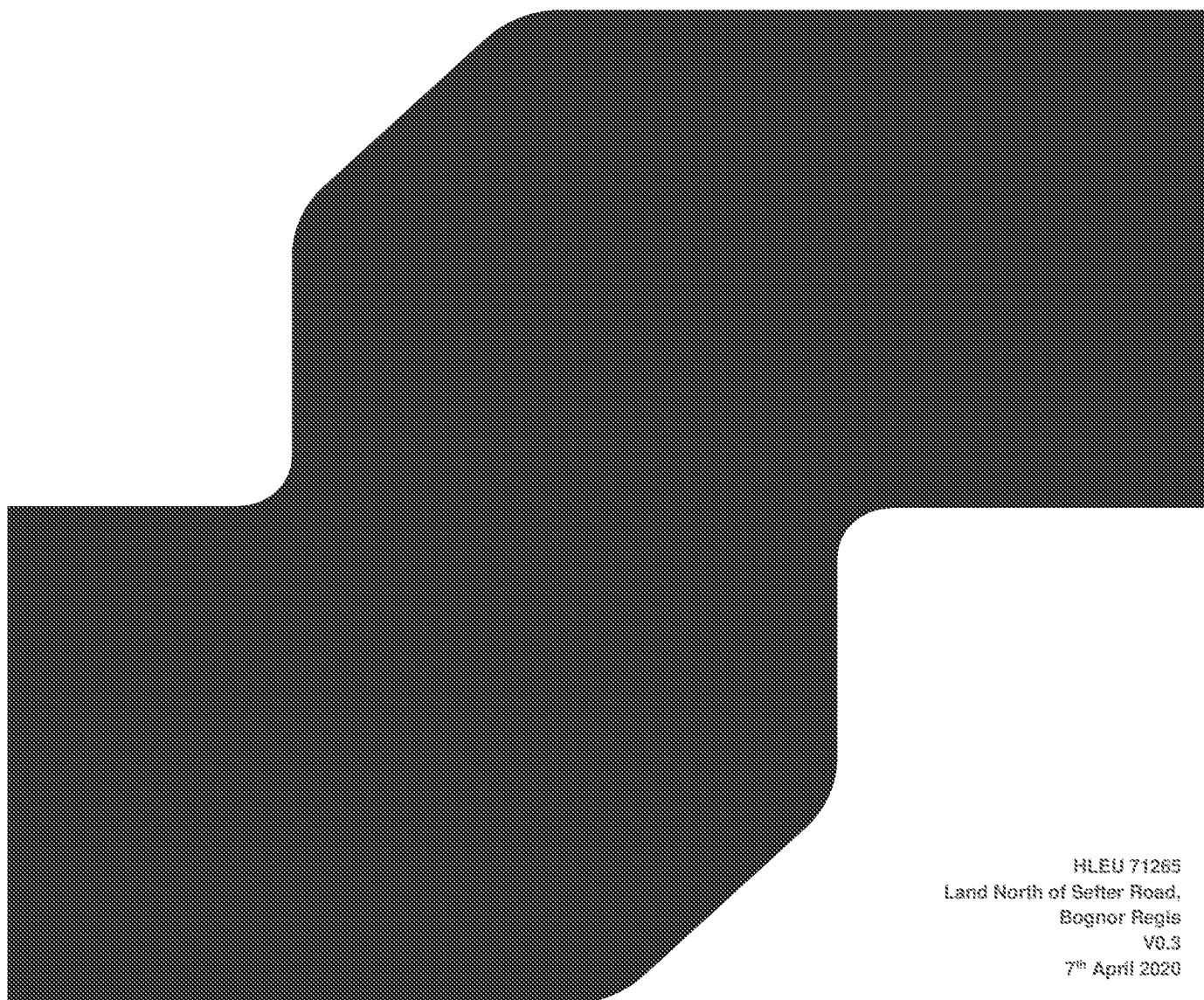


LAND NORTH OF SEFTER ROAD, BOGNOR REGIS

Energy Report



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ENERGY REPORT

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EXECUTIVE SUMMARY

An Energy Strategy has been carried out for the proposed development at Land North of Sefter Road, Bognor Regis. The proposed development includes the creation of 280 dwellings of which 196 dwellings are private housing and 84 dwellings are affordable housing.

The proposed development consists of the construction of 235 houses and 45 flats.

This report establishes how the site will achieve compliance with Condition 28 (Application Ref: P/134/16/OUT), that 10% of the energy demand to be provided by renewable energy technology(ies).

This has been achieved by following best practice procedures of the London Plan's Energy Hierarchy: be lean (improved building performance); be clean (centralised heating and cooling systems); and be green (use of low or zero carbon technologies).

Reducing carbon dioxide emissions through lean measures

To maximise the energy efficiency of the development and thus reduce the energy demands, the following design principles and features have been incorporated:

- Building fabric elements and glazing specifications significantly improved to the Building Regulation requirements.
- Reduced air permeability compared to maximum required standards.
- Specification of efficient heating services and control systems.
- Energy efficient lighting through the development.

It was identified through the modelling undertaken, that the development can reduce its CO₂ by 1.18% When compared to the Notional building.

Reducing carbon dioxide emissions through clean measures

The inclusion of a site wide heating system was investigated. However, there are no existing district heating network in the area. In addition, the new Carbon factor encourages new development to move away from gas CHP. The thermal energy demand of this scheme will therefore be provided by energy efficient boilers, and as such district heating option has not been considered as viable.

Reducing carbon dioxide emissions through green measures

A low or zero carbon (LZC) technology feasibility study was completed as part of this Energy Strategy which compared the feasibility of different technologies based on the energy demand of the development. Based on this, it was identified that the most appropriate technology to meet its sustainability and energy targets, is the installation of 220 kWp of PV panels. This amount of PV panels will provide approximately 190,000 kWh of electricity for the development, which is slightly over 10% of the total energy demand.

Based on the robust approach to the energy hierarchy, the development has met the required sustainability and energy targets. The proposed strategy achieves a site wide total reduction of the regulated carbon dioxide emissions of 23.04% over Part L1A Building Regulations 2013.

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Table 1 illustrates the reductions in CO₂ emissions for the proposed development including both regulated and unregulated emissions. Regulated emissions alone are covered by Part L; and include emissions associated with fixed components of the building (i.e. fixed lighting, ventilation, space heating and water heating). Unregulated emissions are not covered by Part L and include emissions associated with plug-in appliances (i.e. cooking and appliances, catering and computing).

	Carbon dioxide emissions for domestic buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	453,526	25
Be lean: After energy demand reduction	448,168	25
Be clean: N/A	448,168	25
Be green: After renewable energy	349,022	25

Table 1: Carbon dioxide emissions after each stage of the Energy Hierarchy for domestic buildings

In Table 2 the carbon dioxide savings after each step of the energy hierarchy are presented. The savings in absolute values are calculated, for each tier, from the previous stage of the energy hierarchy. However, all savings in percentages (%) are reported against the baseline carbon emissions in order to evaluate the percentage saving against the baseline.

	Regulated domestic carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: Savings from energy demand reduction	5.358	1.18
Be clean: Savings from heat network	0	0
Be green: Savings from renewable energy	99.146	22.12
Cumulative on-site savings	105.504	23.04

Table 2: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings

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Appendix A Analysis of Low and Zero Carbon Technologies

Appendix B SAMPLE SAP Reports

1 INTRODUCTION

- 1.1.1 RPS Consulting Services Ltd (RPS) was commissioned by *Taylor Wimpey UK Ltd* to undertake an Energy Strategy and produce a statement for a proposed development at Land North of Sefter Road, Bognor Regis. This report seeks to discharge planning condition 28 pursuant to Outline planning permission ref: P/134/16/OUT.
- 1.1.2 This report outlines the scheme and current planning context and assesses likely energy demands of the development prior to consideration of low and zero carbon technology options. The report concludes with the proposed energy strategy.
- 1.1.3 This Energy Report comprises:
- The scheme overview.
 - A review of the planning context.
 - An energy assessment of the project, following the energy hierarchy.
 - A presentation of results and recommendations.

1.2 Scheme Overview

- 1.2.1 A residential development comprising 280 dwellings (including affordable homes) is proposed for the site. The proposed development consists of the construction of 235 houses and 45 flats.

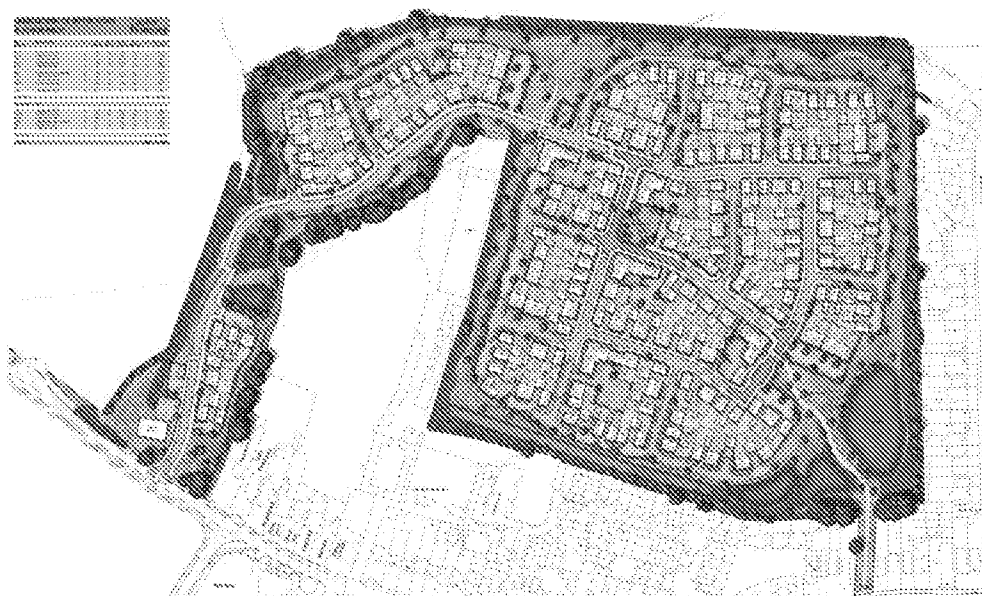


Figure 1. Planning Layout

- 1.2.2 The report has been written in accordance with the planning requirements of an Energy Strategy. A summary of the policy requirements relevant to energy consumption within the development are provided in Section 2 of the report.

- 1.2.3 The method preferred by Arun District Council towards the site wide energy strategy is the adoption of a hierarchical approach which ensures that the energy requirements and associated emissions are reduced as far as possible before applying renewable energy options. Sections 3 of this report detail the steps taken to follow the energy hierarchy (be lean, be clean, be green). Section 4 details how the different measures implemented have followed best practice principles to mitigate overheating. A summary of findings and a suggested approach for the development is presented in Section 5.

2 REGULATIONS & POLICIES

- 2.1.1 The relevant authority for this site is Arun District Council. The requirements of this Council and other relevant planning authorities have been taken into account within this feasibility study. The key policy framework applicable to the energy aspects of the development is outlined below.

2.2 National Level Policies

National Planning Policy Framework

- 2.2.1 The National Planning Policy Framework (NPPF) was published in February 2019, and replaced earlier versions. The NPPF set out the Government's planning policies for England and how these are expected to be applied. The NPPF is designed to make the planning system less complex and more accessible; to protect the environment and promote sustainable growth. It provides a framework within which local people and their respective councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.
- 2.2.2 At the heart of the NPPF is a presumption in favour of sustainable development (paragraph 11). The three dimensions of sustainable development can be defined as the economic, social and environmental.
- 2.2.3 Plans should provide a framework for addressing housing needs and other economic, social and environmental priorities; and a platform for local people to shape their surroundings. Strategic policies should set out an overall strategy for the pattern, scale and quality of development.
- 2.2.4 The NPPF (paragraph 150) states that new development should be planned for in ways that avoid increased vulnerability to the range of impacts arising from climate change; and help to reduce greenhouse gas emissions. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.
- 2.2.5 The NPPF aims to strengthen local decision making, with the use of decision-taking in a positive way, as a means of fostering the delivery of sustainable development.
- 2.2.6 Finally, the NPPF (paragraph 16) also highlights that plans should be prepared with the objective of contributing to the achievement of sustainable development and in a way that is aspirational but deliverable.

Arun Local Plan Policy ECC SP2

Policy ECC SP2

Energy and climate change mitigation

All new residential and commercial development (including conversions, extensions and changes of use) will be expected to be energy efficient and to demonstrate how they will:

- a. Achieve energy efficiency measures that reflect the current standards applicable at the time of submission;
- b. Use design and layout to promote energy efficiency; and
- c. Incorporate decentralised, renewable and low carbon energy supply systems, for example small scale renewable energy systems such as solar panels.

All major developments⁽⁴⁷⁾ must produce 10% of the total predicted energy requirements from renewable or low carbon energy generation on site, unless it can be demonstrated that this is unviable. Energy efficiency measures will be taken into consideration when the total predicted energy requirements are calculated. The Council will consider 'allowable solutions' where it is clearly demonstrated that the provision of on site renewable or low carbon energy generation is unviable or not feasible.

Where planning permission is required to retrofit energy efficiency measures into existing development, schemes will be permitted, subject to the Design and Built Heritage policies.

In assessing the achievement of these standards the Council will consider:

- Site constraints;
- Technical viability;
- Financial viability; and
- Delivery of additional benefits.

Building Regulations Part L

- 2.2.7 Building Regulations are statutory instruments that seek to ensure that the policies set out within any relevant UK legislation are carried out. Building regulations approval is required for the majority of building work carried out in the United Kingdom.
- 2.2.8 Part L of these regulations covers the requirements with respect to the conservation of fuel and power in all building types. It controls the insulation values of building fabric elements and openings, the air permeability of the structure, the heating efficiency of heating, ventilation and air conditioning systems together with hot water storage and lighting efficiency. It also sets out the requirements for calculating the carbon dioxide emissions and the Carbon Emission Targets for each building type.
- 2.2.9 Part L 2013 is split into four sections:
 - L1A New Dwellings.

- L1B Existing Dwellings.
- L2A New Buildings other than Dwellings.
- L2B Existing Buildings other than Dwellings.

2.2.10 This development needs to comply with Part L1A New Dwellings.

2.3 Planning Condition 28

2.3.1 Before development commences a scheme identifying the principles to be incorporated into detailed building design as the means of energy conservation, together with on-site energy renewable devices, shall be submitted to and agreed with the Local Planning Authority. Such scheme as is submitted shall seek as a target the provision of on-site renewable energy which will generate an estimated 10% of annual energy requirements of the buildings granted planning permission. In determining the provision of on-site energy generation account will be taken of the impact on the viability of the development. Such scheme as is approved will be implemented in accordance with the scheme.

Reason: In accordance with Policy ECC SP2 of the Arun Local Plan. It is considered necessary for this be a pre-commencement condition as sustainability goes to the heart of the approval.

2.4 Policy summary

2.4.1 In conclusion, compliance with a number of national, regional and local policy standards is required for the proposed domestic buildings. These are presented in Table 3.

Table 3. Summary of applicable policies

Policy Level	Standard	Buildings
National Policies	National Planning Policy Framework	All buildings
	Building Regulations Part L1A	New Dwellings
Local Policies	Arun Local Plan Policy ECC SP2	Development

2.4.2 The Standard Assessment Procedure (SAP) is the Government's recommended system for the energy rating of residential dwellings. It is a tool which enables qualified energy assessors to calculate the energy demand and the CO₂ emissions of a dwelling. The energy demand calculated using the SAP methodology is relative to the Regulated Emissions which include the energy consumed to power space heating, domestic hot water, ventilation and internal lighting

systems. The unregulated emissions (i.e. cooking and appliances) are calculated using BREDEM (BRE Domestic Energy Model).

- 2.4.3 The proposed energy strategy approach is based on a recognised structure of reduction in carbon dioxide emissions through:
1. Reducing the building energy consumption (Be Lean) by optimising the design and construction of the building to ensure less energy is required.
 2. Supplying the energy required in an efficient manner (Be Clean).
 3. Supplying the energy from Low Zero Carbon and Renewable Energy Sources (Be Green).

