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600	(1a)	x 2.8000	(2a) =	119.4480	(1a) - (3a)
Ground floor	111.9400	(1b)	x 2.5300	(2b) =	283.2082	(1b) - (3b)
First floor	79.7200	(1c)	x 2.6500	(2c) =	211.2580	(1c) - (3c)
Second floor	51.2700	(1d)	x 2.3100	(2d) =	118.4337	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	732.3479	(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	+	1	+	0	=	1 * 20 =	20.0000	(6b)
Number of intermittent fans							8 * 10 =	80.0000	(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) =	100.0000 / (5) =	0.1365 (8)
Pressure test		Yes
Measured/design q50		5.1000
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915 (18)
Number of sides on which dwelling is sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)

Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 238.4581 (33)
Party Wall 51.0500 0.0000 0.0000 (32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area) 46.3976 (36)
Total fabric heat loss (33) + (36) = 284.8557 (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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	425.9718	423.7812	423.7812	419.7755	417.3832	416.2706	415.2135	415.2135	417.9605	419.7755	421.7158	423.7812	(39)
										Average = Sum(39)m / 12 =		420.0520	(39)
(40)m	1.4916	1.4839	1.4839	1.4699	1.4615	1.4576	1.4539	1.4539	1.4635	1.4699	1.4766	1.4839	(40)
										Average = Sum(40)m / 12 =		1.4708	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N 3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 108.1384 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:
b) If manufacturer declared cylinder loss factor is not known :
Cylinder volume (litres) including any solar storage within same cylinder 300.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0115 (51)
Volume factor from Table 2a 0.7368 (52)
Temperature factor from Table 2b 0.5400 (53)
Enter (49) or (54) in (55) 1.3784 (55)

(57)m	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)
Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
								Total per year (kWh/year) = Sum(64)m =				2568.6082	(64)
RHI water heating demand												2569	(64)
(65)m	117.4377	104.3901	111.7062	103.0131	103.0323	95.0560	94.1380	99.3739	97.9686	106.6778	109.1850	115.5825	(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	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	(66)
(67)m	99.5119	88.3856	71.8800	54.4178	40.6779	34.3420	37.1078	48.2341	64.7397	82.2019	95.9418	102.2777	(67)
(68)m	666.4008	673.3160	655.8900	618.7922	571.9628	527.9499	498.5465	491.6313	509.0573	546.1551	592.9845	636.9974	(68)
(69)m	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	(69)
(70)m	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	157.8464	155.3424	150.1427	143.0737	138.4843	132.0222	126.5295	133.5671	136.0675	143.3841	151.6458	155.3529	(72)
(73)m	1096.7563	1090.0412	1050.9099	989.2809	924.1223	867.3112	835.1810	846.4297	882.8617	944.7384	1013.5692	1067.6252	(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	20.9100	11.6736	0.6300	0.7000	0.7700	74.5983	(74)
East	12.7300	21.7895	0.6300	0.7000	0.7700	84.7712	(76)
South	41.0900	49.8711	0.6300	0.7000	0.7700	626.2638	(78)
West	11.7500	21.7895	0.6300	0.7000	0.7700	78.2452	(80)
Horizontal	10.2900	29.0000	0.6300	0.7000	1.0000	108.3299	(82)

(83)m	972.2084	1553.2515	2241.4738	2899.5718	3389.8706	3749.2269	3578.4110	3225.2609	2588.1426	1891.7704	1243.2165	811.0012	(83)
(84)m	2068.9647	2643.2927	3292.3837	3888.8527	4313.9929	4616.5382	4413.5920	4071.6906	3471.0043	2836.5087	2256.7857	1878.6264	(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	18.6234	18.7197	18.7197	18.8983	19.0066	19.0575	19.1060	19.1060	18.9804	18.8983	18.8114	18.7197	
alpha	2.2416	2.2480	2.2480	2.2599	2.2671	2.2705	2.2737	2.2737	2.2654	2.2599	2.2541	2.2480	
(86)m	0.9503	0.9185	0.8546	0.7694	0.6194	0.4456	0.2870	0.3086	0.5694	0.7977	0.9201	0.9564	(86)
(87)m	18.6098	18.9276	19.5052	20.0013	20.5291	20.8025	20.9063	20.9013	20.6974	20.1162	19.1984	18.6215	(87)
(88)m	19.6976	19.7033	19.7033	19.7138	19.7201	19.7230	19.7258	19.7258	19.7186	19.7138	19.7087	19.7033	(88)
(89)m	0.9417	0.9053	0.8309	0.7327	0.5581	0.3604	0.1781	0.1925	0.4795	0.7538	0.9047	0.9486	(89)
(90)m	16.5800	17.0352	17.8501	18.5349	19.2235	19.5329	19.6232	19.6215	19.4353	18.7164	17.4344	16.6017	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	17.1155	17.5345	18.2868	18.9218	19.5680	19.8679	19.9617	19.9591	19.7683	19.0857	17.8999	17.1346	(92)
Temperature adjustment												-0.1500	
(93)m	16.9655	17.3845	18.1368	18.7718	19.4180	19.7179	19.8117	19.8091	19.6183	18.9357	17.7499	16.9846	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9156	0.8728	0.7946	0.7009	0.5420	0.3601	0.1858	0.2004	0.4717	0.7212	0.8724	0.9243	(94)
(95)m	1894.2816	2307.0068	2616.2049	2725.6546	2338.2586	1662.3272	819.8529	816.0764	1637.1786	2045.6544	1968.8528	1736.4438	(95)
(96)m	5.1000	5.5000	7.4000	9.3000	12.6000	15.4000	17.8000	17.8000	15.1000	11.6000	7.6000	5.5000	(96)

(97)m	5054.3793	5036.4366	4550.0544	3976.0312	2845.7213	1797.4180	835.2984	834.2184	1888.4686	3079.3469	4280.3532	4866.9495	(97)
(98)m	2351.1127	1834.1769	1438.7840	900.2712	377.5522	0.0000	0.0000	0.0000	0.0000	769.0672	1664.2803	2329.0963	(98)
Space heating (October to May) (kWh/year)												11664.3407	(98)
RHI space heating demand												11664	(98)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF ENERGY RATINGS
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600 (1a)	x	2.8000 (2a)	=	119.4480	(1a) - (3a)
Ground floor	111.9400 (1b)	x	2.5300 (2b)	=	283.2082	(1b) - (3b)
First floor	79.7200 (1c)	x	2.6500 (2c)	=	211.2580	(1c) - (3c)
Second floor	51.2700 (1d)	x	2.3100 (2d)	=	118.4337	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	732.3479	(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	+	1	+	0	=	1 * 20 =	20.0000	(6b)
Number of intermittent fans							8 * 10 =	80.0000	(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) =	100.0000 / (5) =	0.1365 (8)
Pressure test		Yes
Measured/design q50		5.1000
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915 (18)
Number of sides on which dwelling is sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		238.4581			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area)	46.3976 (36)
Total fabric heat loss (33) + (36) =	284.8557 (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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	425.9718	423.7812	423.7812	419.7755	417.3832	416.2706	415.2135	415.2135	417.9605	419.7755	421.7158	423.7812	(39)
										Average = Sum(39)m / 12 =		420.0520	(39)
(40)m	1.4916	1.4839	1.4839	1.4699	1.4615	1.4576	1.4539	1.4539	1.4635	1.4699	1.4766	1.4839	(40)
										Average = Sum(40)m / 12 =		1.4708	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.1384 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:

b) If manufacturer declared cylinder loss factor is not known :	
Cylinder volume (litres) including any solar storage within same cylinder	300.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0115 (51)
Volume factor from Table 2a	0.7368 (52)
Temperature factor from Table 2b	0.5400 (53)

Enter (49) or (54) in (55)												1.3784	(55)
(57)m	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)
Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
								Total per year (kWh/year) = Sum(64)m =				2568.6082	(64)
(65)m	117.4377	104.3901	111.7062	103.0131	103.0323	95.0560	94.1380	99.3739	97.9686	106.6778	109.1850	115.5825	(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	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	186.7918	(66)
(67)m	99.5119	88.3856	71.8800	54.4178	40.6779	34.3420	37.1078	48.2341	64.7397	82.2019	95.9418	102.2777	(67)
(68)m	666.4008	673.3160	655.8900	618.7922	571.9628	527.9499	498.5465	491.6313	509.0573	546.1551	592.9845	636.9974	(68)
(69)m	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	56.7924	(69)
(70)m	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	157.8464	155.3424	150.1427	143.0737	138.4843	132.0222	126.5295	133.5671	136.0675	143.3841	151.6458	155.3529	(72)
(73)m	1096.7563	1090.0412	1050.9099	989.2809	924.1223	867.3112	835.1810	846.4297	882.8617	944.7384	1013.5692	1067.6252	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457	(74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133	(76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691	(78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614	(80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754	(82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199	(83)
(84)m	2005.5213	2678.4678	3256.3630	3899.2875	4308.9997	4393.0986	4254.1837	3887.8364	3381.7684	2777.8392	2110.2105	1839.6451	(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	18.6234	18.7197	18.7197	18.8983	19.0066	19.0575	19.1060	19.1060	18.9804	18.8983	18.8114	18.7197	
alpha	2.2416	2.2480	2.2480	2.2599	2.2671	2.2705	2.2737	2.2737	2.2654	2.2599	2.2541	2.2480	
(86)m	0.9563	0.9212	0.8664	0.7835	0.6570	0.5112	0.3687	0.3975	0.6262	0.8252	0.9345	0.9611	(86)
(87)m	18.4628	18.8439	19.3856	19.9093	20.4231	20.7319	20.8710	20.8598	20.6031	19.9671	19.0246	18.4842	(87)
(88)m	19.6976	19.7033	19.7033	19.7138	19.7201	19.7230	19.7258	19.7258	19.7186	19.7138	19.7087	19.7033	(88)
(89)m	0.9489	0.9087	0.8451	0.7499	0.6028	0.4320	0.2650	0.2877	0.5475	0.7885	0.9221	0.9543	(89)
(90)m	16.3669	16.9139	17.6812	18.4085	19.0905	19.4619	19.5998	19.5936	19.3301	18.5140	17.1861	16.4024	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	16.9199	17.4231	18.1309	18.8045	19.4421	19.7970	19.9352	19.9276	19.6659	18.8974	17.6712	16.9516	(92)
Temperature adjustment												-0.1500	
(93)m	16.7699	17.2731	17.9809	18.6545	19.2921	19.6470	19.7852	19.7776	19.5159	18.7474	17.5212	16.8016	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9246	0.8766	0.8089	0.7169	0.5824	0.4269	0.2701	0.2925	0.5334	0.7539	0.8922	0.9316	(94)
(95)m	1854.3567	2347.9226	2633.9882	2795.2245	2509.5858	1875.3500	1148.9641	1137.0285	1803.8101	2094.2260	1882.7133	1713.8205	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5226.6367	5201.1140	4738.2504	4178.6444	3168.8254	2100.9119	1197.9804	1194.8387	2180.0507	3336.1239	4436.9390	5043.6900	(97)
(98)m	2508.9763	1917.3446	1565.5711	996.0623	490.4743	0.0000	0.0000	0.0000	0.0000	923.9720	1839.0425	2477.4229	(98)
Space heating (October to May) (kWh/year)												12718.8660	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	44.5354	(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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	3579.9268	2574.3237	2574.3237	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.8032	0.8722	0.8543	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	2875.4184	2245.3736	2199.3240	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	5060.0452	4834.8236	4450.9993	0.0000	0.0000	0.0000	0.0000	(103)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1572.9313	1926.5508	1675.2464	0.0000	0.0000	0.0000	0.0000	(104)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	81.7215	9.3426	11.0274	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1572.9313	1926.5508	1675.2464	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area / (4) =			0.4587	(105)
(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	180.3619	220.9101	192.0940	0.0000	0.0000	0.0000	0.0000	(107)
										Total = Sum(107)6..8 =		593.3661	(107)
Space cooling requirement in kWh/m2/year											(107) / (4) =	2.0777	(108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Fraction of main heating from main system 2	0.4600	(203)
Fraction of total heating from main system 1	0.4860	(204)
Fraction of total heating from main system 2	0.4140	(205)
Efficiency of main space heating system 1 (in %)	93.0000	(206)
Efficiency of main space heating system 2 (in %)	250.0000	(207)
Efficiency of secondary/supplementary heating system, %	37.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.3200	(209)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	2508.9763	1917.3446	1565.5711	996.0623	490.4743	0.0000	0.0000	0.0000	0.0000	923.9720	1839.0425	2477.4229	(98)
(211)m	1311.1425	1001.9672	818.1372	520.5229	256.3124	0.0000	0.0000	0.0000	0.0000	482.8499	961.0480	1294.6532	(211)
(213)m	415.4865	317.5123	259.2586	164.9479	81.2225	0.0000	0.0000	0.0000	0.0000	153.0098	304.5454	410.2612	(213)
(215)m	678.1017	518.2012	423.1273	269.2060	132.5606	0.0000	0.0000	0.0000	0.0000	249.7222	497.0385	669.5737	(215)

Annual totals kWh/year

Space heating fuel used, main system 1	6646.6332	(211)
Space heating fuel used, main system 2	2106.2442	(213)
Space heating fuel used, secondary	3437.5313	(215)

Water heating

(64)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
Efficiency of water heater												79.3000	(216)
(217)m	87.9794	87.7318	87.2413	86.4691	84.6914	79.3000	79.3000	79.3000	79.3000	86.2015	87.5925	87.9955	(217)
(219)m	284.3043	251.7472	266.9509	242.9440	244.1862	234.7293	227.0551	246.9129	245.7759	252.6272	261.0196	277.9115	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	41.7505	51.1366	44.4662	0.0000	0.0000	0.0000	0.0000	(221)