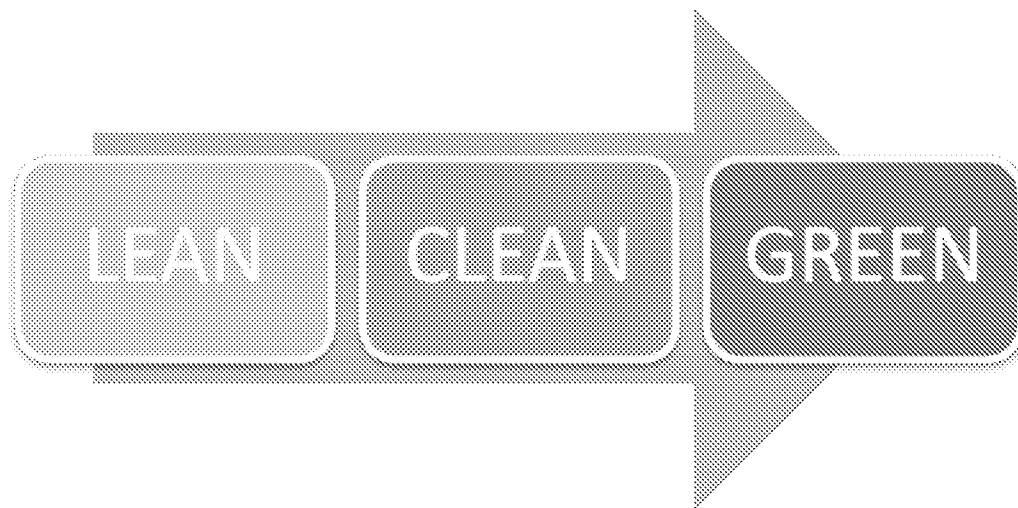


Figure 2. The three stages of the Energy Hierarchy

- 2.4.4 Overall, it becomes more expensive to implement both carbon reduction and sustainability measures the further along the design process, as the opportunities available diminish. This highlights the importance of early consideration of these measures within the design process.

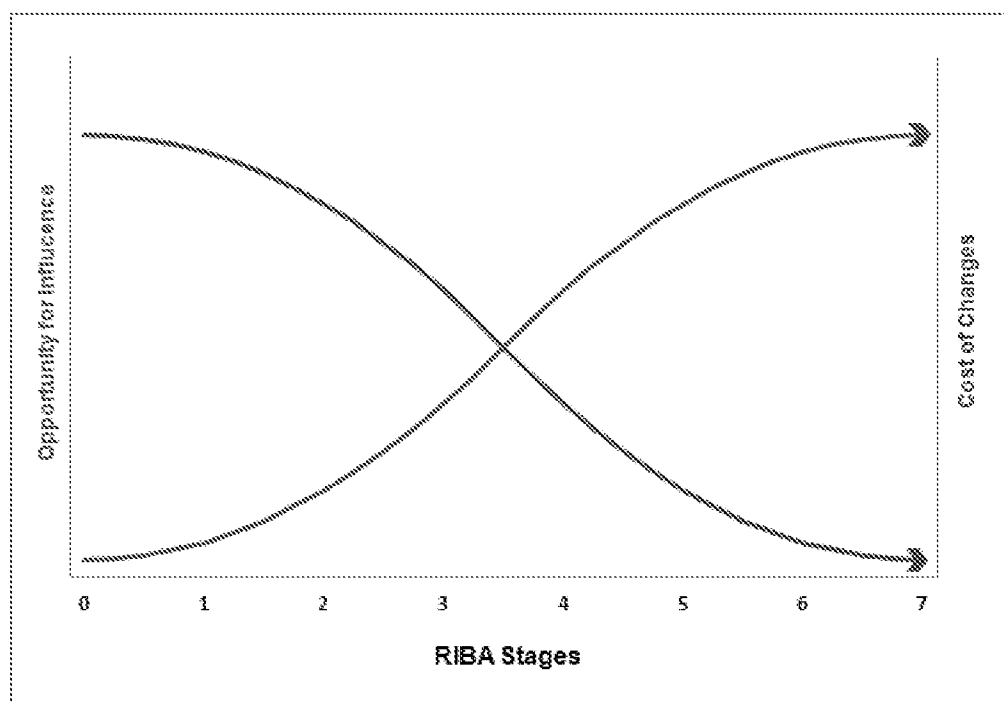


Figure 3. Opportunities to reduce CO2 emissions and associated cost during the construction phases

- 2.4.5 A passive, well insulated envelope will last for the life of the building; with this being difficult to upgrade once building work is complete. The services installed within the building have a shorter life span and can be replaced or upgraded at a later date, when their lifetime will have expired and new more efficient services will be available. Once the most efficient building envelope and services are provided, the installation of Low and Zero Carbon technologies should be considered.

2.5 Baseline scenario

- 2.5.1 In order to establish the baseline carbon dioxide emissions for the proposed development, the Government-approved software SAP2012 was used to model the dwellings.
- 2.5.2 The baseline scenario assumes the minimum values required to meet Building Regulation 2013 Part L1A. When determining this baseline, it is assumed that the heating would be provided by gas boilers and that any active cooling would be provided by electrically powered equipment, in accordance to GLA's Guidance.
- 2.5.3 The results of the SAP 2012 calculations should be compared with the new Carbon factor for electricity.

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- 2.5.4 The modelling undertaken identified the total CO₂ emissions across the site as 478.526 tn p.a. This is broken down to 453.526 tnCO₂/yr. from regulated emissions (covered by Building Regulations) and 25 tnCO₂/yr. from unregulated emissions (cooking and other plug-in appliances). A breakdown of the carbon dioxide emissions per energy use is presented in Table 4.

Table 4. Baseline CO₂ emissions per energy use for domestic buildings

Baseline CO₂ emissions for domestic buildings	
	Total CO₂ (Tonnes CO₂/year)
Heating	238.155
Auxiliary	10.899
Lighting	55.921
Domestic Hot Water	148.551
Cooling	0
Total (regulated)	453.526
Unregulated	25
Total	478.526

2.6 Energy Saving Measures (Lean)

- 2.6.1 Energy demand reduction within the building can be utilised to improve compliance with Part L1A/ L2A 2013. This development has been reviewed to maximise both passive and active design measures to reduce the energy demand within the building.
- 2.6.2 The site location and weather were accounted for in the energy modelling using the local weather file, in accordance to Part L Building Regulations. The site is not deemed to be located in an area with characteristics of a microclimate that would deviate from the local weather file.
- 2.6.3 The building layout and orientation has been set to avoid having any occupied spaces facing north by the architect. In order to maximise solar gains in the winter to reduce heating and lighting load requirements all occupied spaces (i.e. offices) face east, south or west.

Building Fabric

- 2.6.4 To reduce the CO₂ emissions of the development, it is important to minimise the heat losses through the building fabric. In order to achieve this, U-values for all building fabric elements and openings have been specified to exceed the levels required by Building Regulations. In addition, heat losses from infiltration have been minimised and a low air permeability target has been set. The details of these measures are summarised in Table 5.

Table 5. Passive design and fabric values

Element	Proposed values(W/m ² K)	Maximum values under Part L1A 2013(W/m ² K)
Roof	0.10 W/m ² K	0.20 W/m ² K
External wall	0.17 W/m ² K	0.30 W/m ² K
Party walls (between dwellings and unheated areas)	0.17 W/m ² K	0.30 W/m ² K
Party walls (between dwellings)	0.00 W/m ² K	0.20 W/m ² K
Exposed floor	0.12 W/m ² K	0.25 W/m ² K
Windows	1.40 W/m ² K	2.00 W/m ² K
Personnel doors	1.1 W/m ² K	2.00 W/m ² K
Air permeability	5 m ³ /hm ² @50Pa	10 m ³ /hm ² @50Pa

- 2.6.5 The source of natural daylight has been efficiently incorporated into the development by ensuring the occupied areas are south facing where possible to maximise the use of natural daylight and reduce reliance on artificial lighting.
- 2.6.6 The high standard of specification for the building fabric has been used to provide passive energy saving solutions that significantly exceed the Building Regulation requirements. The thermal mass that the lightweight building frame provides is considered appropriate to the building use, due to the majority of the internal area being untreated.

Building Services

- 2.6.7 In addition to upgrading the insulation standards, it is important that the energy used within the building is used efficiently. Therefore, the building systems have been designed to optimise the efficiency of the systems by matching installed capacity to anticipated building demand. Items

of equipment, which make up the building's mechanical building services installation, will be specified to achieve high annual energy efficiency in operation and will be regularly serviced to maintain their performance. Please note that all systems have efficiencies and controls which will meet or exceed the requirements of Part L1A:2013 Domestic Building Services Compliance Guide.

Table 6. Summary of proposed building services and energy efficiency standards in Part L1A and L1A 2013

Building Services	Residential units
Space heating systems	Proposed values
Communal Gas Boilers	94.3%
Domestic hot water systems	
Communal Gas Boilers	94.3%
Distribution systems	
Radiators	
Internal lighting systems	
Luminous efficacy – lumens per circuit watt	> 45 lm/W

Space heating within the building will be provided by an energy efficient (94.3%) communal gas boilers with a very efficient heating control system (time and temperature control) for all dwellings/ building. In addition, the inclusion of smart meters in the development is proposed, to support the growth of demand side response. This will help enhance understanding of the potential for turning off non-essential equipment or running some equipment at a lower capacity during times of peak demand.

- 2.6.8 Domestic hot water for the entire building will be generated by the main heating system.
- 2.6.9 Electrical lighting also represents a significant energy use within a building. To maximise energy savings the installation of low energy lighting (LED) across the development has been specified.
- 2.6.10 In addition to reducing the total energy consumption, it is equally important to be able to accurately measure the energy consumption and to allow for demand side response. Therefore, in accordance to Building Regulations Part L the following provisions have been made:

- At least 90% of the estimated annual energy consumption of each fuel, to be assigned to the various end use categories (heating, lighting etc). This will be completed in accordance to CIBSE TM39 Building Energy Metering.
 - The output of any renewable system to be separately monitored
 - In buildings with a total useful area greater than 1000m², automatic meter reading and data collection facilities will be provided.
- 2.6.11 From the modelling undertaken, the total site wide carbon dioxide emissions, after the inclusion of improved building fabric and systems (i.e. lean measures) are estimated as 448.168 tnCO₂/yr. This is presented in Table 7 and Table 8. This is a reduction of 5.358 tnCO₂/yr. compared to the baseline scenario, which equates to an overall saving of 1.18 % over the regulated emissions.

Table 7. CO₂ emissions after energy demand reduction for domestic buildings

CO ₂ emissions after energy demand reduction (Be Lean) for domestic buildings		
	Baseline Total CO ₂ (TonnesCO ₂ /year)	Be Lean Total CO ₂ (TonnesCO ₂ /year)
Heating	238.155	229.336
Auxiliary	10.899	10.889
Lighting	55.921	55.921
Domestic Hot Water	148.551	152.012
Cooling	0	0
Total (regulated)	453.526	448.168
Unregulated	25	25
Total	478.526	473.168

Table 8. Site wide regulated carbon dioxide emissions and savings

	Total regulated emissions (Tonnes CO ₂ /year)	CO ₂ Savings (Tonnes CO ₂ /year)	Percentage saving (%)
Part L 2013 baseline	453.526		
Be lean	448.168	5.358	1.18

2.7 Heating Infrastructure (Be Clean)

Connection to a decentralised energy network and the use of communal heating system is a recognised method of generating energy more efficiently. The inclusion of a site wide heating system was investigated. However, there are no existing district heating network in the area. In addition, the new Carbon factor encourages new development to move away from gas CHP. The thermal energy demand of this scheme will be provided by energy efficient boilers, and as such district heating option has not been considered as viable.

2.8 Low and Zero Carbon Technologies (Green)

- 2.8.1 This section discusses the feasibility of using low and zero carbon (LZC) technologies for the proposed scheme. Planning Condition 28 requires that an estimated 10% of annual energy requirements of the development is generated by on-site renewable energy. The integration of LZC technologies on site, the installation of solar thermal panels, photovoltaics, wind turbines, biomass and heat pumps were investigated for this development.

Table 9. Summary of LZC technologies

LZC Technology	CO ₂ savings	Capital cost	Considerations
Photovoltaic panels	Medium	Medium	Proposed. 10% of the total energy demand by PV panels
Solar thermal panels	Low	Medium	Not Recommended.
Air source heat pumps	Medium	Medium	Not Recommended. Not enough roof area. Noise issues.
Ground source heat pumps	Medium	High	Not feasible.
Wind turbines	Low	High	Not feasible
Biomass	High	High	Not feasible

- 2.8.2 These technologies meet all requirements as defined by Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources.

After taking into consideration a number of different factors, including local authority requirements, land use, potential noise impacts and available space within the development, it was concluded that the best strategy for this development is the installation of PV panels to provide 10% of the energy demand of the development.

- 2.8.3 Upon consideration of the LZC technology, the modelling identified that a further reduction of 99.146 tCO₂/yr. has been achieved for the regulated emissions. The total CO₂ emissions for the development after the incorporation of the LZC technologies are illustrated in 10 and Table 11. This equates to a 22.12% reduction in CO₂ over regulated emissions compared to the Notional building.

Table 10. CO2 emissions after LZC for domestic buildings

CO ₂ emissions after LZC Technologies (Be Green) for domestic buildings				
	Baseline Total CO ₂ (TonnesCO ₂ /year)	Be Lean Total CO ₂ (TonnesCO ₂ /year)	Be Clean Total CO ₂ (TonnesCO ₂ /year)	Be Green Total CO ₂ (TonnesCO ₂ /year)
Heating	238.155	229.336	229.336	229.336
Auxiliary	10.899	10.889	10.889	10.889
Lighting	55.921	55.921	55.921	55.921
Domestic Hot Water	148.551	152.012	152.012	152.012
PV Panels	0	0	0	-99.146
Total (regulated)	453.526	448.168	448.168	349.022
Unregulated	25	25	25	25
Total	478.526	473.168	473.168	374.022

Table 11. Site wide regulated carbon dioxide emissions and savings

	Total regulated emissions (Tonnes CO ₂ /year)	CO ₂ Savings (Tonnes CO ₂ /year)	Percentage saving (%)
Part L 2013 baseline	453.526		
Be lean	448.168	5.358	1.18
Be clean	448.168	N/A	0
Be green	349.022	99.146	22.12
Overall Savings		104.504	23.04

3 CONCLUSIONS

- 3.1.1 This energy strategy has been produced in line with the energy hierarchy. Carbon dioxide emission savings have been achieved through the following step process. The specified 'Be Lean' measures include improved building fabric and high specification systems. Moreover, 'Be Green' measures on site include the installation of PV panels on site to provide 10% of the energy demand of the development.
- 3.1.2 In conclusion, based on the measures outlined in the report, the development achieves both its sustainability and energy targets. The proposed strategy includes high insulation standards, very efficient building services, and installation of Photovoltaic panels. It has been confirmed that an 23.04% of the total CO₂ emissions reduction of this development will be achieved by the incorporation of a low or zero carbon technology onsite, and thereby exceeding the planning permission requirement that 10% of the energy demand to be provided by PV panels.
- 3.1.3 The reduction in total carbon dioxide emissions and savings at each stage of the Energy Hierarchy process are provided in Tables 10 and 11.

Appendix A

Analysis of Low and Zero Carbon Technologies

Solar Thermal

Solar thermal generates energy for the provision of domestic hot water; this system typically works in tandem with a conventional boiler in the event that the hot water demand cannot be solely met by the renewable technology. The two types of solar thermal technology suitable for inclusion are flat plate collectors and evacuated tubes; with the latter typically being more efficient. The panels are most efficient when they face south at 30°.

Solar thermal is mostly suited to houses. Providing solar panels and associated pipework to each flat within the main block would not be a practical approach. For non-residential buildings, they should only be considered for buildings with high hot water demand, like hotels and gyms.

Wind Turbines

Wind technology is now a well-established technology for the generation of electricity in large scale projects. Small scale wind projects within built up areas however is less common.

The lower uptake of wind turbines in urban settings is due to the reduced efficiency of smaller scale turbines as a result of the high surface roughness reducing wind speeds. Furthermore, it is likely that the surrounding buildings will create turbulence and locally reduce near surface wind speeds thus further reducing the potential of good wind speeds. In addition, wind turbines integrated on buildings might cause other problems, like vibrations.

Photovoltaic panels

The photovoltaic panel converts free solar energy directly into electricity. The electricity produced is on direct current (DC). Therefore, inverters are used to convert the output into alternating current (AC) for connection to the building's supply board. The electricity generated can either be used to supply communal (landlord) areas or for individual dwellings, the latter configuration tending to be more complex and costly owing to the need for multiple meters.

The panels are most efficient when they face south at 30°. Photovoltaic panels should not be considered in cases with significant overshadow (i.e. next to taller buildings).

Heat Pumps

A heat pump is a machine that moves heat from one location (the 'source') at a lower temperature to another location (the 'sink' or 'heat sink') at a higher temperature using mechanical work or a high-temperature heat source. There are two main categories of heat pumps, the Ground Source Heat Pump (GSHP) and the Air Source Heat Pump (ASHP). They operate very similarly; the difference is on the source of the heat.

Several options are possible for a GSHP, depending on local geology and hydrology. Various types of ground source heat pump arrangements are available including: vertical boreholes, horizontal coils and slinky coils, e.g. around perimeter of building.

The ASHP is an alternative system of the GSHP but they operate with the same physics. Their only difference is that the ASHP uses the ambient outdoor air to provide the low-grade source heat instead of the ground. Owing to the greater seasonal variation in air temperatures, air-source heat pumps are unable to provide year-round heating requirements alone; hence they operate less efficiently, the running costs are higher and CO₂ savings lower than for a ground source heat pump.

The main advantage of a heat pump over a conventional heating system is that very high efficiencies can be achieved; typically, up to around 350-400% compared to 90% for a modern gas boiler.

Biomass

Biomass is a term used to describe all plant and animal material. A range of biomass material can be burnt to generate energy including wood, straw, poultry litter and energy crops such as willow or poplar. Biomass material is considered carbon neutral if the fuel comes from a sustainably managed source.

The primary disadvantage for any biomass installation is that it requires large amounts of fuel storage (which will need to be fed by deliveries of biomass fuel). Developments that use biomass need to secure constant delivery of wood chips or wood pellets, from a local supplier. Finally, biomass requires a suitable flue design to address air quality issues.

LZC technology	Basic Technical Information	Technical, Environmental and Economic implications/considerations	Suited Application	Site specific comment	Further analysis
Solar thermal	Solar collectors (flat plate or tube) transfer energy into liquid to a closed loop twin coil hot water cylinder	+ Government grants available (RHIs) + Can meet a significant proportion of the DHW demand - Efficiency effected by site factors shading, orientation and roof/ground space - Requires considerable hot water demand all year round to be financially beneficial	Domestic and commercial applications with high annual hot water load; leisure centers, canteens, washrooms		NO
Wind turbine	Turbine/generator converts wind energy to electrical power.	+ Allows on site generation of renewable electricity - Can create structural, vibrations and noise implications - Not suited for urban environments - Electricity generation varies due to wind speed - Generally payback over 20 years	Large sized turbines in non-urban or offshore locations		NO

ENERGY REPORT

Photovoltaic	Converts sunlight to electrical power.	+ Allows on site generation of renewable electricity + Generally payback between 7-12 years + Low maintenance requirements - Efficiency effected by site factors – shading, orientation and roof/ground space	Applicable to all buildings with limited solar shading and available roof	YES
Air source heat pump (ASHP)	ASHP capture heat from the outside air and transfer the heat directly to the air inside the building or transferring the heat to a liquid medium that can be pumped around the building.	+ Lower installation cost that ground source heat pump + Can provide heating and cooling + Government grants available (RHIs) - COP is lower during the heating season - Can restrict distribution strategies	Wide range of building types particularly buildings designed to have low temperature heat emitters. Combines well with cooling systems	NO
Ground source heat pump (GSHP)	GSHP capture heat from the ground and transfer the heat to a liquid medium that can be pumped around the building.	+ More heat is supplied to the building than energy is consumed by the heat pump + COP is much better than air source heat pumps + Government grants available (RHIs) - Requires area for ground collector or borehole - High initial capital cost - Can restrict distribution strategies - Subject to soil conditions	Wide range of building types particularly buildings designed to have low temperature heat emitters and sufficient space for necessary ground works	NO
Biomass	Uses biomass as a fuel source for space heating and hot water.	+ Government grants available (RHIs) + Renewable source of heating - Requires large fuel storage capacity - Generally a large capital cost - Potential issue with air quality especially in urban areas	Building/site with sufficient access and storage facilities. Local supply of fuel	NO

Table A1: LZC Technologies Matrix

Appendix B

SAMPLE SAP Reports

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.25

Property Address: 1BF (S) GF

Address : 1BF (S) GF, Land North of Sefter Road, Bognor Regis, PO21 3FF

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52.6 (1a)	2.85 (2a)	149.91 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	149.91 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.13 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)

Additional infiltration

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0

If no draught lobby, enter 0.05, else enter 0

Percentage of windows and doors draught stripped

Window infiltration

$$0.25 - [0.2 \times (14) \div 100] =$$

Infiltration rate

$$(8) + (10) + (11) + (12) + (13) + (15) =$$

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area

If based on air permeability value, then (18) = [(17) + 20] ÷ (8), otherwise (18) = (16)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered

Shelter factor

$$(20) = 1 - [0.075 \times (19)] =$$

Infiltration rate incorporating shelter factor

$$(21) = (18) \times (20) =$$

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

SAP WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.36	0.35	0.35	0.31	0.3	0.27	0.27	0.26	0.28	0.3	0.32	0.33
------	------	------	------	-----	------	------	------	------	-----	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.57 0.56 0.56 0.55 0.55 0.54 0.54 0.53 0.54 0.55 0.55 0.56 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.57 0.56 0.56 0.55 0.55 0.54 0.54 0.53 0.54 0.55 0.55 0.56 (25)

3. Building fabric and openings calculator

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A x U (W/K)	k-value kJ/m²·K	A X k
Doors			1.96	1.1	2.156		(26)
Windows Type 1			1.82	1/[1/(1.2) + 0.04]	2.08		(27)
Windows Type 2			0.67	1/[1/(1.2) + 0.04]	0.77		(27)
Windows Type 3			1.27	1/[1/(1.2) + 0.04]	1.45		(27)
Windows Type 4			3.99	1/[1/(1.2) + 0.04]	4.57		(27)
Windows Type 5			1.82	1/[1/(1.2) + 0.04]	2.08		(27)
Floor			52.6	0.11	5.786		(28)
Walls Type1	58.34	11.39	46.95	0.17	7.98		(29)
Walls Type2	4.28	1.96	2.32	0.16	0.37		(29)
Total area of elements, m²			115.22				(31)
Party wall			21.75	0	0		(32)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)

{(26) ... (30) + (32) = 29.33 (33)

Heat capacity Cm = S(A x k)

{(28) ... (30) + (32) + (32a) ... (32e) = 11134.7 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K

Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K

9.95 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss

{(33) + (36) = 39.28 (37)

SAP WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly

$$(38)m = 0.33 \times (25)m \times (5)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.96	27.84	27.72	27.14	27.03	26.53	26.53	26.44	26.72	27.03	27.25	27.48	(38)

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	67.25	67.12	67	66.42	66.31	65.81	65.81	65.72	66	66.31	66.53	66.76	
Average = Sum(39) _{1..12} / 12 =												66.42	(39)

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.28	1.28	1.27	1.26	1.26	1.25	1.25	1.25	1.25	1.26	1.26	1.27	
Average = Sum(40) _{1..12} / 12 =												1.26	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement (kWh/year)

Assumed occupancy, N

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

	1.77	(42)
--	------	------

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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=	83.78	80.73	77.68	74.64	71.59	68.54	68.54	71.59	74.64	77.68	80.73	83.78	
Total = Sum(44) _{1..12} =												913.93	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	124.24	108.66	112.13	97.76	93.8	80.94	75	86.07	87.1	101.5	110.8	120.32	
Total = Sum(45) _{1..12} =												1198.31	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	18.64	16.3	16.82	14.66	14.07	12.14	11.25	12.91	13.06	15.23	16.62	18.05	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel	0	(47)
---	---	------

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	0	(48)
---	---	------

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

110

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0.02

(51)

If community heating see section 4.3

Volume factor from Table 2a

1.03

(52)

Temperature factor from Table 2b

0.6

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

1.03

(54)

Enter (50) or (54) in (55)

1.03

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	179.52	158.59	167.4	151.25	149.08	134.43	130.28	141.34	140.59	156.78	164.29	175.6	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	179.52	158.59	167.4	151.25	149.08	134.43	130.28	141.34	140.59	156.78	164.29	175.6	
Output from water heater (annual) × 1.12												1849.15	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m + 0.8 × [(46)m + (57)m + (59)m]]

(65)m=	85.53	76.07	81.5	75.3	75.41	69.71	69.16	72.84	71.75	77.97	79.63	84.23	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	106.01	106.01	106.01	106.01	106.01	106.01	106.01	106.01	106.01	106.01	106.01	106.01	(66)

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

(67)m=	34.35	30.51	24.81	18.79	14.04	11.85	12.81	16.65	22.35	28.38	33.12	35.31	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	229.82	232.21	226.2	213.4	197.25	182.08	171.93	169.55	175.56	188.35	204.5	219.68	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

(69)m=	47.37	47.37	47.37	47.37	47.37	47.37	47.37	47.37	47.37	47.37	47.37	47.37	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	114.96	113.2	109.55	104.58	101.36	96.82	92.96	97.9	99.66	104.8	110.6	113.21	(72)
--------	--------	-------	--------	--------	--------	-------	-------	------	-------	-------	-------	--------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	461.84	458.62	443.26	419.47	395.36	373.45	360.4	366.81	380.27	404.23	430.93	450.9	(73)
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6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m ²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
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North	0.9x	0.77	x	3.99	x	10.63	x	0.63	x	0.7	=	12.97	(74)
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91	(74)
North	0.9x	0.77	x	3.99	x	20.32	x	0.63	x	0.7	=	24.78	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	3.99	x	34.53	x	0.63	x	0.7	=	42.11	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	3.99	x	55.46	x	0.63	x	0.7	=	67.63	(74)
North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)
North	0.9x	0.77	x	3.99	x	74.72	x	0.63	x	0.7	=	91.11	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	3.99	x	79.99	x	0.63	x	0.7	=	97.53	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	3.99	x	74.68	x	0.63	x	0.7	=	91.06	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	3.99	x	59.25	x	0.63	x	0.7	=	72.24	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	3.99	x	41.52	x	0.63	x	0.7	=	50.63	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	3.99	x	24.19	x	0.63	x	0.7	=	29.5	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	3.99	x	13.12	x	0.63	x	0.7	=	16	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	3.99	x	8.86	x	0.63	x	0.7	=	10.81	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
East	0.9x	0.77	x	1.82	x	19.64	x	0.63	x	0.7	=	21.85	(76)
East	0.9x	0.77	x	1.82	x	38.42	x	0.63	x	0.7	=	42.74	(76)
East	0.9x	0.77	x	1.82	x	63.27	x	0.63	x	0.7	=	70.39	(76)
East	0.9x	0.77	x	1.82	x	92.28	x	0.63	x	0.7	=	102.66	(76)
East	0.9x	0.77	x	1.82	x	113.09	x	0.63	x	0.7	=	125.81	(76)
East	0.9x	0.77	x	1.82	x	115.77	x	0.63	x	0.7	=	128.79	(76)
East	0.9x	0.77	x	1.82	x	110.22	x	0.63	x	0.7	=	122.61	(76)
East	0.9x	0.77	x	1.82	x	94.68	x	0.63	x	0.7	=	105.32	(76)
East	0.9x	0.77	x	1.82	x	73.59	x	0.63	x	0.7	=	81.86	(76)
East	0.9x	0.77	x	1.82	x	45.59	x	0.63	x	0.7	=	50.71	(76)
East	0.9x	0.77	x	1.82	x	24.49	x	0.63	x	0.7	=	27.24	(76)
East	0.9x	0.77	x	1.82	x	16.15	x	0.63	x	0.7	=	17.97	(76)
South	0.9x	0.77	x	0.67	x	46.75	x	0.63	x	0.7	=	9.57	(78)
South	0.9x	0.77	x	1.27	x	46.75	x	0.63	x	0.7	=	18.15	(78)
South	0.9x	0.77	x	0.67	x	76.57	x	0.63	x	0.7	=	15.68	(78)
South	0.9x	0.77	x	1.27	x	76.57	x	0.63	x	0.7	=	29.72	(78)
South	0.9x	0.77	x	0.67	x	97.53	x	0.63	x	0.7	=	19.97	(78)

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South	0.9x	0.77	x	1.27	x	97.53	x	0.63	x	0.7	=	37.86	(78)
South	0.9x	0.77	x	0.67	x	110.23	x	0.63	x	0.7	=	22.57	(78)
South	0.9x	0.77	x	1.27	x	110.23	x	0.63	x	0.7	=	42.79	(78)
South	0.9x	0.77	x	0.67	x	114.87	x	0.63	x	0.7	=	23.52	(78)
South	0.9x	0.77	x	1.27	x	114.87	x	0.63	x	0.7	=	44.58	(78)
South	0.9x	0.77	x	0.67	x	110.55	x	0.63	x	0.7	=	22.64	(78)
South	0.9x	0.77	x	1.27	x	110.55	x	0.63	x	0.7	=	42.91	(78)
South	0.9x	0.77	x	0.67	x	108.01	x	0.63	x	0.7	=	22.12	(78)
South	0.9x	0.77	x	1.27	x	108.01	x	0.63	x	0.7	=	41.92	(78)
South	0.9x	0.77	x	0.67	x	104.89	x	0.63	x	0.7	=	21.48	(78)
South	0.9x	0.77	x	1.27	x	104.89	x	0.63	x	0.7	=	40.71	(78)
South	0.9x	0.77	x	0.67	x	101.89	x	0.63	x	0.7	=	20.86	(78)
South	0.9x	0.77	x	1.27	x	101.89	x	0.63	x	0.7	=	39.54	(78)
South	0.9x	0.77	x	0.67	x	82.59	x	0.63	x	0.7	=	16.91	(78)
South	0.9x	0.77	x	1.27	x	82.59	x	0.63	x	0.7	=	32.05	(78)
South	0.9x	0.77	x	0.67	x	55.42	x	0.63	x	0.7	=	11.35	(78)
South	0.9x	0.77	x	1.27	x	55.42	x	0.63	x	0.7	=	21.51	(78)
South	0.9x	0.77	x	0.67	x	40.4	x	0.63	x	0.7	=	8.27	(78)
South	0.9x	0.77	x	1.27	x	40.4	x	0.63	x	0.7	=	15.68	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	68.45	124.22	189.53	266.5	326.38	326.35	313.25	272.71	215.99	142.63	83.39	57.66	(83)
--------	-------	--------	--------	-------	--------	--------	--------	--------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	530.29	532.84	632.79	685.97	721.94	709.8	679.85	639.51	596.26	546.86	514.32	508.56	(84)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.97	0.95	0.88	0.75	0.57	0.42	0.47	0.7	0.9	0.97	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.95	20.1	20.35	20.65	20.87	20.97	20.99	20.99	20.93	20.66	20.26	19.92	(87)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.87	19.88	19.88	19.88	19.88	19.87	19.87	19.87	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.98	0.96	0.93	0.85	0.69	0.48	0.32	0.36	0.61	0.87	0.96	0.98	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.51	18.73	19.08	19.49	19.76	19.86	19.88	19.88	19.83	19.51	18.96	18.47	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.21	19.4	19.7	20.06	20.3	20.4	20.42	20.42	20.37	20.07	19.59	19.17	(92)
--------	-------	------	------	-------	------	------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.21	19.4	19.7	20.06	20.3	20.4	20.42	20.42	20.37	20.07	19.59	19.17	(93)
--------	-------	------	------	-------	------	------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.97	0.96	0.93	0.85	0.72	0.52	0.37	0.41	0.65	0.88	0.96	0.98	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	516.76	559.76	587.82	585.69	516.42	372.14	250.1	261.84	387.62	478.82	491.89	497.51	(95)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]$