Water heating fuel used	3036.1641	(219)
Space cooling fuel used	137.3533	(221)

Electricity for pumps, fans and electric keep-hot (Table 4f):		
warm air heating system fans	439.4087	(230b)
central heating pump	130.0000	(230c)
boiler with a fan-assisted flue	45.0000	(230e)
Total electricity for the above, kWh/year	614.4087	(231)
Electricity for lighting (calculated in Appendix L)	702.9648	(232)

Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 3.00 * 1073 * 1.00)	-2575.2000	(233)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6646.6332	3.1000	206.0456	(240)
Space heating - main system 2	2106.2442	11.4600	241.3756	(241)
Space heating - secondary	3437.5313	3.4200	117.5636	(242)
Water heating cost (other fuel)	3036.1641	3.1000	94.1211	(247)
Space cooling	137.3533	11.4600	15.7407	(248)
Pumps and fans for heating	614.4087	11.4600	70.4112	(249)
Energy for lighting	702.9648	11.4600	80.5598	(250)
Additional standing charges			106.0000	(251)
Energy saving/generation technologies				
PV Unit	-2575.2000	11.4600	-295.1179	(252)
Total energy cost			636.6996	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4700	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.9052	(257)
SAP value	87.3725	
SAP rating (Section 12)	87	(258)
SAP band	B	

10a. Fuel costs - using BEDF prices (341)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6646.6332	3.6400	241.9374	(240)
Space heating - main system 2	2106.2442	13.5900	286.2386	(241)
Space heating - secondary	3437.5313	4.6000	158.1264	(242)
Water heating cost (other fuel)	3036.1641	3.6400	110.5164	(247)
Space cooling	137.3533	13.5900	18.6663	(248)
Pumps and fans for heating	614.4087	13.5900	83.4981	(249)
Energy for lighting	702.9648	13.5900	95.5329	(250)
Additional standing charges			119.0000	(251)
Energy saving/generation technologies				
PV Unit	-2575.2000	13.5900	-349.9697	(252)
Total energy cost			763.5465	(255)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6646.6332	0.1980	1316.0334	(261)
Space heating - main system 2	2106.2442	0.5170	1088.9283	(262)
Space heating - secondary	3437.5313	0.0080	27.5003	(263)
Water heating cost (other fuel)	3036.1641	0.1980	601.1605	(264)
Space and water heating			3033.6224	(265)
Space cooling	137.3533	0.5170	71.0116	(266)
Pumps and fans	614.4087	0.5170	317.6493	(267)
Energy for lighting	702.9648	0.5170	363.4328	(268)
Energy saving/generation technologies				
PV Unit	-2575.2000	0.5290	-1362.2808	(269)
Total CO2, kg/year			2423.4353	(272)
CO2 emissions per m2			8.4900	(273)
EI value			90.1769	
EI rating			90	(274)
EI band			B	

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	6646.6332	1.0200	6779.5659 (261)
Space heating - main system 2	2106.2442	2.9200	6150.2331 (262)
Space heating - secondary	3437.5313	1.0500	3609.4079 (263)
Water heating cost (other fuel)	3036.1641	1.0200	3096.8873 (264)
Space and water heating			19636.0942 (265)
Space cooling	137.3533	2.9200	401.0715 (266)
Pumps and fans	614.4087	2.9200	1794.0735 (267)
Energy for lighting	702.9648	2.9200	2052.6573 (268)
Energy saving/generation technologies			
PV Unit	-2575.2000	2.9200	-7519.5840 (269)
Primary energy kWh/year			16364.3125 (272)
Primary energy kWh/m2/year			57.3000 (273)

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600	(1a)	x 2.8000	(2a) =	119.4480	(1a) - (3a)
Ground floor	111.9400	(1b)	x 2.5300	(2b) =	283.2082	(1b) - (3b)
First floor	79.7200	(1c)	x 2.6500	(2c) =	211.2580	(1c) - (3c)
Second floor	51.2700	(1d)	x 2.3100	(2d) =	118.4337	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	732.3479	(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	+	1	+	0	=	1 * 20 =	20.0000	(6b)
Number of intermittent fans							8 * 10 =	80.0000	(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) =	100.0000 / (5) =	0.1365 (8)
Pressure test		Yes
Measured/design q50		5.1000
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915 (18)
Number of sides on which dwelling is sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		238.4581			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area)		46.3976 (36)
Total fabric heat loss	(33) + (36) =	284.8557 (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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	425.9718	423.7812	423.7812	419.7755	417.3832	416.2706	415.2135	415.2135	417.9605	419.7755	421.7158	423.7812	(39)
									Average = Sum(39)m / 12 =			420.0520	(39)
(40)m	1.4916	1.4839	1.4839	1.4699	1.4615	1.4576	1.4539	1.4539	1.4635	1.4699	1.4766	1.4839	(40)
									Average = Sum(40)m / 12 =			1.4708	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.1384 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)