(97)m=	1002.86	973.29	884.39	741.18	570.46	382.02	251.59	264.28	413.69	628.13	831.02	999.67	(97)
--------	---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	361.66	277.89	220.65	111.95	40.21	0	0	0	0	111.09	244.18	373.61	
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1..12} =$ 1741.22 (98)

Space heating requirement in $kWh/m^2/year$

33.1 (99)

9. Energy requirements: Community heating system

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0 (301)

Fraction of space heat from community system $1 - (301) =$

1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers

1 (303a)

Fraction of total space heat from Community boilers

(302) $\times$ (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system

1 (305)

Distribution loss factor (Table 12c) for community heating system

1.05 (306)

Space heating

kWh/year

Annual space heating requirement

1741.22

Space heat from Community boilers

(98) $\times$ (304a) $\times$ (305) $\times$ (306) = 1828.28 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0 (308)

Space heating requirement from secondary/supplementary system

(98) $\times$ (301) $\times$ 100 $\div$ (308) = 0 (309)

Water heating

Annual water heating requirement

1849.15

If DHW from community scheme:

Water heat from Community boilers

(64) $\times$ (303a) $\times$ (305) $\times$ (306) = 1941.6 (310a)

Electricity used for heat distribution

$0.01 \times [(307a) \dots (307e) + (310a) \dots (310e)] =$ 37.7 (313)

Cooling System Energy Efficiency Ratio

0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0)

= (107) $\div$ (314) = 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):

mechanical ventilation - balanced, extract or positive input from outside

0 (330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	$= (330a) + (330b) + (330g) =$	0	(331)
Energy for lighting (calculated in Appendix L)		242.67	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-682.26	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

10b Fuel costs – Community heating scheme

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating from CHP	(307a) x	4.24	$\times 0.01 = 77.52$ (340a)
Water heating from CHP	(310a) x	4.24	$\times 0.01 = 82.32$ (342a)
Pumps and fans	(331)	13.19	$\times 0.01 = 0$ (349)
Energy for lighting	(332)	13.19	$\times 0.01 = 32.01$ (350)
Additional standing charges (Table 12)			120 (351)
Energy saving/generation technologies			
Total energy cost	$= (340a) + (342a) + (349) + (351) =$		311.85 (355)

11 SAP rating – Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	$[(355) \times (356)] \div [(4) + 45.0] =$	1.34	(357)
SAP rating (section 12)		81.28	(358)

12b CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		94.3 (367a)
CO2 associated with heat source 1	$[(307b) + (310b)] \times 100 \div (367b) \times$	0.22	$= 863.52$ (367)
Electrical energy for heat distribution	$[(313) \times$	0.52	$= 19.57$ (372)
Total CO2 associated with community systems	$(363) \dots (366) + (368) \dots (372)$		$= 883.08$ (373)
CO2 associated with space heating (secondary)	$(309) \times$	0	$= 0$ (374)
CO2 associated with water from immersion heater or instantaneous heater	$(312) \times$	0.22	$= 0$ (375)
Total CO2 associated with space and water heating	$(373) + (374) + (375) =$		883.08 (376)
CO2 associated with electricity for pumps and fans within dwelling	$(331) \times$	0.52	$= 0$ (378)
CO2 associated with electricity for lighting	$(332) \times$	0.52	$= 125.94$ (379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	$\times 0.01 = -354.09$ (380)
Total CO2, kg/year	sum of (376) ... (382) =		654.93 (383)

SAP WorkSheet: New dwelling design stage

Dwelling CO2 Emission Rate (383) ÷ (4) =

12.45 (384)

El rating (section 14)

91.01 (385)

3b Primary Energy – Community heating scheme

	Energy kWh/year	Primary factor	P.Energy kWh/year
Energy from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		94.3 (367a)
Energy associated with heat source 1	$[(307b) + (310b)] \times 100 \div (367b) \times$	1.22	4877.26 (367)
Electrical energy for heat distribution	$[(313) \times$		115.74 (372)
Total Energy associated with community systems	$(363) \dots (366) + (368) \dots (372)$		4993 (373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)			4993 (373)
Energy associated with space heating (secondary)	$(309) \times$	0	0 (374)
Energy associated with water from immersion heater or instantaneous heater	$(312) \times$	1.22	0 (375)
Total Energy associated with space and water heating	$(373) + (374) + (375) =$		4993 (376)
Energy associated with space cooling	$(315) \times$	3.07	0 (377)
Energy associated with electricity for pumps and fans within dwelling	$(331) \times$	3.07	0 (378)
Energy associated with electricity for lighting	$(332) \times$	3.07	744.98 (379)
Energy saving/generation technologies			
Item 1		3.07	-2094.34 (380)
Total Primary Energy, kWh/year	sum of (376) (382) =		3843.45 (383)

DER WorkSheet: New dwelling design stage

User Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.25

Property Address: 1BF (S) GF

Address : 1BF (S) GF, Land North of Sefter Road, Bognor Regis, PO21 3FF

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52.6 (1a)	2.85 (2a)	149.91 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	149.91 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.13 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.28 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 0 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 1 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.28 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.36	0.35	0.35	0.31	0.3	0.27	0.27	0.26	0.28	0.3	0.32	0.33
------	------	------	------	-----	------	------	------	------	-----	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.57 0.56 0.56 0.55 0.55 0.54 0.54 0.53 0.54 0.55 0.55 0.56 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.57 0.56 0.56 0.55 0.55 0.54 0.54 0.53 0.54 0.55 0.55 0.56 (25)

3. Building fabric and openings heat transfer

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A x U (W/K)	k-value kJ/m²·K	A X k
Doors			1.96	1.1	2.156		(26)
Windows Type 1			1.82	1/[1/(1.2) + 0.04]	2.08		(27)
Windows Type 2			0.67	1/[1/(1.2) + 0.04]	0.77		(27)
Windows Type 3			1.27	1/[1/(1.2) + 0.04]	1.45		(27)
Windows Type 4			3.99	1/[1/(1.2) + 0.04]	4.57		(27)
Windows Type 5			1.82	1/[1/(1.2) + 0.04]	2.08		(27)
Floor			52.6	0.11	5.786		(28)
Walls Type1	58.34	11.39	46.95	0.17	7.98		(29)
Walls Type2	4.28	1.96	2.32	0.16	0.37		(29)
Total area of elements, m²			115.22				(31)
Party wall			21.75	0	0		(32)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26) ... (30) + (32) = 29.33 (33)

Heat capacity Cm = S(A x k) ((28) ... (30) + (32) + (32a) ... (32e) = 11134.7 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 9.95 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 39.28 (37)

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Ventilation heat loss calculated monthly

$$(38)m = 0.33 \times (25)m \times (5)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	27.96	27.84	27.72	27.14	27.03	26.53	26.53	26.44	26.72	27.03	27.25	27.48	(38)

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	67.25	67.12	67	66.42	66.31	65.81	65.81	65.72	66	66.31	66.53	66.76	
Average = Sum(39) _{1..12} / 12 =												66.42	(39)

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.28	1.28	1.27	1.26	1.26	1.25	1.25	1.25	1.25	1.26	1.26	1.27	
Average = Sum(40) _{1..12} / 12 =												1.26	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N

$$\text{if TFA} > 13.9, N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$$

$$\text{if TFA} \leq 13.9, N = 1$$

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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=	83.78	80.73	77.68	74.64	71.59	68.54	68.54	71.59	74.64	77.68	80.73	83.78	
Total = Sum(44) _{1..12} =												913.93	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	124.24	108.66	112.13	97.76	93.8	80.94	75	86.07	87.1	101.5	110.8	120.32	
Total = Sum(45) _{1..12} =												1198.31	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	18.64	16.3	16.82	14.66	14.07	12.14	11.25	12.91	13.06	15.23	16.62	18.05	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

Temperature factor from Table 2b

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

If community heating see section 4.3

Volume factor from Table 2a

Temperature factor from Table 2b

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

Enter (50) or (54) in (55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

DER WorkSheet: New dwelling design stage

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	179.52	158.59	167.4	151.25	149.08	134.43	130.28	141.34	140.59	156.78	164.29	175.6	(62)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	179.52	158.59	167.4	151.25	149.08	134.43	130.28	141.34	140.59	156.78	164.29	175.6	
Output from water heater (annual) $\times 12$												1849.15	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m + 0.8 \times [(46)m + (57)m + (59)m]]$

(65)m=	85.53	76.07	81.5	75.3	75.41	69.71	69.16	72.84	71.75	77.97	79.63	84.23	(65)
--------	-------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (Table 5) Watts

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	(66)

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

(67)m=	13.74	12.2	9.93	7.51	5.62	4.74	5.12	6.66	8.94	11.35	13.25	14.12	(67)
--------	-------	------	------	------	------	------	------	------	------	-------	-------	-------	------

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

(68)m=	153.98	155.58	151.55	142.98	132.16	121.99	115.2	113.6	117.63	126.2	137.02	147.19	(68)
--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	-------	--------	--------	------

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

(69)m=	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	(71)
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Water heating gains (Table 5)

(72)m=	114.96	113.2	109.55	104.58	101.36	96.82	92.96	97.9	99.66	104.8	110.6	113.21	(72)
--------	--------	-------	--------	--------	--------	-------	-------	------	-------	-------	-------	--------	------

Total internal gains = $(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$

(73)m=	332.18	330.49	320.53	304.58	288.64	273.05	262.78	267.66	275.72	291.85	310.37	324.02	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m ²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
--------------	---------------------------	------------------------	------------------	----------------	----------------	--------------

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	3.99	x	10.63	x	0.63	x	0.7	=	12.97	(74)
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91	(74)
North	0.9x	0.77	x	3.99	x	20.32	x	0.63	x	0.7	=	24.78	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	3.99	x	34.53	x	0.63	x	0.7	=	42.11	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	3.99	x	55.46	x	0.63	x	0.7	=	67.63	(74)
North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)
North	0.9x	0.77	x	3.99	x	74.72	x	0.63	x	0.7	=	91.11	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	3.99	x	79.99	x	0.63	x	0.7	=	97.53	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	3.99	x	74.68	x	0.63	x	0.7	=	91.06	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	3.99	x	59.25	x	0.63	x	0.7	=	72.24	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	3.99	x	41.52	x	0.63	x	0.7	=	50.63	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	3.99	x	24.19	x	0.63	x	0.7	=	29.5	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	3.99	x	13.12	x	0.63	x	0.7	=	16	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	3.99	x	8.86	x	0.63	x	0.7	=	10.81	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
East	0.9x	0.77	x	1.82	x	19.64	x	0.63	x	0.7	=	21.85	(76)
East	0.9x	0.77	x	1.82	x	38.42	x	0.63	x	0.7	=	42.74	(76)
East	0.9x	0.77	x	1.82	x	63.27	x	0.63	x	0.7	=	70.39	(76)
East	0.9x	0.77	x	1.82	x	92.28	x	0.63	x	0.7	=	102.66	(76)
East	0.9x	0.77	x	1.82	x	113.09	x	0.63	x	0.7	=	125.81	(76)
East	0.9x	0.77	x	1.82	x	115.77	x	0.63	x	0.7	=	128.79	(76)
East	0.9x	0.77	x	1.82	x	110.22	x	0.63	x	0.7	=	122.61	(76)
East	0.9x	0.77	x	1.82	x	94.68	x	0.63	x	0.7	=	105.32	(76)
East	0.9x	0.77	x	1.82	x	73.59	x	0.63	x	0.7	=	81.86	(76)
East	0.9x	0.77	x	1.82	x	45.59	x	0.63	x	0.7	=	50.71	(76)
East	0.9x	0.77	x	1.82	x	24.49	x	0.63	x	0.7	=	27.24	(76)
East	0.9x	0.77	x	1.82	x	16.15	x	0.63	x	0.7	=	17.97	(76)
South	0.9x	0.77	x	0.67	x	46.75	x	0.63	x	0.7	=	9.57	(78)
South	0.9x	0.77	x	1.27	x	46.75	x	0.63	x	0.7	=	18.15	(78)
South	0.9x	0.77	x	0.67	x	76.57	x	0.63	x	0.7	=	15.68	(78)
South	0.9x	0.77	x	1.27	x	76.57	x	0.63	x	0.7	=	29.72	(78)
South	0.9x	0.77	x	0.67	x	97.53	x	0.63	x	0.7	=	19.97	(78)

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South	0.9x	0.77	x	1.27	x	97.53	x	0.63	x	0.7	=	37.86	(78)
South	0.9x	0.77	x	0.67	x	110.23	x	0.63	x	0.7	=	22.57	(78)
South	0.9x	0.77	x	1.27	x	110.23	x	0.63	x	0.7	=	42.79	(78)
South	0.9x	0.77	x	0.67	x	114.87	x	0.63	x	0.7	=	23.52	(78)
South	0.9x	0.77	x	1.27	x	114.87	x	0.63	x	0.7	=	44.58	(78)
South	0.9x	0.77	x	0.67	x	110.55	x	0.63	x	0.7	=	22.64	(78)
South	0.9x	0.77	x	1.27	x	110.55	x	0.63	x	0.7	=	42.91	(78)
South	0.9x	0.77	x	0.67	x	108.01	x	0.63	x	0.7	=	22.12	(78)
South	0.9x	0.77	x	1.27	x	108.01	x	0.63	x	0.7	=	41.92	(78)
South	0.9x	0.77	x	0.67	x	104.89	x	0.63	x	0.7	=	21.48	(78)
South	0.9x	0.77	x	1.27	x	104.89	x	0.63	x	0.7	=	40.71	(78)
South	0.9x	0.77	x	0.67	x	101.89	x	0.63	x	0.7	=	20.86	(78)
South	0.9x	0.77	x	1.27	x	101.89	x	0.63	x	0.7	=	39.54	(78)
South	0.9x	0.77	x	0.67	x	82.59	x	0.63	x	0.7	=	16.91	(78)
South	0.9x	0.77	x	1.27	x	82.59	x	0.63	x	0.7	=	32.05	(78)
South	0.9x	0.77	x	0.67	x	55.42	x	0.63	x	0.7	=	11.35	(78)
South	0.9x	0.77	x	1.27	x	55.42	x	0.63	x	0.7	=	21.51	(78)
South	0.9x	0.77	x	0.67	x	40.4	x	0.63	x	0.7	=	8.27	(78)
South	0.9x	0.77	x	1.27	x	40.4	x	0.63	x	0.7	=	15.68	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	68.45	124.22	189.53	266.5	326.38	326.35	319.25	272.71	215.99	142.63	83.39	57.66	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	400.83	454.71	510.05	571.07	615.22	609.4	582.02	540.37	491.73	434.43	393.76	381.68	(84)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.93	0.82	0.65	0.49	0.54	0.79	0.95	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.74	19.9	20.17	20.52	20.81	20.95	20.99	20.98	20.88	20.52	20.06	19.7	(87)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.86	19.86	19.86	19.87	19.87	19.88	19.88	19.88	19.88	19.87	19.87	19.87	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.91	0.77	0.55	0.37	0.42	0.71	0.93	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.2	18.44	18.83	19.33	19.69	19.85	19.88	19.87	19.79	19.33	18.69	18.16	(90)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.95	19.15	19.49	19.91	20.24	20.39	20.42	20.42	20.32	19.91	19.36	18.91	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.95	19.15	19.49	19.91	20.24	20.39	20.42	20.42	20.32	19.91	19.36	18.91	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.99	0.98	0.96	0.91	0.79	0.6	0.43	0.48	0.74	0.93	0.98	0.99	(94)
--------	------	------	------	------	------	-----	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	396.89	446.95	491.38	518.77	484.7	364.15	248.61	259.23	365.36	405.64	386.81	378.78	(95)
--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	985.17	956.59	870.11	731.53	566.17	381.01	251.39	263.95	410.78	617.54	815.58	982.28	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	437.68	342.48	281.78	153.19	60.62	0	0	0	0	157.65	308.72	449	
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	-----	--

Total per year ($kWh/year$) = $Sum(98)_{1..12} =$ 2191.12 (98)

Space heating requirement in $kWh/m^2/year$

41.66 (99)

9. Energy requirements: Community heating system

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0 (301)

Fraction of space heat from community system $1 - (301) =$

1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers

1 (303a)

Fraction of total space heat from Community boilers

$(302) \times (303a) =$ 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system

1 (305)

Distribution loss factor (Table 12c) for community heating system

1.05 (306)

Space heating

Annual space heating requirement

kWh/year
2191.12

Space heat from Community boilers

$(98) \times (304a) \times (305) \times (306) =$ 2300.67 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0 (308)

Space heating requirement from secondary/supplementary system

$(98) \times (301) \times 100 \div (308) =$ 0 (309)

Water heating

Annual water heating requirement

1849.15

If DHW from community scheme:

Water heat from Community boilers

$(64) \times (303a) \times (305) \times (306) =$ 1941.6 (310a)

Electricity used for heat distribution

$0.01 \times [(307a) \dots (307e) + (310a) \dots (310e)] =$ 42.42 (313)

Cooling System Energy Efficiency Ratio

0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0)

$= (107) \div (314) =$ 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):

mechanical ventilation - balanced, extract or positive input from outside

0 (330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	$= (330a) + (330b) + (330g) =$	0	(331)
Energy for lighting (calculated in Appendix L)		242.67	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-682.26	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

2b CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		94.3 (367a)
CO2 associated with heat source 1	$[(307b) + (310b)] \times 100 \div (367b) \times$	0.22	= 971.72 (367)
Electrical energy for heat distribution	$[(313) \times$	0.52	= 22.02 (372)
Total CO2 associated with community systems	$(363) \dots (366) + (368) \dots (372)$		= 993.74 (373)
CO2 associated with space heating (secondary)	$(309) \times$	0	= 0 (374)
CO2 associated with water from immersion heater or instantaneous heater	$(312) \times$	0.22	= 0 (375)
Total CO2 associated with space and water heating	$(373) + (374) + (375) =$		993.74 (376)
CO2 associated with electricity for pumps and fans within dwelling	$(331) \times$	0.52	= 0 (378)
CO2 associated with electricity for lighting	$(332) \times$	0.52	= 125.94 (379)
Energy saving/generation technologies (333) to (334) as applicable			
Item 1		0.52	$\times 0.01 =$ -554.09 (380)
Total CO2, kg/year	sum of (376) - (382) =		765.59 (383)
Dwelling CO2 Emission Rate	$(383) \div (4) =$		14.55 (384)
EI rating (section 14)			89.49 (385)

TER WorkSheet: New dwelling design stage

User Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.25

Property Address: 1BF (S) GF

Address : 1BF (S) GF, Land North of Sefter Road, Bognor Regis, PO21 3FF

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52.6 (1a)	2.85 (2a)	149.91 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	149.91 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 20 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.38 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 0 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 1 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.38 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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TER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.49	0.48	0.47	0.42	0.41	0.36	0.36	0.35	0.38	0.41	0.43	0.45
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.62 0.61 0.61 0.59 0.58 0.57 0.57 0.56 0.57 0.58 0.59 0.6 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.62 0.61 0.61 0.59 0.58 0.57 0.57 0.56 0.57 0.58 0.59 0.6 (25)

3. Building fabric and openings calculator

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A x U (W/K)	k-value kJ/m²·K	A X k
Doors			1.96	1	1.96		(26)
Windows Type 1			1.79	$\times 1/[1/(1.4) + 0.04]$	2.37		(27)
Windows Type 2			0.66	$\times 1/[1/(1.4) + 0.04]$	0.88		(27)
Windows Type 3			1.25	$\times 1/[1/(1.4) + 0.04]$	1.66		(27)
Windows Type 4			3.92	$\times 1/[1/(1.4) + 0.04]$	5.2		(27)
Windows Type 5			1.79	$\times 1/[1/(1.4) + 0.04]$	2.37		(27)
Floor			52.6	0.13	6.837999		(28)
Walls Type1	58.34	11.2	47.14	0.18	8.49		(29)
Walls Type2	4.28	1.96	2.32	0.18	0.42		(29)
Total area of elements, m²			115.22				(31)
Party wall			21.75	0	0		(32)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26) ... (30) + (32) = 32.55 (33)

Heat capacity Cm = S(A x k) ((28) ... (30) + (32) + (32a) ... (32e) = 11146.1 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 8.01 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 40.56 (37)

TER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly

$$(38)m = 0.33 \times (25)m \times (5)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	30.65	30.42	30.19	29.13	28.94	28.02	28.02	27.85	28.37	28.94	29.34	29.76	(38)

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	71.2	70.97	70.75	69.69	69.49	68.57	68.57	68.4	68.93	69.49	69.89	70.31	
Average = Sum(39) ₁₋₁₂ / 12 =												69.69	(39)

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.35	1.35	1.35	1.32	1.32	1.3	1.3	1.3	1.31	1.32	1.33	1.34	
Average = Sum(40) ₁₋₁₂ / 12 =												1.32	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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=	83.78	80.73	77.68	74.64	71.59	68.54	68.54	71.59	74.64	77.68	80.73	83.78	
Total = Sum(44) ₁₋₁₂ =												913.93	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	124.24	108.66	112.13	97.76	93.8	80.94	75	86.07	87.1	101.5	110.8	120.32	
Total = Sum(45) ₁₋₁₂ =												1198.31	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	18.64	16.3	16.82	14.66	14.07	12.14	11.25	12.91	13.06	15.23	16.62	18.05	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

Temperature factor from Table 2b

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

If community heating see section 4.3

Volume factor from Table 2a

Temperature factor from Table 2b

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

Enter (50) or (54) in (55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

TER WorkSheet: New dwelling design stage

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	170.83	150.75	158.72	142.85	140.39	126.03	121.6	132.66	132.19	148.1	155.89	166.91	(62)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	--------	--------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	170.83	150.75	158.72	142.85	140.39	126.03	121.6	132.66	132.19	148.1	155.89	166.91	
Output from water heater (annual) $\times 12$												1746.92	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

(65)m=	78.59	69.8	74.56	68.58	68.46	62.99	62.21	65.89	65.03	73.03	72.91	77.28	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (Table 5) Watts

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	(66)

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

(67)m=	13.75	12.22	9.93	7.52	5.62	4.75	5.13	6.67	8.95	11.36	13.26	14.14	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	153.98	155.58	151.55	142.98	132.16	121.99	115.2	113.6	117.63	126.2	137.02	147.19	(68)
--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	-------	--------	--------	------

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

(69)m=	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	(71)
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Water heating gains (Table 5)

(72)m=	105.63	103.87	100.21	95.25	92.02	87.48	83.62	88.57	90.32	95.46	101.27	103.87	(72)
--------	--------	--------	--------	-------	-------	-------	-------	-------	-------	-------	--------	--------	------

Total internal gains = $(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m$

(73)m=	325.86	324.16	314.2	298.25	282.31	266.72	256.45	261.33	269.4	285.52	304.05	317.7	(73)
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6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m ²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
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TER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	3.92	x	10.63	x	0.63	x	0.7	=	12.74	(74)
North	0.9x	0.77	x	1.79	x	10.63	x	0.63	x	0.7	=	5.82	(74)
North	0.9x	0.77	x	3.92	x	20.32	x	0.63	x	0.7	=	24.34	(74)
North	0.9x	0.77	x	1.79	x	20.32	x	0.63	x	0.7	=	11.12	(74)
North	0.9x	0.77	x	3.92	x	34.53	x	0.63	x	0.7	=	41.37	(74)
North	0.9x	0.77	x	1.79	x	34.53	x	0.63	x	0.7	=	18.89	(74)
North	0.9x	0.77	x	3.92	x	55.46	x	0.63	x	0.7	=	66.45	(74)
North	0.9x	0.77	x	1.79	x	55.46	x	0.63	x	0.7	=	30.34	(74)
North	0.9x	0.77	x	3.92	x	74.72	x	0.63	x	0.7	=	89.51	(74)
North	0.9x	0.77	x	1.79	x	74.72	x	0.63	x	0.7	=	40.87	(74)
North	0.9x	0.77	x	3.92	x	79.99	x	0.63	x	0.7	=	95.82	(74)
North	0.9x	0.77	x	1.79	x	79.99	x	0.63	x	0.7	=	43.76	(74)
North	0.9x	0.77	x	3.92	x	74.68	x	0.63	x	0.7	=	89.46	(74)
North	0.9x	0.77	x	1.79	x	74.68	x	0.63	x	0.7	=	40.85	(74)
North	0.9x	0.77	x	3.92	x	59.25	x	0.63	x	0.7	=	70.98	(74)
North	0.9x	0.77	x	1.79	x	59.25	x	0.63	x	0.7	=	32.41	(74)
North	0.9x	0.77	x	3.92	x	41.52	x	0.63	x	0.7	=	49.74	(74)
North	0.9x	0.77	x	1.79	x	41.52	x	0.63	x	0.7	=	22.71	(74)
North	0.9x	0.77	x	3.92	x	24.19	x	0.63	x	0.7	=	28.98	(74)
North	0.9x	0.77	x	1.79	x	24.19	x	0.63	x	0.7	=	13.23	(74)
North	0.9x	0.77	x	3.92	x	13.12	x	0.63	x	0.7	=	15.71	(74)
North	0.9x	0.77	x	1.79	x	13.12	x	0.63	x	0.7	=	7.18	(74)
North	0.9x	0.77	x	3.92	x	8.86	x	0.63	x	0.7	=	10.62	(74)
North	0.9x	0.77	x	1.79	x	8.86	x	0.63	x	0.7	=	4.65	(74)
East	0.9x	0.77	x	1.79	x	19.64	x	0.63	x	0.7	=	21.49	(76)
East	0.9x	0.77	x	1.79	x	38.42	x	0.63	x	0.7	=	42.04	(76)
East	0.9x	0.77	x	1.79	x	63.27	x	0.63	x	0.7	=	69.23	(76)
East	0.9x	0.77	x	1.79	x	92.28	x	0.63	x	0.7	=	100.96	(76)
East	0.9x	0.77	x	1.79	x	113.09	x	0.63	x	0.7	=	123.73	(76)
East	0.9x	0.77	x	1.79	x	115.77	x	0.63	x	0.7	=	126.66	(76)
East	0.9x	0.77	x	1.79	x	110.22	x	0.63	x	0.7	=	120.59	(76)
East	0.9x	0.77	x	1.79	x	94.68	x	0.63	x	0.7	=	103.58	(76)
East	0.9x	0.77	x	1.79	x	73.59	x	0.63	x	0.7	=	80.51	(76)
East	0.9x	0.77	x	1.79	x	45.59	x	0.63	x	0.7	=	49.88	(76)
East	0.9x	0.77	x	1.79	x	24.49	x	0.63	x	0.7	=	26.79	(76)
East	0.9x	0.77	x	1.79	x	16.15	x	0.63	x	0.7	=	17.67	(76)
South	0.9x	0.77	x	0.66	x	46.75	x	0.63	x	0.7	=	9.43	(78)
South	0.9x	0.77	x	1.25	x	46.75	x	0.63	x	0.7	=	17.86	(78)
South	0.9x	0.77	x	0.66	x	76.57	x	0.63	x	0.7	=	15.44	(78)
South	0.9x	0.77	x	1.25	x	76.57	x	0.63	x	0.7	=	29.25	(78)
South	0.9x	0.77	x	0.66	x	97.53	x	0.63	x	0.7	=	19.67	(78)

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South	0.9x	0.77	x	1.25	x	97.53	x	0.63	x	0.7	=	37.26	(78)
South	0.9x	0.77	x	0.66	x	110.23	x	0.63	x	0.7	=	22.23	(78)
South	0.9x	0.77	x	1.25	x	110.23	x	0.63	x	0.7	=	42.11	(78)
South	0.9x	0.77	x	0.66	x	114.87	x	0.63	x	0.7	=	23.17	(78)
South	0.9x	0.77	x	1.25	x	114.87	x	0.63	x	0.7	=	43.88	(78)
South	0.9x	0.77	x	0.66	x	110.55	x	0.63	x	0.7	=	22.3	(78)
South	0.9x	0.77	x	1.25	x	110.55	x	0.63	x	0.7	=	42.23	(78)
South	0.9x	0.77	x	0.66	x	108.01	x	0.63	x	0.7	=	21.79	(78)
South	0.9x	0.77	x	1.25	x	108.01	x	0.63	x	0.7	=	41.26	(78)
South	0.9x	0.77	x	0.66	x	104.89	x	0.63	x	0.7	=	21.16	(78)
South	0.9x	0.77	x	1.25	x	104.89	x	0.63	x	0.7	=	40.07	(78)
South	0.9x	0.77	x	0.66	x	101.89	x	0.63	x	0.7	=	20.55	(78)
South	0.9x	0.77	x	1.25	x	101.89	x	0.63	x	0.7	=	38.92	(78)
South	0.9x	0.77	x	0.66	x	82.59	x	0.63	x	0.7	=	16.66	(78)
South	0.9x	0.77	x	1.25	x	82.59	x	0.63	x	0.7	=	31.55	(78)
South	0.9x	0.77	x	0.66	x	55.42	x	0.63	x	0.7	=	11.18	(78)
South	0.9x	0.77	x	1.25	x	55.42	x	0.63	x	0.7	=	21.17	(78)
South	0.9x	0.77	x	0.66	x	40.4	x	0.63	x	0.7	=	8.15	(78)
South	0.9x	0.77	x	1.25	x	40.4	x	0.63	x	0.7	=	15.43	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	67.33	122.18	186.42	262.1	321.17	320.77	313.95	268.2	212.43	130.3	82.03	56.72	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	393.2	446.35	500.62	580.35	603.47	597.49	570.4	529.53	481.83	425.82	386.08	374.42	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.94	0.85	0.68	0.51	0.57	0.81	0.96	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.63	19.79	20.08	20.45	20.76	20.94	20.99	20.98	20.86	20.46	19.98	19.6	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.8	19.8	19.81	19.82	19.82	19.84	19.84	19.84	19.83	19.82	19.82	19.81	(88)
--------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.92	0.79	0.58	0.39	0.44	0.73	0.94	0.99	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18	18.25	18.66	19.2	19.6	19.8	19.83	19.83	19.72	19.21	18.53	17.98	(90)
--------	----	-------	-------	------	------	------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.79	19	19.35	19.81	20.17	20.36	20.4	20.39	20.28	19.82	19.24	18.77	(92)
--------	-------	----	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	18.79	19	19.35	19.81	20.17	20.36	20.4	20.39	20.28	19.82	19.24	18.77	(93)
--------	-------	----	-------	-------	-------	-------	------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.99	0.98	0.97	0.92	0.81	0.62	0.45	0.5	0.77	0.94	0.98	0.99	(94)
--------	------	------	------	------	------	------	------	-----	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	389.76	439.36	484.08	514.35	487.56	372.16	256.27	266.42	368.66	400.48	379.84	371.75	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	1032.06	1000.79	909.05	760.31	588.56	394.72	260.31	273.04	425.66	640.78	848.46	1024.57	(97)
--------	---------	---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	---------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	477.87	377.28	316.17	177.09	75.14	0	0	0	0	178.79	337.41	485.7	
Total per year ($kWh/year$) = $Sum(98)_{1..12} =$												2425.45	(98)

Space heating requirement in $kWh/m^2/year$

46.11	(99)
-------	------

9. Energy requirements - individual heating systems (including micro CHPs)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

93.5	(206)
------	-------

Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	$kWh/year$
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	------------

Space heating requirement (calculated above)

477.87	377.28	316.17	177.09	75.14	0	0	0	0	178.79	337.41	485.7
--------	--------	--------	--------	-------	---	---	---	---	--------	--------	-------

$$(211)m = \{[(98)m \times (204)]\} \times 100 \div (206) \quad (211)$$

511.09	403.51	338.15	189.4	80.36	0	0	0	0	191.22	360.87	519.47
--------	--------	--------	-------	-------	---	---	---	---	--------	--------	--------

$$Total (kWh/year) = Sum(211)_{1..12} = 2594.07 \quad (211)$$

Space heating fuel (secondary), $kWh/month$

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0		
Total (kWh/year) =Sum(215) _{1..5,10...12} =												0	(215)

Water heating

Output from water heater (calculated above)