(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)
Water storage loss:													
b) If manufacturer declared cylinder loss factor is not known :													
Cylinder volume (litres) including any solar storage within same cylinder												300.0000	(50)
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0115	(51)
Volume factor from Table 2a												0.7368	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												1.3784	(55)
(57)m	42.7290	38.5939	42.7290	41.3506	42.7290	41.3506	42.7290	42.7290	41.3506	42.7290	41.3506	42.7290	(57)
Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
								Total per year (kWh/year) = Sum(64)m =				2568.6082	(64)
(65)m	117.4377	104.3901	111.7062	103.0131	103.0323	95.0560	94.1380	99.3739	97.9686	106.6778	109.1850	115.5825	(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	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	(66)
(67)m	39.8048	35.3543	28.7520	21.7671	16.2712	13.7368	14.8431	19.2936	25.8959	32.8808	38.3767	40.9111	(67)
(68)m	446.4885	451.1217	439.4463	414.5908	383.2151	353.7264	334.0261	329.3930	341.0684	365.9239	397.2996	426.7883	(68)
(69)m	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	(69)
(70)m	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	53.9409	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	157.8464	155.3424	150.1427	143.0737	138.4843	132.0222	126.5295	133.5671	136.0675	143.3841	151.6458	155.3529	(72)
(73)m	767.7785	765.4572	741.9798	703.0704	661.6094	623.1242	599.0376	605.8925	626.6706	665.8276	710.9609	746.6911	(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	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457	(74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133	(76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691	(78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614	(80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754	(82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199	(83)
(84)m	1676.5435	2353.8837	2947.4329	3613.0770	4046.4869	4148.9115	4018.0403	3647.2992	3125.5773	2498.9285	1807.6022	1518.7110	(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	18.6234	18.7197	18.7197	18.8983	19.0066	19.0575	19.1060	19.1060	18.9804	18.8983	18.8114	18.7197	
alpha	2.2416	2.2480	2.2480	2.2599	2.2671	2.2705	2.2737	2.2737	2.2654	2.2599	2.2541	2.2480	
(86)m	0.9691	0.9375	0.8863	0.8052	0.6794	0.5323	0.3868	0.4188	0.6548	0.8509	0.9508	0.9733	(86)
(87)m	18.3210	18.7175	19.2841	19.8381	20.3832	20.7136	20.8640	20.8509	20.5685	19.8863	18.9015	18.3436	(87)
(88)m	19.6976	19.7033	19.7033	19.7138	19.7201	19.7230	19.7258	19.7258	19.7186	19.7138	19.7087	19.7033	(88)
(89)m	0.9637	0.9272	0.8673	0.7734	0.6260	0.4518	0.2792	0.3047	0.5768	0.8177	0.9411	0.9684	(89)
(90)m	16.1634	16.7354	17.5423	18.3161	19.0445	19.4453	19.5960	19.5885	19.2952	18.4092	17.0120	16.2002	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	16.7326	17.2584	18.0018	18.7177	19.3977	19.7799	19.9305	19.9216	19.6311	18.7989	17.5105	16.7657	(92)
Temperature adjustment												-0.1500	
(93)m	16.5826	17.1084	17.8518	18.5677	19.2477	19.6299	19.7805	19.7716	19.4811	18.6489	17.3605	16.6157	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9440	0.8980	0.8317	0.7391	0.6036	0.4454	0.2841	0.3091	0.5601	0.7823	0.9150	0.9505	(94)
(95)m	1582.5892	2113.7822	2451.4860	2670.4060	2442.2872	1848.0137	1141.5915	1127.5008	1750.6828	1954.8581	1653.9569	1443.5778	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5146.8614	5131.3065	4683.5619	4142.1988	3150.2805	2093.8050	1196.0413	1192.3216	2165.5140	3294.7907	4369.1938	4964.8894	(97)
(98)m	2651.8185	2027.7763	1660.6645	1059.6909	526.7470	0.0000	0.0000	0.0000	0.0000	996.9098	1954.9706	2619.8558	(98)
Space heating (October to May) (kWh/year)												13498.4333	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	47.2651	(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.	0.0000	0.0000	0.0000	0.0000	0.0000	15.4000	17.8000	17.8000	0.0000	0.0000	0.0000	0.0000	
(100)m	0.0000	0.0000	0.0000	0.0000	0.0000	3579.9268	2574.3237	2574.3237	0.0000	0.0000	0.0000	0.0000	(100)
(101)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.8032	0.8722	0.8543	0.0000	0.0000	0.0000	0.0000	(101)
(102)m	0.0000	0.0000	0.0000	0.0000	0.0000	2875.4184	2245.3736	2199.3240	0.0000	0.0000	0.0000	0.0000	(102)
(103)m	0.0000	0.0000	0.0000	0.0000	0.0000	5060.0452	4834.8236	4450.9993	0.0000	0.0000	0.0000	0.0000	(103)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1572.9313	1926.5508	1675.2464	0.0000	0.0000	0.0000	0.0000	(104)
(98)m	0.0000	0.0000	0.0000	0.0000	0.0000	81.7215	9.3426	11.0274	0.0000	0.0000	0.0000	0.0000	(98)
(104)m	0.0000	0.0000	0.0000	0.0000	0.0000	1572.9313	1926.5508	1675.2464	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction									fC = cooled area / (4) =			0.4587	(105)
(106)m	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)
(107)m	0.0000	0.0000	0.0000	0.0000	0.0000	180.3619	220.9101	192.0940	0.0000	0.0000	0.0000	0.0000	(107)
									Total = Sum(107)6..8 =			593.3661	(107)
Space cooling requirement in kWh/m2/year											(107) / (4) =	2.0777	(108)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Fraction of main heating from main system 2	0.4600	(203)
Fraction of total heating from main system 1	0.4860	(204)
Fraction of total heating from main system 2	0.4140	(205)
Efficiency of main space heating system 1 (in %)	93.0000	(206)
Efficiency of main space heating system 2 (in %)	250.0000	(207)
Efficiency of secondary/supplementary heating system, %	37.0000	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.3200	(209)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	2651.8185	2027.7763	1660.6645	1059.6909	526.7470	0.0000	0.0000	0.0000	0.0000	996.9098	1954.9706	2619.8558	(98)
(211)m	1385.7890	1059.6766	867.8311	553.7739	275.2678	0.0000	0.0000	0.0000	0.0000	520.9658	1021.6298	1369.0859	(211)
(213)m	439.1411	335.7998	275.0060	175.4848	87.2293	0.0000	0.0000	0.0000	0.0000	165.0883	323.7431	433.8481	(213)
(215)m	716.7077	548.0476	448.8282	286.4029	142.3641	0.0000	0.0000	0.0000	0.0000	269.4351	528.3704	708.0691	(215)

Annual totals kWh/year		
Space heating fuel used, main system 1	7054.0200	(211)
Space heating fuel used, main system 2	2235.3406	(213)
Space heating fuel used, secondary	3648.2252	(215)

Water heating

(64)m	250.1291	220.8624	232.8914	210.0716	206.8047	186.1403	180.0547	195.8019	194.9003	217.7685	228.6336	244.5497	(64)
Efficiency of water heater												79.3000	(216)
(217)m	88.0686	87.8303	87.3603	86.6141	84.8821	79.3000	79.3000	79.3000	79.3000	86.3855	87.7046	88.0850	(217)
(219)m	284.0164	251.4650	266.5873	242.5375	243.6375	234.7293	227.0551	246.9129	245.7759	252.0890	260.6858	277.6292	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	41.7505	51.1366	44.4662	0.0000	0.0000	0.0000	0.0000	(221)

Water heating fuel used	3033.1209	(219)
Space cooling fuel used	137.3533	(221)
Electricity for pumps, fans and electric keep-hot (Table 4f):		
warm air heating system fans	439.4087	(230b)
central heating pump	130.0000	(230c)
boiler with a fan-assisted flue	45.0000	(230e)
Total electricity for the above, kWh/year	614.4087	(231)
Electricity for lighting (calculated in Appendix L)	702.9648	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 3.00 * 1073 * 1.00) -2575.2000		(233)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7054.0200	0.1980	1396.6960	(261)
Space heating - main system 2	2235.3406	0.5170	1155.6711	(262)
Space heating - secondary	3648.2252	0.0080	29.1858	(263)
Water heating cost (other fuel)	3033.1209	0.1980	600.5579	(264)
Space and water heating			3182.1108	(265)
Space cooling	137.3533	0.5170	71.0116	(266)
Pumps and fans	614.4087	0.5170	317.6493	(267)
Energy for lighting	702.9648	0.5170	363.4328	(268)
Energy saving/generation technologies				
PV Unit	-2575.2000	0.5290	-1362.2808	(269)
Total CO2, kg/year			2571.9237	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.0100	(273)