170.83	150.75	158.72	142.85	140.39	126.03	121.6	132.66	132.19	148.1	155.89	166.91
--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	--------	--------

Efficiency of water heater 79.8 (216)

(217)m=	87.41	87.16	86.62	85.39	83.23	79.8	79.8	79.8	79.8	85.32	86.82	87.5	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	------	-------

Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	195.43	172.95	183.24	167.29	168.68	157.94	152.38	166.24	165.65	173.58	179.55	190.76	
Total = $Sum(219a)_{1..12} =$												2073.7	(219)

Annual totals

$kWh/year$

$kWh/year$

Space heating fuel used, main system 1

2594.07

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Water heating fuel used		2073.7	
Electricity for pumps, fans and electric keep-hot			
central heating pump:	30		(230c)
boiler with a fan-assisted flue	45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75 (231)
Electricity for lighting		242.88	(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)	(211) x	0.216	560.32 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.216	447.92 (264)
Space and water heating	(261) + (262) + (263) + (264) =		1008.24 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	38.93 (267)
Electricity for lighting	(232) x	0.519	126.05 (268)
Total CO2, kg/year	sum of (265) ... (271) =		1173.22 (272)
TER =			22.3 (273)

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User Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.25

Property Address: 1BF (S) MF

Address : 1BF (S) MF, Land North of Sefter Road, Bognor Regis, PO21 3FF

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52.6 (1a)	2.7 (2a)	142.02 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	142.02 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.14 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)

Additional infiltration

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0

If no draught lobby, enter 0.05, else enter 0

Percentage of windows and doors draught stripped

Window infiltration

$$0.25 - [0.2 \times (14) \div 100] =$$

Infiltration rate

$$(8) + (10) + (11) + (12) + (13) + (15) =$$

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area

If based on air permeability value, then (18) = [(17) + 20] ÷ (8), otherwise (18) = (16)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered

Shelter factor

$$(20) = 1 - [0.075 \times (19)] =$$

Infiltration rate incorporating shelter factor

$$(21) = (18) \times (20) =$$

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.37	0.36	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m x 0.5]

(24d)m= 0.57 0.57 0.56 0.55 0.55 0.54 0.54 0.54 0.54 0.55 0.55 0.56 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.57 0.57 0.56 0.55 0.55 0.54 0.54 0.54 0.54 0.55 0.55 0.56 (25)

3. Building fabric and openings calculator

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A x U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			1.96	1.1	2.156		(26)
Windows Type 1			1.45	1/[1/(1.2) + 0.04]	1.68		(27)
Windows Type 2			0.67	1/[1/(1.2) + 0.04]	0.77		(27)
Windows Type 3			1.27	1/[1/(1.2) + 0.04]	1.45		(27)
Windows Type 4			3.99	1/[1/(1.2) + 0.04]	4.57		(27)
Windows Type 5			1.82	1/[1/(1.2) + 0.04]	2.08		(27)
Walls Type1	55.27	10.65	44.62	0.17	7.59		(29)
Walls Type2	4.05	1.96	2.09	0.16	0.33		(29)
Total area of elements, m²			59.32				(31)
Party wall			20.6	0	0		(32)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 22.27 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5068.6 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 9.31 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 31.58 (37)

Ventilation heat loss calculated monthly (36)m = 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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(38)m=	26.66	26.53	26.41	25.83	25.72	25.22	25.22	25.13	25.42	25.72	25.94	26.17	(38)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

(39)m=	58.23	58.11	57.99	57.41	57.3	56.8	56.8	56.71	56.99	57.3	57.52	57.75	
Average = Sum(39) _{1...12} / 12 =												57.41	(39)

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	1.11	1.1	1.1	1.09	1.09	1.08	1.08	1.08	1.08	1.09	1.09	1.1	
Average = Sum(40) _{1...12} / 12 =												1.09	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N

1.77

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

76.16

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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=	83.78	80.73	77.68	74.64	71.59	68.54	68.54	71.59	74.64	77.68	80.73	83.78	
Total = Sum(44) _{1...12} =												913.93	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x mm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	124.24	108.66	112.13	97.76	93.8	80.94	75	86.07	87.1	101.5	110.8	120.32	
Total = Sum(45) _{1...12} =												1198.31	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.64	16.3	16.82	14.66	14.07	12.14	11.25	12.91	13.06	15.23	16.62	18.05	(46)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

110

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0.02

(51)

If community heating see section 4.3

Volume factor from Table 2a

1.03

(52)

Temperature factor from Table 2b

0.6

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

1.03

(54)

Enter (50) or (54) in (55)

1.03

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0
--------	---	---	---	---	---	---	---	---	---	---	---	---

(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	179.52	158.59	167.4	151.25	149.08	134.43	130.28	141.34	140.59	156.78	164.29	175.6
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(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0
--------	---	---	---	---	---	---	---	---	---	---	---	---

(63)

Output from water heater

(64)m=	179.52	158.59	167.4	151.25	149.08	134.43	130.28	141.34	140.59	156.78	164.29	175.6
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------

Output from water heater (annual) 1, 12

1849.15

(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	85.53	76.07	81.5	75.3	75.41	69.71	69.16	72.84	71.75	77.97	79.63	84.23
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(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (Table 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m=	106.01	106.01	106.01	106.01	106.01	106.01	106.01	106.01	106.01	106.01	106.01	106.01

(66)

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

(67)m=	34.52	30.66	24.93	18.88	14.11	11.91	12.87	16.73	22.48	28.51	33.28	35.48
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(67)

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

(68)m=	229.82	232.21	226.2	213.4	197.25	182.08	171.93	169.55	175.56	188.35	204.5	219.68
--------	--------	--------	-------	-------	--------	--------	--------	--------	--------	--------	-------	--------

(68)

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

(69)m=	47.37	47.37	47.37	47.37	47.37	47.37	47.37	47.37	47.37	47.37	47.37	47.37
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0
--------	---	---	---	---	---	---	---	---	---	---	---	---

(70)

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

(71)m=	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(71)

Water heating gains (Table 5)

(72)m=	114.96	113.2	109.55	104.58	101.36	96.82	92.96	97.9	99.66	104.8	110.6	113.21
--------	--------	-------	--------	--------	--------	-------	-------	------	-------	-------	-------	--------

(72)

Total internal gains =

(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	462	458.77	443.38	419.56	395.42	373.51	360.47	366.89	380.38	404.37	431.09	451.07
--------	-----	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m ²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)	
North	0.9x 0.77	x 3.99	x 10.63	x 0.63	x 0.7	= 12.97	(74)
North	0.9x 0.77	x 1.82	x 10.63	x 0.63	x 0.7	= 5.91	(74)

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North	0.9x	0.77	x	3.99	x	20.32	x	0.63	x	0.7	=	24.78	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	3.99	x	34.53	x	0.63	x	0.7	=	42.11	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	3.99	x	55.46	x	0.63	x	0.7	=	67.63	(74)
North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)
North	0.9x	0.77	x	3.99	x	74.72	x	0.63	x	0.7	=	91.11	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	3.99	x	79.99	x	0.63	x	0.7	=	97.53	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	3.99	x	74.68	x	0.63	x	0.7	=	91.06	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	3.99	x	59.25	x	0.63	x	0.7	=	72.24	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	3.99	x	41.52	x	0.63	x	0.7	=	50.63	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	3.99	x	24.19	x	0.63	x	0.7	=	29.5	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	3.99	x	13.12	x	0.63	x	0.7	=	16	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	3.99	x	8.86	x	0.63	x	0.7	=	10.81	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
East	0.9x	0.77	x	1.45	x	19.64	x	0.63	x	0.7	=	17.41	(76)
East	0.9x	0.77	x	1.45	x	38.42	x	0.63	x	0.7	=	34.05	(76)
East	0.9x	0.77	x	1.45	x	63.27	x	0.63	x	0.7	=	56.08	(76)
East	0.9x	0.77	x	1.45	x	92.28	x	0.63	x	0.7	=	81.79	(76)
East	0.9x	0.77	x	1.45	x	113.09	x	0.63	x	0.7	=	100.23	(76)
East	0.9x	0.77	x	1.45	x	115.77	x	0.63	x	0.7	=	102.6	(76)
East	0.9x	0.77	x	1.45	x	110.22	x	0.63	x	0.7	=	97.68	(76)
East	0.9x	0.77	x	1.45	x	94.68	x	0.63	x	0.7	=	83.91	(76)
East	0.9x	0.77	x	1.45	x	73.59	x	0.63	x	0.7	=	65.22	(76)
East	0.9x	0.77	x	1.45	x	45.59	x	0.63	x	0.7	=	40.4	(76)
East	0.9x	0.77	x	1.45	x	24.49	x	0.63	x	0.7	=	21.7	(76)
East	0.9x	0.77	x	1.45	x	16.15	x	0.63	x	0.7	=	14.31	(76)
South	0.9x	0.77	x	0.67	x	46.75	x	0.63	x	0.7	=	9.57	(78)
South	0.9x	0.77	x	1.27	x	46.75	x	0.63	x	0.7	=	18.15	(78)
South	0.9x	0.77	x	0.67	x	76.57	x	0.63	x	0.7	=	15.68	(78)
South	0.9x	0.77	x	1.27	x	76.57	x	0.63	x	0.7	=	29.72	(78)
South	0.9x	0.77	x	0.67	x	97.53	x	0.63	x	0.7	=	19.97	(78)
South	0.9x	0.77	x	1.27	x	97.53	x	0.63	x	0.7	=	37.86	(78)
South	0.9x	0.77	x	0.67	x	110.23	x	0.63	x	0.7	=	22.57	(78)

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South	0.9x	0.77	x	1.27	x	110.23	x	0.63	x	0.7	=	42.79	(78)
South	0.9x	0.77	x	0.67	x	114.87	x	0.63	x	0.7	=	23.52	(78)
South	0.9x	0.77	x	1.27	x	114.87	x	0.63	x	0.7	=	44.58	(78)
South	0.9x	0.77	x	0.67	x	110.55	x	0.63	x	0.7	=	22.64	(78)
South	0.9x	0.77	x	1.27	x	110.55	x	0.63	x	0.7	=	42.91	(78)
South	0.9x	0.77	x	0.67	x	108.01	x	0.63	x	0.7	=	22.12	(78)
South	0.9x	0.77	x	1.27	x	108.01	x	0.63	x	0.7	=	41.92	(78)
South	0.9x	0.77	x	0.67	x	104.89	x	0.63	x	0.7	=	21.48	(78)
South	0.9x	0.77	x	1.27	x	104.89	x	0.63	x	0.7	=	40.71	(78)
South	0.9x	0.77	x	0.67	x	101.89	x	0.63	x	0.7	=	20.86	(78)
South	0.9x	0.77	x	1.27	x	101.89	x	0.63	x	0.7	=	39.54	(78)
South	0.9x	0.77	x	0.67	x	82.59	x	0.63	x	0.7	=	16.91	(78)
South	0.9x	0.77	x	1.27	x	82.59	x	0.63	x	0.7	=	32.05	(78)
South	0.9x	0.77	x	0.67	x	55.42	x	0.63	x	0.7	=	11.35	(78)
South	0.9x	0.77	x	1.27	x	55.42	x	0.63	x	0.7	=	21.51	(78)
South	0.9x	0.77	x	0.67	x	40.4	x	0.63	x	0.7	=	8.27	(78)
South	0.9x	0.77	x	1.27	x	40.4	x	0.63	x	0.7	=	15.68	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	64.01	115.53	175.22	245.63	301	310.17	294.32	251.3	199.34	132.32	77.85	54.01	(83)
--------	-------	--------	--------	--------	-----	--------	--------	-------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m, watts

(84)m=	526.01	574.3	618.6	665.19	696.43	683.68	654.79	618.18	579.72	536.69	508.94	505.08	(84)
--------	--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. fLA = internal temperature in living area

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

(85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

(86)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(86)
	0.98	0.97	0.94	0.86	0.71	0.52	0.38	0.42	0.65	0.88	0.96	0.98	

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.18	20.32	20.53	20.78	20.93	20.99	21	21	20.97	20.78	20.44	20.15	(87)
--------	-------	-------	-------	-------	-------	-------	----	----	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.01	20.01	20.02	20.02	20.02	20.01	20.01	20.01	20	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.96	0.92	0.82	0.65	0.45	0.3	0.33	0.57	0.84	0.95	0.98	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.94	19.14	19.43	19.77	19.95	20.01	20.02	20.02	19.99	19.78	19.32	18.9	(90)
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fLA = Living area ÷ (4) =

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.54	19.71	19.97	20.26	20.43	20.49	20.5	20.5	20.47	20.27	19.87	19.51	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.54	19.71	19.97	20.26	20.43	20.49	20.5	20.5	20.47	20.27	19.87	19.51	(93)
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8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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SAP WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.97	0.96	0.92	0.83	0.68	0.48	0.34	0.37	0.61	0.85	0.95	0.98	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	511.19	548.82	568.53	553.01	471.81	330.51	220.82	231.45	350.83	457.77	483.44	493.03	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, Lm, W = [(39)m x ((93)m - (96)m)]

(97)m=	887.68	860.71	781.03	652.14	500.21	334.46	221.29	232.27	362.96	553.89	734.55	884.02	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m

(98)m=	280.11	209.59	158.1	71.37	21.12	0	0	0	0	71.52	180.8	290.89	(98)
--------	--------	--------	-------	-------	-------	---	---	---	---	-------	-------	--------	------

Total per year (kWh/year) = Sum(98)_{1..12} = 1283.51 (99)

Space heating requirement in kWh/m²/year

24.4 (99)

3b Energy requirements - Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0 (301)

Fraction of space heat from community system 1 - (301) =

1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers

1 (303a)

Fraction of total space heat from Community boilers

(302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system

1 (305)

Distribution loss factor (Table 12c) for community heating system

1.05 (306)

Space heating

kWh/year

Annual space heating requirement

1283.51

Space heat from Community boilers

(98) x (304a) x (305) x (306) = 1347.68 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0 (308)

Space heating requirement from secondary/supplementary system

(98) x (301) x 100 ÷ (308) = 0 (309)

Water heating

Annual water heating requirement

1849.15

If DHW from community scheme:

Water heat from Community boilers

(64) x (303a) x (305) x (306) = 1941.6 (310a)

Electricity used for heat distribution

0.01 x [(307a)...(307e) + (310a)...(310e)] = 32.89 (313)

Cooling System Energy Efficiency Ratio

0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0)

= (107) ÷ (314) = 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):

mechanical ventilation - balanced, extract or positive input from outside

0 (330a)

warm air heating system fans

0 (330b)

pump for solar water heating

0 (330g)

Total electricity for the above, kWh/year

= (330a) + (330b) + (330g) = 0 (331)

SAP WorkSheet: New dwelling design stage

Energy for lighting (calculated in Appendix L)	243.84	(332)
Electricity generated by PVs (Appendix M) (negative quantity)	-682.26	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)	0	(334)

11b Fuel costs – Community heating scheme

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating from CHP	{307a} x	4.24	x 0.01 = 57.14 (340a)
Water heating from CHP	{310a} x	4.24	x 0.01 = 82.32 (342a)
Pumps and fans	{331}	13.19	x 0.01 = 0 (349)
Energy for lighting	{332}	13.19	x 0.01 = 32.16 (350)
Additional standing charges (Table 12)			120 (351)
Energy saving/generation technologies			
Total energy cost	= {340a}...{342e} + {345}...{354} =		291.63 (355)

11b SAP rating – Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	$[(355) \times (356)] \div [(4) + 45.0] =$	1.25	(357)
SAP rating (section 12)		82.49	(358)

2b CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		94.3 (367a)
CO2 associated with heat source 1	[{307b}+{310b}] x 100 ÷ {367b} x		0.22 = 753.43 (367)
Electrical energy for heat distribution	{313} x	0.52	= 17.07 (372)
Total CO2 associated with community systems	{363}...{366} + {368}...{372}		= 770.5 (373)
CO2 associated with space heating (secondary)	{369} x	0	= 0 (374)
CO2 associated with water from immersion heater or instantaneous heater	{312} x	0.22	= 0 (375)
Total CO2 associated with space and water heating	{373} + {374} + {375} =		770.5 (376)
CO2 associated with electricity for pumps and fans within dwelling	{331} x	0.52	= 0 (378)
CO2 associated with electricity for lighting	{332} x	0.52	= 126.55 (379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	x 0.01 = -354.09 (380)
Total CO2, kg/year	sum of {376}...{382} =		542.96 (383)
Dwelling CO2 Emission Rate	{383} ÷ (4) =		10.32 (384)
EI rating (section 14)			92.55 (385)

13b Primary Energy – Community heating scheme

Energy kWh/year	Primary factor	P.Energy kWh/year
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SAP WorkSheet: New dwelling design stage

Energy from other sources of space and water heating (not CHP)

Efficiency of heat source 1 (%) If there is CHP using two fuels repeat (363) to (366) for the second fuel 94.3 (367a)

Energy associated with heat source 1 $[(307b)+(310b)] \times 100 \div (367b) \times$ 1.22 = 4255.49 (367)

Electrical energy for heat distribution $[(313) \times$ = 100.98 (372)

Total Energy associated with community systems $(363)...(366) + (368)...(372)$ = 4356.47 (373)

if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C) 4356.47 (373)

Energy associated with space heating (secondary) $(309) \times$ 0 = 0 (374)

Energy associated with water from immersion heater or instantaneous heater $(312) \times$ 1.22 = 0 (375)

Total Energy associated with space and water heating $(373) + (374) + (375) =$ 4356.47 (376)

Energy associated with space cooling $(315) \times$ 3.07 = 0 (377)

Energy associated with electricity for pumps and fans within dwelling $(331) \times$ 3.07 = 0 (378)

Energy associated with electricity for lighting $(332) \times$ 3.07 = 748.59 (379)

Energy saving/generation technologies
Item 1 3.07 $\times 0.01 =$ -2094.54 (380)

Total Primary Energy, kWh/year sum of (376)...(382) = 3010.52 (383)

DRAFT

DER WorkSheet: New dwelling design stage

User Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.25

Property Address: 1BF (S) MF

Address : 1BF (S) MF, Land North of Sefter Road, Bognor Regis, PO21 3FF

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52.6 (1a)	2.7 (2a)	142.02 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	142.02 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	(5)	0.14 (8)
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If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.29 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 0 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 1 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.29 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.37	0.36	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m x 0.5]

(24d)m= 0.57 0.57 0.56 0.55 0.55 0.54 0.54 0.54 0.54 0.55 0.55 0.56 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.57 0.57 0.56 0.55 0.55 0.54 0.54 0.54 0.54 0.55 0.55 0.56 (25)

3. Building fabric and openings calculator

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A x U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			1.96	1.1	2.156		(26)
Windows Type 1			1.45	$\times 1/[1/(1.2) + 0.04]$	1.66		(27)
Windows Type 2			0.67	$\times 1/[1/(1.2) + 0.04]$	0.77		(27)
Windows Type 3			1.27	$\times 1/[1/(1.2) + 0.04]$	1.45		(27)
Windows Type 4			3.99	$\times 1/[1/(1.2) + 0.04]$	4.57		(27)
Windows Type 5			1.82	$\times 1/[1/(1.2) + 0.04]$	2.08		(27)
Walls Type1	55.27	10.65	44.62	0.17	7.59		(29)
Walls Type2	4.05	1.96	2.09	0.16	0.33		(29)
Total area of elements, m²			59.32				(31)
Party wall			20.6	0	0		(32)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 22.27 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5068.6 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 9.31 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 31.58 (37)

Ventilation heat loss calculated monthly (36)m = 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

DER WorkSheet: New dwelling design stage

(36)m=	26.66	26.53	26.41	25.83	25.72	25.22	25.22	25.13	25.42	25.72	25.94	26.17	(38)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

(39)m=	58.23	58.11	57.99	57.41	57.3	56.8	56.8	56.71	56.99	57.3	57.52	57.75	
Average = Sum(39) _{1...12} / 12 =												57.41	(39)

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	1.11	1.1	1.1	1.09	1.09	1.08	1.08	1.08	1.08	1.09	1.09	1.1	
Average = Sum(40) _{1...12} / 12 =												1.09	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N

1.77

(42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

76.16

(43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	83.78	80.73	77.68	74.64	71.59	68.54	68.54	71.59	74.64	77.68	80.73	83.78	
Total = Sum(44) _{1...12} =												913.93	(44)
Energy content of hot water used - calculated monthly = 4.190 x Vd,m x mm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)													
(45)m=	124.24	108.66	112.13	97.76	93.8	80.94	75	86.07	87.1	101.5	110.8	120.32	
Total = Sum(45) _{1...12} =												1198.31	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.64	16.3	16.82	14.66	14.07	12.14	11.25	12.91	13.06	15.23	16.62	18.05	(46)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

110

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0.02

(51)

If community heating see section 4.3

Volume factor from Table 2a

1.03

(52)

Temperature factor from Table 2b

0.6

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

1.03

(54)

Enter (50) or (54) in (55)

1.03

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

DER WorkSheet: New dwelling design stage

Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0
--------	---	---	---	---	---	---	---	---	---	---	---	---

(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	179.52	158.59	167.4	151.25	149.08	134.43	130.28	141.34	140.59	156.78	164.29	175.6
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------

(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0
--------	---	---	---	---	---	---	---	---	---	---	---	---

(63)

Output from water heater

(64)m=	179.52	158.59	167.4	151.25	149.08	134.43	130.28	141.34	140.59	156.78	164.29	175.6
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------

Output from water heater (annual) 1849.15

(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	85.53	76.07	81.5	75.3	75.41	69.71	69.16	72.84	71.75	77.97	79.63	84.23
--------	-------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------

(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Solar gains (Table 5a and 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m=	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34

(66)

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

(67)m=	13.81	12.26	9.97	7.55	5.64	4.76	5.15	6.69	8.98	11.41	13.31	14.19
--------	-------	-------	------	------	------	------	------	------	------	-------	-------	-------

(67)

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

(68)m=	153.98	155.58	151.55	142.98	132.16	121.99	115.2	113.6	117.63	126.2	137.02	147.19
--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	-------	--------	--------

(68)

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

(69)m=	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(69)

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0
--------	---	---	---	---	---	---	---	---	---	---	---	---

(70)

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

(71)m=	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(71)

Water heating gains (Table 5)

(72)m=	114.96	113.2	109.55	104.58	101.36	96.82	92.96	97.9	99.66	104.8	110.6	113.21
--------	--------	-------	--------	--------	--------	-------	-------	------	-------	-------	-------	--------

(72)

Total internal gains =

(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	332.25	330.55	320.58	304.61	288.66	273.07	262.8	267.69	275.77	291.9	310.44	324.09
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	--------	--------

(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	3.99	x	10.63	x	0.63	x	0.7	=	12.97
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91

(74)

(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	3.99	x	20.32	x	0.63	x	0.7	=	24.78	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	3.99	x	34.53	x	0.63	x	0.7	=	42.11	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	3.99	x	55.46	x	0.63	x	0.7	=	67.63	(74)
North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)
North	0.9x	0.77	x	3.99	x	74.72	x	0.63	x	0.7	=	91.11	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	3.99	x	79.99	x	0.63	x	0.7	=	97.53	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	3.99	x	74.68	x	0.63	x	0.7	=	91.06	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	3.99	x	59.25	x	0.63	x	0.7	=	72.24	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	3.99	x	41.52	x	0.63	x	0.7	=	50.63	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	3.99	x	24.19	x	0.63	x	0.7	=	29.5	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	3.99	x	13.12	x	0.63	x	0.7	=	16	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	3.99	x	8.86	x	0.63	x	0.7	=	10.81	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
East	0.9x	0.77	x	1.45	x	19.64	x	0.63	x	0.7	=	17.41	(76)
East	0.9x	0.77	x	1.45	x	38.42	x	0.63	x	0.7	=	34.05	(76)
East	0.9x	0.77	x	1.45	x	63.27	x	0.63	x	0.7	=	56.08	(76)
East	0.9x	0.77	x	1.45	x	92.28	x	0.63	x	0.7	=	81.79	(76)
East	0.9x	0.77	x	1.45	x	113.09	x	0.63	x	0.7	=	100.23	(76)
East	0.9x	0.77	x	1.45	x	115.77	x	0.63	x	0.7	=	102.6	(76)
East	0.9x	0.77	x	1.45	x	110.22	x	0.63	x	0.7	=	97.68	(76)
East	0.9x	0.77	x	1.45	x	94.68	x	0.63	x	0.7	=	83.91	(76)
East	0.9x	0.77	x	1.45	x	73.59	x	0.63	x	0.7	=	65.22	(76)
East	0.9x	0.77	x	1.45	x	45.59	x	0.63	x	0.7	=	40.4	(76)
East	0.9x	0.77	x	1.45	x	24.49	x	0.63	x	0.7	=	21.7	(76)
East	0.9x	0.77	x	1.45	x	16.15	x	0.63	x	0.7	=	14.31	(76)
South	0.9x	0.77	x	0.67	x	46.75	x	0.63	x	0.7	=	9.57	(78)
South	0.9x	0.77	x	1.27	x	46.75	x	0.63	x	0.7	=	18.15	(78)
South	0.9x	0.77	x	0.67	x	76.57	x	0.63	x	0.7	=	15.68	(78)
South	0.9x	0.77	x	1.27	x	76.57	x	0.63	x	0.7	=	29.72	(78)
South	0.9x	0.77	x	0.67	x	97.53	x	0.63	x	0.7	=	19.97	(78)
South	0.9x	0.77	x	1.27	x	97.53	x	0.63	x	0.7	=	37.86	(78)
South	0.9x	0.77	x	0.67	x	110.23	x	0.63	x	0.7	=	22.57	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.27	x	110.23	x	0.63	x	0.7	=	42.79	(78)
South	0.9x	0.77	x	0.67	x	114.87	x	0.63	x	0.7	=	23.52	(78)
South	0.9x	0.77	x	1.27	x	114.87	x	0.63	x	0.7	=	44.58	(78)
South	0.9x	0.77	x	0.67	x	110.55	x	0.63	x	0.7	=	22.64	(78)
South	0.9x	0.77	x	1.27	x	110.55	x	0.63	x	0.7	=	42.91	(78)
South	0.9x	0.77	x	0.67	x	108.01	x	0.63	x	0.7	=	22.12	(78)
South	0.9x	0.77	x	1.27	x	108.01	x	0.63	x	0.7	=	41.92	(78)
South	0.9x	0.77	x	0.67	x	104.89	x	0.63	x	0.7	=	21.48	(78)
South	0.9x	0.77	x	1.27	x	104.89	x	0.63	x	0.7	=	40.71	(78)
South	0.9x	0.77	x	0.67	x	101.89	x	0.63	x	0.7	=	20.86	(78)
South	0.9x	0.77	x	1.27	x	101.89	x	0.63	x	0.7	=	39.54	(78)
South	0.9x	0.77	x	0.67	x	82.59	x	0.63	x	0.7	=	16.91	(78)
South	0.9x	0.77	x	1.27	x	82.59	x	0.63	x	0.7	=	32.05	(78)
South	0.9x	0.77	x	0.67	x	55.42	x	0.63	x	0.7	=	11.35	(78)
South	0.9x	0.77	x	1.27	x	55.42	x	0.63	x	0.7	=	21.51	(78)
South	0.9x	0.77	x	0.67	x	40.4	x	0.63	x	0.7	=	8.27	(78)
South	0.9x	0.77	x	1.27	x	40.4	x	0.63	x	0.7	=	15.68	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	64.01	115.53	175.22	245.63	301	310.17	294.32	251.3	199.34	132.33	77.85	54.01	(83)
--------	-------	--------	--------	--------	-----	--------	--------	-------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m, watts

(84)m=	396.26	446.08	495.79	550.24	589.67	583.24	557.12	518.99	475.11	424.22	388.29	378.09	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. fLA = internal temperature during heating periods

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

(85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.92	0.79	0.6	0.45	0.5	0.75	0.95	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.96	20.11	20.35	20.66	20.88	20.98	21	20.99	20.93	20.65	20.25	19.93	(87)
--------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	20	20	20	20.01	20.01	20.02	20.02	20.02	20.01	20.01	20.01	20	(88)
--------	----	----	----	-------	-------	-------	-------	-------	-------	-------	-------	----	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.96	0.89	0.74	0.52	0.35	0.39	0.67	0.92	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.62	18.84	19.19	19.62	19.9	20	20.02	20.02	19.97	19.62	19.05	18.59	(90)
--------	-------	-------	-------	-------	------	----	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.28	19.46	19.76	20.13	20.38	20.48	20.49	20.49	20.44	20.12	19.64	19.24	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.28	19.46	19.76	20.13	20.38	20.48	20.49	20.49	20.44	20.12	19.64	19.24	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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DER WorkSheet: New dwelling design stage

Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.9	0.76	0.56	0.4	0.44	0.71	0.93	0.98	0.99	(94)
--------	------	------	------	-----	------	------	-----	------	------	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	392.6	438.33	476.54	494.29	448.79	326.26	220.21	230.31	336.4	392.44	381.12	375.29	(95)
--------	-------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x ((93)m - (96)m)]

(97)m=	872.06	846.13	768.94	644.69	497.48	333.98	221.22	232.14	361.3	545.57	721.17	868.64	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m

(98)m=	356.72	274.04	217.54	108.29	36.22	0	0	0	0	113.93	244.84	367.05	(98)
--------	--------	--------	--------	--------	-------	---	---	---	---	--------	--------	--------	------

Total per year (kWh/year) = Sum(98)_{1..12} = 1718.63 (98)

Space heating requirement in kWh/m²/year

32.67 (99)

35 Energy requirements - Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0 (301)

Fraction of space heat from community system 1 - (301) =

1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers

1 (303a)

Fraction of total space heat from Community boilers

(302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system

1 (305)

Distribution loss factor (Table 12c) for community heating system

1.05 (306)

Space heating

kWh/year

Annual space heating requirement

1718.63

Space heat from Community boilers

(98) x (304a) x (305) x (306) = 1804.56 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0 (308)

Space heating requirement from secondary/supplementary system

(98) x (301) x 100 ÷ (308) = 0 (309)

Water heating

Annual water heating requirement

1849.15

If DHW from community scheme:

Water heat from Community boilers

(64) x (303a) x (305) x (306) = 1941.6 (310a)

Electricity used for heat distribution

0.01 x [(307a)...(307e) + (310a)...(310e)] = 37.46 (313)

Cooling System Energy Efficiency Ratio

0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0)

= (107) ÷ (314) = 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):

mechanical ventilation - balanced, extract or positive input from outside

0 (330a)

warm air heating system fans

0 (330b)

pump for solar water heating

0 (330g)

Total electricity for the above, kWh/year

= (330a) + (330b) + (330g) = 0 (331)

DER WorkSheet: New dwelling design stage

Energy for lighting (calculated in Appendix L)	243.84	(332)
Electricity generated by PVs (Appendix M) (negative quantity)	-682.26	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)	0	(334)

25. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		94.3 (367a)
CO2 associated with heat source 1	$[(307b)+(310b)] \times 100 \div (367b) \times$	0.22	= 858.08 (367)
Electrical energy for heat distribution	$[(313) \times$	0.52	= 19.44 (372)
Total CO2 associated with community systems	$(363) \dots (366) + (368) \dots (372)$		= 877.52 (373)
CO2 associated with space heating (secondary)	$(309) \times$	0	= 0 (374)
CO2 associated with water from immersion heater or instantaneous heater	$(312) \times$	0.22	= 0 (375)
Total CO2 associated with space and water heating	$(373) + (374) + (375) =$		877.52 (376)
CO2 associated with electricity for pumps and fans within dwelling	$(331) \times$	0.52	= 0 (378)
CO2 associated with electricity for lighting	$(332) \times$	0.52	= 126.55 (379)
Energy saving/generation technologies (333) to (334) as applicable			
Item 1	0.32	$\times 0.01 =$	354.09 (380)
Total CO2, kg/year	sum of (376) ... (382) =		649.98 (383)
Dwelling CO2 Emission Rate	$(383) \div (4) =$		12.36 (384)
EI rating (section 14)			91.08 (385)

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User Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.25