---

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

DER		9.0100	ZC1
Total Floor Area	TFA	285.5900	
Assumed number of occupants	N	3.1132	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5290	
CO2 emissions from appliances, equation (L14)		9.4428	ZC2
CO2 emissions from cooking, equation (L16)		0.6783	ZC3
Total CO2 emissions		19.1311	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		19.1311	ZC8

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF TARGET EMISSIONS
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

---

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600	(1a)	x 2.8000	(2a) =	119.4480	(1a) - (3a)
Ground floor	111.9400	(1b)	x 2.5300	(2b) =	283.2082	(1b) - (3b)
First floor	79.7200	(1c)	x 2.6500	(2c) =	211.2580	(1c) - (3c)
Second floor	51.2700	(1d)	x 2.3100	(2d) =	118.4337	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 285.5900						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		732.3479	(5)

---

2. Ventilation rate

---

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0410	(8)
Pressure test		Yes	

Measured/design q50 10.0000
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16) 0.5410 (18)
Number of sides on which dwelling is 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) = 0.4598 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.6208	0.5863	0.5863	0.5173	0.4713	0.4483	0.4253	0.4253	0.4828	0.5173	0.5518	0.5863	(22b)
Effective ach	0.6927	0.6719	0.6719	0.6338	0.6111	0.6005	0.5905	0.5905	0.6166	0.6338	0.6522	0.6719	(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	
Doors			1.8500	2.0000	3.7000			(26)
Windows (Uw = 2.00)			69.5475	1.8519	128.7917			(27)
Basement Floor			42.6600	0.2500	10.6650			(28a)
Ground Floor			77.7500	0.2500	19.4375			(28a)
Basement Wall	332.4600	71.3975	261.0625	0.3500	91.3719			(29a)
Flat Roof	127.1000		127.1000	0.1600	20.3360			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		274.3020			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 250.0000 (35)
Thermal bridges (User defined value 0.110 * total exposed area) 63.7967 (36)
Total fabric heat loss (33) + (36) = 338.0987 (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	167.4007	162.3707	162.3707	153.1730	147.6800	145.1250	142.6979	142.6979	149.0053	153.1730	157.6282	162.3707	(38)
(39)m	505.4994	500.4695	500.4695	491.2718	485.7787	483.2238	480.7966	480.7966	487.1041	491.2718	495.7269	500.4695	(39)
									Average = Sum(39)m / 12 =			491.9065	(39)
(40)m	1.7700	1.7524	1.7524	1.7202	1.7010	1.6920	1.6835	1.6835	1.7056	1.7202	1.7358	1.7524	(40)
									Average = Sum(40)m / 12 =			1.7224	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N 3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 113.8299 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	125.2129	120.6597	116.1065	111.5533	107.0001	102.4469	102.4469	107.0001	111.5533	116.1065	120.6597	125.2129	(44)
(45)m	186.1314	162.7917	167.9864	146.4546	140.5267	121.2639	112.3688	128.9448	130.4849	152.0675	165.9936	180.2583	(45)
Energy content (annual)										Total = Sum(45)m =		1795.2726	(45)
(46)m	27.9197	24.4188	25.1980	21.9682	21.0790	18.1896	16.8553	19.3417	19.5727	22.8101	24.8990	27.0387	(46)
Water storage loss:													
b) If manufacturer declared cylinder loss factor is not known :													
Cylinder volume (litres) including any solar storage within same cylinder												150.0000	(50)
Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0191	(51)
Volume factor from Table 2a												0.9283	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												1.4364	(55)
(57)m	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(57)
Primary circuit loss (annual) from Table 3												610.0000	(58)
(59)m	51.8082	46.7945	51.8082	50.1370	51.8082	50.1370	51.8082	51.8082	50.1370	51.8082	50.1370	51.8082	(59)
(62)m	282.4678	249.8052	264.3228	239.6834	236.8631	214.4927	208.7052	225.2813	223.7136	248.4039	259.2224	276.5947	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	282.4678	249.8052	264.3228	239.6834	236.8631	214.4927	208.7052	225.2813	223.7136	248.4039	259.2224	276.5947	(64)
								Total per year (kWh/year) = Sum(64)m =				2929.5561	(64)
(65)m	138.9578	123.7391	132.9246	123.2792	123.7943	114.9033	114.4318	119.9433	117.9692	127.6316	129.7759	137.0050	(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	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	(66)
(67)m	67.6681	60.1022	48.8784	37.0041	27.6610	23.3526	25.2333	32.7992	44.0230	55.8973	65.2404	69.5488	(67)
(68)m	446.4885	451.1217	439.4463	414.5908	383.2151	353.7264	334.0261	329.3930	341.0684	365.9239	397.2996	426.7883	(68)
(69)m	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	(69)
(70)m	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	186.7712	184.1355	178.6621	171.2211	166.3901	159.5879	153.8061	161.2141	163.8462	171.5478	180.2443	184.1465	(72)
(73)m	780.6259	775.0574	746.6848	702.5139	656.9642	616.3648	592.7635	603.1042	628.6355	673.0670	722.4823	760.1816	(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	
East	69.5475	19.8726	0.7200	0.7000	0.7700	482.7244	(76)

(83)m	482.7244	935.6570	1495.4811	2220.4346	2701.6367	2819.0202	2736.1785	2381.3561	1787.9087	1139.4543	600.1517	398.2000	(83)
(84)m	1263.3502	1710.7144	2242.1659	2922.9485	3358.6009	3435.3850	3328.9420	2984.4603	2416.5443	1812.5213	1322.6340	1158.3816	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	39.2338	39.6281	39.6281	40.3700	40.8265	41.0423	41.2495	41.2495	40.7154	40.3700	40.0072	39.6281	
alpha	3.6156	3.6419	3.6419	3.6913	3.7218	3.7362	3.7500	3.7500	3.7144	3.6913	3.6671	3.6419	
(86)m	0.9991	0.9972	0.9897	0.9634	0.8870	0.7456	0.5552	0.6055	0.8878	0.9849	0.9981	0.9993	(86)
(87)m	18.9084	19.1326	19.5516	20.0388	20.5402	20.8410	20.9632	20.9508	20.6661	20.0390	19.3300	18.9553	(87)
(88)m	19.4963	19.5086	19.5086	19.5313	19.5450	19.5513	19.5574	19.5574	19.5417	19.5313	19.5203	19.5086	(88)
(89)m	0.9987	0.9960	0.9854	0.9475	0.8349	0.6297	0.3772	0.4178	0.8090	0.9756	0.9973	0.9990	(89)
(90)m	17.6292	17.8618	18.2786	18.7711	19.2441	19.4827	19.5508	19.5481	19.3630	18.7802	18.0680	17.6850	(90)
Living area fraction									fLA = Living area / (4) =			0.2638	(91)
(92)m	17.9667	18.1971	18.6144	19.1056	19.5861	19.8411	19.9234	19.9182	19.7068	19.1123	18.4010	18.0201	(92)
Temperature adjustment												0.0000	
(93)m	17.9667	18.1971	18.6144	19.1056	19.5861	19.8411	19.9234	19.9182	19.7068	19.1123	18.4010	18.0201	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9982	0.9946	0.9816	0.9413	0.8367	0.6560	0.4255	0.4689	0.8204	0.9716	0.9963	0.9985	(94)
(95)m	1261.0173	1701.4418	2200.9766	2751.5158	2810.2301	2253.7504	1416.3054	1399.5589	1982.5000	1761.1131	1317.7009	1156.6610	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	6807.4065	6604.7532	5912.7688	5111.9727	3830.8807	2532.6058	1453.6643	1451.1440	2633.6768	4083.6177	5651.7641	6566.2302	(97)
(98)m	4126.5136	3295.0253	2761.5734	1699.5289	759.3640	0.0000	0.0000	0.0000	0.0000	1727.9434	3120.5255	4024.7195	(98)
Space heating (October to May) (kWh/year)												21515.1937	(98)
Space heating requirement in kWh/m2/year											(98) / (4) =	75.3359	(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)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Efficiency of main space heating system 1 (in %)	78.9000	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	4126.5136	3295.0253	2761.5734	1699.5289	759.3640	0.0000	0.0000	0.0000	0.0000	1727.9434	3120.5255	4024.7195	(98)
(211)m	4707.0498	3758.5840	3150.0837	1938.6262	866.1947	0.0000	0.0000	0.0000	0.0000	1971.0381	3559.5348	4590.9348	(211)
(215)m	412.6514	329.5025	276.1573	169.9529	75.9364	0.0000	0.0000	0.0000	0.0000	172.7943	312.0526	402.4720	(215)

Annual totals kWh/year		
Space heating fuel used, main system 1	24542.0460	(211)
Space heating fuel used, secondary	2151.5194	(215)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating													
(64)m	282.4678	249.8052	264.3228	239.6834	236.8631	214.4927	208.7052	225.2813	223.7136	248.4039	259.2224	276.5947	(64)
Efficiency of water heater												68.8000	(216)
(217)m	78.0897	78.0103	77.8021	77.3615	76.0274	68.8000	68.8000	68.8000	68.8000	77.3363	77.9332	78.0868	(217)
(219)m	361.7221	320.2210	339.7375	309.8227	311.5497	311.7626	303.3506	327.4437	325.1652	321.1995	332.6210	354.2146	(219)

Water heating fuel used	3918.8101	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):		
central heating pump	130.0000	(230c)
boiler with a fan-assisted flue	45.0000	(230e)
Total electricity for the above, kWh/year	175.0000	(231)
Electricity for lighting (calculated in Appendix L)	1195.0402	(232)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	24542.0460	0.1940	4761.1569	(261)
Space heating - secondary	2151.5194	0.4220	907.9412	(263)
Water heating cost (other fuel)	3918.8101	0.1940	760.2492	(264)
Space and water heating			6429.3473	(265)
Pumps and fans	175.0000	0.4220	73.8500	(267)
Energy for lighting	1195.0402	0.4220	504.3070	(268)
Total CO2, kg/year			7007.5042	(272)
Emissions per m2 for space and water heating			22.7711	(272a)
Emissions per m2 for lighting			1.7658	(272b)
Target Carbon Dioxide Emission Rate (TER)			15.2400	(273)

= [(22.7711 * 1.00 * 1.0206) + (1.7658 * 1.2251)] * 0.60

SAP 2009 WORKSHEET FOR New Build (As Designed) BRE SAP Worksheet 9.90
CALCULATION OF STANDARD ENE7 CO2
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Basement floor	42.6600	(1a)	x 2.8000	(2a) =	119.4480	(1a) - (3a)
Ground floor	111.9400	(1b)	x 2.5300	(2b) =	283.2082	(1b) - (3b)
First floor	79.7200	(1c)	x 2.6500	(2c) =	211.2580	(1c) - (3c)
Second floor	51.2700	(1d)	x 2.3100	(2d) =	118.4337	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	285.5900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		732.3479	(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	+	1	+	0	= 1 * 20 = 20.0000 (6b)
Number of intermittent fans						8 * 10 = 80.0000 (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) =	100.0000 / (5) =	0.1365 (8)
Pressure test		Yes
Measured/design q50		5.1000
If based on air permeability value, then (18) = [(17)/20]+(8), otherwise (18) = (16)		0.3915 (18)
Number of sides on which dwelling is sheltered		3 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.7750 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3034 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.4000	5.1000	5.1000	4.5000	4.1000	3.9000	3.7000	3.7000	4.2000	4.5000	4.8000	5.1000	(22)
Wind factor	1.3500	1.2750	1.2750	1.1250	1.0250	0.9750	0.9250	0.9250	1.0500	1.1250	1.2000	1.2750	(22a)
(22b)m	0.4097	0.3869	0.3869	0.3414	0.3110	0.2959	0.2807	0.2807	0.3186	0.3414	0.3641	0.3869	(22b)
Effective ach	0.5839	0.5748	0.5748	0.5583	0.5484	0.5438	0.5394	0.5394	0.5508	0.5583	0.5663	0.5748	(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	
Solid Door			3.2700	1.2000	3.9240			(26)
Window/Glazed Door (Uw = 1.50)			86.4800	1.4151	122.3774			(27)
Roof Lights (Uw = 1.50)			10.2900	1.4151	14.5613			(27a)
Basement Floor			42.6600	0.1800	7.6788			(28a)
Ground Floor			77.7500	0.2000	15.5500			(28a)
Basement Wall	84.1800		84.1800	0.2200	18.5196			(29a)
External Wall	233.7700	89.7500	144.0200	0.2500	36.0050			(29a)
Room in Roof	14.5100		14.5100	0.1200	1.7412			(29a)
Flat Roof	89.2600	8.8200	80.4400	0.1600	12.8704			(30)
Sloped Roof	23.1200	1.4700	21.6500	0.1600	3.4640			(30)
Room in Roof	14.7200		14.7200	0.1200	1.7664			(30)
Total net area of external elements Aum(A, m2)			579.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		238.4581			(33)
Party Wall			51.0500	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area)	46.3976 (36)
Total fabric heat loss (33) + (36) =	284.8557 (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	141.1161	138.9255	138.9255	134.9198	132.5276	131.4149	130.3578	130.3578	133.1048	134.9198	136.8601	138.9255	(38)
(39)m	425.9718	423.7812	423.7812	419.7755	417.3832	416.2706	415.2135	415.2135	417.9605	419.7755	421.7158	423.7812	(39)
									Average = Sum(39)m / 12 =			420.0520	(39)
(40)m	1.4916	1.4839	1.4839	1.4699	1.4615	1.4576	1.4539	1.4539	1.4635	1.4699	1.4766	1.4839	(40)
									Average = Sum(40)m / 12 =			1.4708	(40)
(41)m	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy, N	3.1132 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.1384 (43)
Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more that 125 litres per person per day (all water use, hot and cold)	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m	118.9523	114.6267	110.3012	105.9757	101.6501	97.3246	97.3246	101.6501	105.9757	110.3012	114.6267	118.9523	(44)
(45)m	176.8248	154.6521	159.5871	139.1319	133.5004	115.2007	106.7504	122.4976	123.9606	144.4641	157.6939	171.2454	(45)
Energy content (annual)										Total = Sum(45)m =		1705.5090	(45)
(46)m	26.5237	23.1978	23.9381	20.8698	20.0251	17.2801	16.0126	18.3746	18.5941	21.6696	23.6541	25.6868	(46)

Water storage loss:	
b) If manufacturer declared cylinder loss factor is not known :	
Cylinder volume (litres) including any solar storage within same cylinder	150.0000 (50)
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.0191 (51)
Volume factor from Table 2a	0.9283 (52)
Temperature factor from Table 2b	0.5400 (53)
Enter (49) or (54) in (55)	1.4364 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(57)m	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(57)
Primary circuit loss (annual) from Table 3												360.0000	(58)
(59)m	30.5753	27.6164	30.5753	29.5890	30.5753	29.5890	30.5753	30.5753	29.5890	30.5753	29.5890	30.5753	(59)
(62)m	251.9283	222.4875	234.6906	211.8127	208.6039	187.8815	181.8539	197.6011	196.6415	219.5677	230.3747	246.3489	(62)
(63)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	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Water heat.	251.9283	222.4875	234.6906	211.8127	208.6039	187.8815	181.8539	197.6011	196.6415	219.5677	230.3747	246.3489	(64)
								Total per year (kWh/year) = Sum(64)m =				2589.7925	(64)
(65)m	118.8771	105.6902	113.1455	104.4060	104.4717	96.4489	95.5773	100.8133	99.3616	108.1172	110.5779	117.0219	(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	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	155.6598	(66)
(67)m	39.8048	35.3543	28.7520	21.7671	16.2712	13.7368	14.8431	19.2936	25.8959	32.8808	38.3767	40.9111	(67)
(68)m	446.4885	451.1217	439.4463	414.5908	383.2151	353.7264	334.0261	329.3930	341.0684	365.9239	397.2996	426.7883	(68)
(69)m	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	38.5660	(69)
(70)m	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	(70)
(71)m	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	-124.5279	(71)
(72)m	159.7810	157.2771	152.0773	145.0084	140.4190	133.9568	128.4641	135.5017	138.0022	145.3188	153.5804	157.2875	(72)
(73)m	725.7723	723.4510	699.9736	661.0642	619.6032	581.1180	557.0314	563.8863	584.6644	623.8214	668.9547	704.6848	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a	g Specific data	FF Specific data	Access factor	Gains W

		W/m2	or Table 6b	or Table 6c	Table 6d	
North	20.9100	10.7264	0.6300	0.7000	0.7700	68.5457 (74)
East	12.7300	19.8726	0.6300	0.7000	0.7700	77.3133 (76)
South	41.0900	47.3233	0.6300	0.7000	0.7700	594.2691 (78)
West	11.7500	19.8726	0.6300	0.7000	0.7700	71.3614 (80)
Horizontal	10.2900	26.0000	0.6300	0.7000	1.0000	97.2754 (82)

(83)m	908.7650	1588.4266	2205.4531	2910.0066	3384.8775	3525.7873	3419.0027	3041.4067	2498.9066	1833.1009	1096.6413	772.0199 (83)
(84)m	1634.5372	2311.8775	2905.4267	3571.0708	4004.4806	4106.9053	3976.0341	3605.2930	3083.5710	2456.9223	1765.5960	1476.7048 (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	18.6234	18.7197	18.7197	18.8983	19.0066	19.0575	19.1060	19.1060	18.9804	18.8983	18.8114	18.7197	
alpha	2.2416	2.2480	2.2480	2.2599	2.2671	2.2705	2.2737	2.2737	2.2654	2.2599	2.2541	2.2480	
(86)m	0.9706	0.9395	0.8889	0.8084	0.6830	0.5360	0.3902	0.4227	0.6597	0.8548	0.9529	0.9747	(86)
(87)m	17.9558	18.4160	19.0740	19.7179	20.3527	20.7384	20.9146	20.8990	20.5677	19.7714	18.6276	17.9814	(87)
(88)m	19.6976	19.7033	19.7033	19.7138	19.7201	19.7230	19.7258	19.7258	19.7186	19.7138	19.7087	19.7033	(88)
(89)m	0.9654	0.9295	0.8703	0.7769	0.6298	0.4554	0.2819	0.3079	0.5818	0.8221	0.9436	0.9701	(89)
(90)m	16.9590	17.4144	18.0550	18.6725	19.2540	19.5747	19.6961	19.6900	19.4529	18.7441	17.6331	16.9890	(90)

Living area fraction fLA = Living area / (4) = 0.2638 (91)

(92)m	17.2220	17.6786	18.3238	18.9483	19.5439	19.8818	20.0176	20.0090	19.7471	19.0152	17.8955	17.2509	(92)

Temperature adjustment 0.0000

(93)m	17.2220	17.6786	18.3238	18.9483	19.5439	19.8818	20.0176	20.0090	19.7471	19.0152	17.8955	17.2509	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(94)m	0.9514	0.9085	0.8453	0.7549	0.6216	0.4662	0.3080	0.3350	0.5837	0.8002	0.9254	0.9576	(94)
(95)m	1555.1639	2100.3723	2455.9957	2695.6950	2489.2714	1914.5735	1224.6205	1207.8083	1800.0315	1966.0051	1633.8423	1414.0209	(95)
(96)m	4.5000	5.0000	6.8000	8.7000	11.7000	14.6000	16.9000	16.9000	14.3000	10.8000	7.0000	4.9000	(96)
(97)m	5419.2185	5372.9717	4883.5772	4301.9992	3273.8929	2198.6428	1294.4530	1290.8896	2276.6573	3448.5241	4594.8002	5234.0646	(97)
(98)m	2874.8566	2199.1868	1806.1206	1156.5390	583.7584	0.0000	0.0000	0.0000	0.0000	1102.9941	2131.8897	2842.1125	(98)

Space heating (October to May) (kWh/year) 14697.4577 (98)

Space heating requirement in kWh/m2/year (98) / (4) = 51.4635 (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) 0.1000 (201)
Fraction of space heat from main system(s) 0.9000 (202)
Fraction of main heating from main system 2 0.4600 (203)
Fraction of total heating from main system 1 0.4860 (204)
Fraction of total heating from main system 2 0.4140 (205)
Efficiency of main space heating system 1 (in %) 88.9000 (206)
Efficiency of main space heating system 2 (in %) 88.9000 (207)
Efficiency of secondary/supplementary heating system, % 100.0000 (208)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(98)m	2874.8566	2199.1868	1806.1206	1156.5390	583.7584	0.0000	0.0000	0.0000	0.0000	1102.9941	2131.8897	2842.1125	(98)
(211)m	1571.6314	1202.2551	987.3730	632.2587	319.1300	0.0000	0.0000	0.0000	0.0000	602.9867	1165.4650	1553.7308	(211)
(213)m	1338.7971	1024.1432	841.0955	538.5907	271.8515	0.0000	0.0000	0.0000	0.0000	513.6553	992.8035	1323.5485	(213)
(215)m	287.4857	219.9187	180.6121	115.6539	58.3758	0.0000	0.0000	0.0000	0.0000	110.2994	213.1890	284.2113	(215)

Annual totals kWh/year
Space heating fuel used, main system 1 8034.8307 (211)
Space heating fuel used, main system 2 6844.4854 (213)
Space heating fuel used, secondary 1469.7458 (215)

Water heating

(64)m	251.9283	222.4875	234.6906	211.8127	208.6039	187.8815	181.8539	197.6011	196.6415	219.5677	230.3747	246.3489	(64)

Efficiency of water heater 78.8000 (216)

(217)m	87.1927	86.9792	86.5594	85.8870	84.3206	78.8000	78.8000	78.8000	78.8000	85.7079	86.8745	87.2082	(217)
(219)m	288.9327	255.7941	271.1323	246.6179	247.3939	238.4283	230.7791	250.7629	249.5450	256.1814	265.1810	282.4837	(219)

Water heating fuel used 3083.2323 (219)

Electricity for pumps, fans and electric keep-hot (Table 4f):
central heating pump 130.0000 (230c)
boiler with a fan-assisted flue 90.0000 (230e)
Total electricity for the above, kWh/year 220.0000 (231)
Electricity for lighting (calculated in Appendix L) 702.9648 (232)

12a. CO2 emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	8034.8307	0.1980	1590.8965	(261)
Space heating - main system 2	6844.4854	0.1980	1355.2081	(262)
Space heating - secondary	1469.7458	0.5170	759.8586	(263)
Water heating cost (other fuel)	3083.2323	0.1980	610.4800	(264)
Space and water heating			4316.4431	(265)
Pumps and fans	220.0000	0.5170	113.7400	(267)
Energy for lighting	702.9648	0.5170	363.4328	(268)
Total CO2, kg/year			4793.6159	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.7800	(273)

No improvements selected

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2010 Edition
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

New Build (As Designed)

1 TER and DER
Fuels for main heating:Mains gas, Electricity
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 15.24 kg/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.01 kg/m²OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.25 (max. 0.70)	OK
Floor	0.19 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.15 (max. 0.20)	0.16 (max. 0.35)	OK
Openings	1.49 (max. 2.00)	1.50 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.080

3 Air permeability
Air permeability at 50 pascals: 5.10 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system 1: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
TBC TBC

Efficiency: 89.0% SEDBUK2009
Minimum: 88.0% OK

Main heating system 2: Heat pump with warm air distribution - Electric

Secondary heating system: Room heaters - Wood Logs
RWJ Open fire in grate
Efficiency: 37%
Minimum: 37% OK

5 Cylinder insulation
Hot water storage Nominal cylinder loss: 2.55 kWh/day
Permitted by DBSCG 2.86 OK
Primary pipework insulated: Yes OK

6 Controls
Space heating controls 1: Time and temperature zone control OK

Space heating controls 2: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

Boiler interlock Yes OK

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

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 22.38 m², No overhang
Windows facing East: 12.73 m², No overhang
Windows facing South: 41.09 m², No overhang
Windows facing West: 11.75 m², No overhang
Windows facing Horizontal: 8.82 m², No overhang
Ventilation rate: 8.00
Blinds/curtains: None

10 Key features
External wall U-value 0.12 W/m²K
Roof U-value 0.12 W/m²K
Floor U-value 0.18 W/m²K
Door U-value 1.20 W/m²K
Party wall U-value 0.00 W/m²K
Secondary heating (wood logs)
Fixed cooling system
Secondary heating fuel: wood logs
Photovoltaic array

SAP 2009 OVERHEATING ASSESSMENT FOR New Build (As Designed) BRE SAP Worksheet 9.90

Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

Overheating Calculation Input Data

Dwelling type	MidTerrace House
Number of storeys	4
Cross ventilation possible	Yes
Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	1933.40 (P1)
Transmission heat loss coefficient	284.86 (37)
Summer heat loss coefficient	2218.25 (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)
North	1.000	1.00	1.000	1.000 (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)
Horizontal	1.000	1.00	1.000	1.000 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	20.9100	85.3441	0.6300	0.7000	0.9000	637.4576
East	12.7300	117.7842	0.6300	0.7000	0.9000	535.5981
South	41.0900	110.5233	0.6300	0.7000	0.9000	1622.2343
West	11.7500	117.7842	0.6300	0.7000	0.9000	494.3659
Horizontal	10.2900	204.0000	0.6300	0.7000	1.0000	714.1342
					total:	4053.5835

	Jun	Jul	Aug	
Solar gains	4247	4054	3659	(P3)
Internal gains	813	781	792	
Total summer gains	5060	4835	4451	(P5)
Summer gain/loss ratio	2.28	2.18	2.01	(P6)
Summer external temperature	15.40	17.80	17.80	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	18.98	21.28	21.11	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

---

SAP 2009 IMPROVEMENTS
Calculated by program Elmhurst Energy Systems Design SAP 2009 version 4.01r01

0006-Kemplay-Road

Current energy efficiency rating:	B 87
Current environmental impact rating:	B 90

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
L	Not considered
M	Not considered
N Solar water heating	SAP increase too small
O	Not considered
P	Not considered
Q	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic (PV) panels	Already installed
V Wind turbine	SAP increase too small

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

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.7	-£ 41	-241 kg (9.9%)
V Wind turbine	+ 0.1	-£ 8	-33 kg (1.3%)

		Typical annual savings		Energy efficiency	Environmental impact
Lower cost measures					
(none)					
	Sub Total	£0	0.00 kg/m^2		
Higher cost measures					
(none)					
	Sub Total	£0	0.00 kg/m^2		
Potential energy efficiency rating:				B 87	
Potential environmental impact rating:					B 90
Further improvements to achieve even higher standards					
(none)					
	Total Savings	£0	0.00 kg/m^2		
Enhanced energy efficiency rating:				B 87	
Enhanced environmental impact rating:					B 90

Fuel prices for cost data on this page from database revision number 341 TEST (31 Jul 2013)
Recommendation texts revision number 4.6 (10 Dec 2012)

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

	Current	Potential	Enhanced
Electricity	£484	£484	£484
Mains gas	£471	£471	£471
Wood	£158	£158	£158
Space heating	£889	£889	£889
Space cooling	£19	£19	£19
Water heating	£111	£111	£111
Lighting	£96	£96	£96
Generated (PV)	-£350	-£350	-£350
Total cost	£763	£763	£763
Carbon dioxide emissions	2.4 tonnes	2.4 tonnes	2.4 tonnes
Primary energy	57 kWh/m^2	57 kWh/m^2	57 kWh/m^2