Property Address: 1BF (S) MF

Address : 1BF (S) MF, Land North of Seftor Road, Bognor Regis, PO21 3FF

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52.6 (1a)	2.7 (2a)	142.02 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	142.02 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	(5)	0.14 (8)
---	----	-----	----------

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.39 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 0 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 1 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.39 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.5	0.49	0.48	0.43	0.42	0.37	0.37	0.36	0.39	0.42	0.44	0.46
-----	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.62 0.62 0.61 0.59 0.59 0.57 0.57 0.57 0.58 0.59 0.6 0.61 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.62 0.62 0.61 0.59 0.59 0.57 0.57 0.57 0.58 0.59 0.6 0.61 (25)

3. Building fabric and openings calculator

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors			1.96	1	1.96		(26)
Windows Type 1			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 2			0.67	$\times 1/[1/(1.4) + 0.04]$	0.89		(27)
Windows Type 3			1.27	$\times 1/[1/(1.4) + 0.04]$	1.68		(27)
Windows Type 4			3.99	$\times 1/[1/(1.4) + 0.04]$	5.29		(27)
Windows Type 5			1.82	$\times 1/[1/(1.4) + 0.04]$	2.41		(27)
Walls Type1	55.27	10.65	44.62	0.18	8.03		(29)
Walls Type2	4.05	1.96	2.09	0.18	0.38		(29)
Total area of elements, m²			59.32				(31)
Party wall			20.6	0	0		(32)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 24.49 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 5068.6 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 5.3 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 29.79 (37)

Ventilation heat loss calculated monthly (36)m = 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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(36)m=	29.25	29.03	28.8	27.76	27.57	26.66	26.66	26.5	27.01	27.57	27.96	28.37	(38)
--------	-------	-------	------	-------	-------	-------	-------	------	-------	-------	-------	-------	------

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

(39)m=	59.04	58.82	58.6	57.56	57.36	56.45	56.45	56.29	56.8	57.36	57.75	58.17	(39)
--------	-------	-------	------	-------	-------	-------	-------	-------	------	-------	-------	-------	------

$$\text{Average} = \text{Sum}(39)_{1..12} / 12 =$$

57.55

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m + (4)$$

(40)m=	1.12	1.12	1.11	1.09	1.09	1.07	1.07	1.07	1.08	1.09	1.1	1.11	(40)
--------	------	------	------	------	------	------	------	------	------	------	-----	------	------

$$\text{Average} = \text{Sum}(40)_{1..12} / 12 =$$

1.09

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N

1.77

(42)

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

76.16

(43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--

Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$

(44)m=	83.78	80.73	77.68	74.64	71.59	68.54	68.54	71.59	74.64	77.68	80.73	83.78	(44)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

$$\text{Total} = \text{Sum}(44)_{1..12} =$$

913.93

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times \text{mm} \times \text{DTm} / 3600 \text{ kWh/month}$ (see Tables 1b, 1c, 1d)

(45)m=	124.24	108.66	112.13	97.76	93.8	80.94	75	86.07	87.1	101.5	110.8	120.32	(45)
--------	--------	--------	--------	-------	------	-------	----	-------	------	-------	-------	--------	------

$$\text{Total} = \text{Sum}(45)_{1..12} =$$

1198.31

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.64	16.3	16.82	14.66	14.07	12.14	11.25	12.91	13.06	15.23	16.62	18.05	(46)
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

150

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

1.39

(48)

Temperature factor from Table 2b

0.54

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

0.75

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0

(51)

If community heating see section 4.3

Volume factor from Table 2a

0

(52)

Temperature factor from Table 2b

0

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

0

(54)

Enter (50) or (54) in (55)

0.75

(55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

If cylinder contains dedicated solar storage, $(57)m = (56)m \times [(50) - (H11)] \div (50)$, else $(57)m = (56)m$ where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(59)

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0
--------	---	---	---	---	---	---	---	---	---	---	---	---

(61)

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	170.83	150.75	158.72	142.85	140.39	126.03	121.6	132.66	132.19	148.1	155.89	166.91
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(62)

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0
--------	---	---	---	---	---	---	---	---	---	---	---	---

(63)

Output from water heater

(64)m=	170.83	150.75	158.72	142.85	140.39	126.03	121.6	132.66	132.19	148.1	155.89	166.91
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	--------	--------

Output from water heater (annual) 12

1746.92

(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	78.59	69.8	74.56	68.58	68.46	62.99	62.21	65.89	65.03	71.03	72.91	77.28
--------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (Table 5a)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m=	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34

(66)

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

(67)m=	13.81	12.26	9.97	7.55	5.64	4.76	5.15	6.69	8.98	11.41	13.31	14.19
--------	-------	-------	------	------	------	------	------	------	------	-------	-------	-------

(67)

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

(68)m=	153.98	155.58	151.55	142.98	132.16	121.99	115.2	113.6	117.63	126.2	137.02	147.19
--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	-------	--------	--------

(68)

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

(69)m=	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

(69)

Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3
--------	---	---	---	---	---	---	---	---	---	---	---	---

(70)

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

(71)m=	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

(71)

Water heating gains (Table 5)

(72)m=	105.63	103.87	100.21	95.25	92.02	87.48	83.62	88.57	90.32	95.46	101.27	103.87
--------	--------	--------	--------	-------	-------	-------	-------	-------	-------	-------	--------	--------

(72)

Total internal gains =

(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	325.92	324.21	314.24	298.28	282.33	266.74	256.47	261.36	269.43	285.57	304.1	317.75
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------

(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)		
North	0.9x	0.77	x	3.99	x	10.63	x	0.63	x	0.7	=	12.97	(74)
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91	(74)

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North	0.9x	0.77	x	3.99	x	20.32	x	0.63	x	0.7	=	24.78	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	3.99	x	34.53	x	0.63	x	0.7	=	42.11	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	3.99	x	55.46	x	0.63	x	0.7	=	67.63	(74)
North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)
North	0.9x	0.77	x	3.99	x	74.72	x	0.63	x	0.7	=	91.11	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	3.99	x	79.99	x	0.63	x	0.7	=	97.53	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	3.99	x	74.68	x	0.63	x	0.7	=	91.06	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	3.99	x	59.25	x	0.63	x	0.7	=	72.24	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	3.99	x	41.52	x	0.63	x	0.7	=	50.63	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	3.99	x	24.19	x	0.63	x	0.7	=	29.5	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	3.99	x	13.12	x	0.63	x	0.7	=	16	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	3.99	x	8.86	x	0.63	x	0.7	=	10.81	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
East	0.9x	0.77	x	1.45	x	19.64	x	0.63	x	0.7	=	17.41	(76)
East	0.9x	0.77	x	1.45	x	38.42	x	0.63	x	0.7	=	34.05	(76)
East	0.9x	0.77	x	1.45	x	63.27	x	0.63	x	0.7	=	56.08	(76)
East	0.9x	0.77	x	1.45	x	92.28	x	0.63	x	0.7	=	81.79	(76)
East	0.9x	0.77	x	1.45	x	113.09	x	0.63	x	0.7	=	100.23	(76)
East	0.9x	0.77	x	1.45	x	115.77	x	0.63	x	0.7	=	102.6	(76)
East	0.9x	0.77	x	1.45	x	110.22	x	0.63	x	0.7	=	97.68	(76)
East	0.9x	0.77	x	1.45	x	94.68	x	0.63	x	0.7	=	83.91	(76)
East	0.9x	0.77	x	1.45	x	73.59	x	0.63	x	0.7	=	65.22	(76)
East	0.9x	0.77	x	1.45	x	45.59	x	0.63	x	0.7	=	40.4	(76)
East	0.9x	0.77	x	1.45	x	24.49	x	0.63	x	0.7	=	21.7	(76)
East	0.9x	0.77	x	1.45	x	16.15	x	0.63	x	0.7	=	14.31	(76)
South	0.9x	0.77	x	0.67	x	46.75	x	0.63	x	0.7	=	9.57	(78)
South	0.9x	0.77	x	1.27	x	46.75	x	0.63	x	0.7	=	18.15	(78)
South	0.9x	0.77	x	0.67	x	76.57	x	0.63	x	0.7	=	15.68	(78)
South	0.9x	0.77	x	1.27	x	76.57	x	0.63	x	0.7	=	29.72	(78)
South	0.9x	0.77	x	0.67	x	97.53	x	0.63	x	0.7	=	19.97	(78)
South	0.9x	0.77	x	1.27	x	97.53	x	0.63	x	0.7	=	37.86	(78)
South	0.9x	0.77	x	0.67	x	110.23	x	0.63	x	0.7	=	22.57	(78)

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South	0.9x	0.77	x	1.27	x	110.23	x	0.63	x	0.7	=	42.79	(78)
South	0.9x	0.77	x	0.67	x	114.87	x	0.63	x	0.7	=	23.52	(78)
South	0.9x	0.77	x	1.27	x	114.87	x	0.63	x	0.7	=	44.58	(78)
South	0.9x	0.77	x	0.67	x	110.55	x	0.63	x	0.7	=	22.64	(78)
South	0.9x	0.77	x	1.27	x	110.55	x	0.63	x	0.7	=	42.91	(78)
South	0.9x	0.77	x	0.67	x	108.01	x	0.63	x	0.7	=	22.12	(78)
South	0.9x	0.77	x	1.27	x	108.01	x	0.63	x	0.7	=	41.92	(78)
South	0.9x	0.77	x	0.67	x	104.89	x	0.63	x	0.7	=	21.48	(78)
South	0.9x	0.77	x	1.27	x	104.89	x	0.63	x	0.7	=	40.71	(78)
South	0.9x	0.77	x	0.67	x	101.89	x	0.63	x	0.7	=	20.86	(78)
South	0.9x	0.77	x	1.27	x	101.89	x	0.63	x	0.7	=	39.54	(78)
South	0.9x	0.77	x	0.67	x	82.59	x	0.63	x	0.7	=	16.91	(78)
South	0.9x	0.77	x	1.27	x	82.59	x	0.63	x	0.7	=	32.05	(78)
South	0.9x	0.77	x	0.67	x	55.42	x	0.63	x	0.7	=	11.35	(78)
South	0.9x	0.77	x	1.27	x	55.42	x	0.63	x	0.7	=	21.51	(78)
South	0.9x	0.77	x	0.67	x	40.4	x	0.63	x	0.7	=	8.27	(78)
South	0.9x	0.77	x	1.27	x	40.4	x	0.63	x	0.7	=	15.68	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	64.01	115.53	175.22	245.63	301	310.17	294.32	251.3	199.34	132.32	77.85	54.01	(83)
--------	-------	--------	--------	--------	-----	--------	--------	-------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m, watts

(84)m=	389.92	439.74	489.46	543.9	583.33	576.91	550.79	512.66	468.78	417.89	381.95	371.76	(84)
--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. fLA = internal temperature during heating periods

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

21

(85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.92	0.8	0.61	0.45	0.5	0.76	0.95	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.93	20.08	20.33	20.65	20.88	20.98	21	20.99	20.93	20.64	20.23	19.91	(87)
--------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.98	19.99	19.99	20.01	20.01	20.02	20.02	20.03	20.02	20.01	20	20	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	----	----	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.9	0.74	0.52	0.35	0.4	0.68	0.93	0.98	0.99	(89)
--------	------	------	------	-----	------	------	------	-----	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.57	18.79	19.15	19.61	19.9	20.01	20.02	20.02	19.97	19.6	19.03	18.55	(90)
--------	-------	-------	-------	-------	------	-------	-------	-------	-------	------	-------	-------	------

fLA = Living area ÷ (4) =

0.49

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.23	19.42	19.73	20.12	20.38	20.48	20.5	20.5	20.44	20.11	19.62	19.21	(92)
--------	-------	-------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	19.23	19.42	19.73	20.12	20.38	20.48	20.5	20.5	20.44	20.11	19.62	19.21	(93)
--------	-------	-------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
--	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	--

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Utilisation factor for gains, hm:

(94)m=	0.99	0.98	0.96	0.9	0.77	0.56	0.4	0.45	0.71	0.93	0.98	0.99	(94)
--------	------	------	------	-----	------	------	-----	------	------	------	------	------	------

Useful gains, hmGm, W = (94)m x (84)m

(95)m=	386.57	432.59	471.54	490.65	447.19	324.37	219.02	228.79	334.52	388.08	375.37	369.2	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, Lm, W = [(39)m x ((93)m - (96)m)]

(97)m=	881.55	854.12	775.1	645.6	497.71	332.1	220.03	230.6	360.09	545.47	722.91	873.19	(97)
--------	--------	--------	-------	-------	--------	-------	--------	-------	--------	--------	--------	--------	------

Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m

(98)m=	368.26	283.27	225.85	111.56	37.58	0	0	0	0	117.1	250.23	374.97	(98)
--------	--------	--------	--------	--------	-------	---	---	---	---	-------	--------	--------	------

Total per year (kWh/year) = Sum(98)_{1..5,9..12} = 1768.83 (98)

Space heating requirement in kWh/m²/year

33.63 (99)

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

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = 1 - (201) =

1 (202)

Fraction of total heating from main system 1

(204) = (202) x [1 - (203)] =

1 (204)

Efficiency of main space heating system 1

93.5 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

368.26	283.27	225.85	111.56	37.58	0	0	0	0	117.1	250.23	374.97
--------	--------	--------	--------	-------	---	---	---	---	-------	--------	--------

(211)m = [(98)m x (204)] x 100 + (206) (211)

393.86	302.96	241.55	119.32	40.2	0	0	0	0	125.24	267.62	401.04
--------	--------	--------	--------	------	---	---	---	---	--------	--------	--------

Total (kWh/year) = Sum(211)_{1..5,10..12} = 1891.79 (211)

Space heating fuel (secondary), kWh/month

= [(98)m x (201)] x 100 ÷ (208)

(215)m=	0	0	0	0	0	0	0	0	0	0	0	(215)
---------	---	---	---	---	---	---	---	---	---	---	---	-------

Total (kWh/year) = Sum(215)_{1..5,10..12} = 0 (215)

Water heating

Output from water heater (calculated above)

170.83	150.75	158.72	142.85	140.39	126.03	121.6	132.66	132.19	148.1	155.89	166.91
--------	--------	--------	--------	--------	--------	-------	--------	--------	-------	--------	--------

Efficiency of water heater

79.8 (216)

(217)m=	86.81	86.47	85.75	84.16	81.84	79.8	79.8	79.8	79.8	84.2	86.07	86.91	(217)
---------	-------	-------	-------	-------	-------	------	------	------	------	------	-------	-------	-------

Fuel for water heating, kWh/month

(219)m = (64)m x 100 ÷ (217)m

(219)m=	196.79	174.33	185.09	169.73	171.54	157.94	152.38	166.24	165.65	175.9	181.12	192.05	(219)
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	-------

Total = Sum(219a)_{1..12} = 2088.74 (219)

Annual totals

kWh/year

kWh/year

Space heating fuel used, main system 1

1891.79

Water heating fuel used

2088.74

Electricity for pumps, fans and electric keep-hot

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central heating pump:		30	(230c)
boiler with a fan-assisted flue		45	(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =	75	(231)
Electricity for lighting		243.84	(232)

24. 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)	(211) x	0.216	408.63 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.216	451.17 (264)
Space and water heating	(261) + (262) + (263) + (264) =		859.8 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	38.93 (267)
Electricity for lighting	(232) x	0.519	126.55 (268)
Total CO2, kg/year	sum of (265)...(271) =		1025.27 (272)

TER = 19.49 (273)

DRAFT

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.25

Property Address: 1BF (S) TF

Address : 1BF (S) TF, Land North of Sefter Road, Bognor Regis, PO21 3FF

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52.6 (1a)	2.31 (2a)	121.51 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	121.51 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.16 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)

Additional infiltration

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0

If no draught lobby, enter 0.05, else enter 0

Percentage of windows and doors draught stripped

Window infiltration

$$0.25 - [0.2 \times (14) \div 100] =$$

Infiltration rate

$$(8) + (10) + (11) + (12) + (13) + (15) =$$

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area

If based on air permeability value, then (18) = [(17) + 20] ÷ (8), otherwise (18) = (16)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered

Shelter factor

$$(20) = 1 - [0.075 \times (19)] =$$

Infiltration rate incorporating shelter factor

$$(21) = (18) \times (20) =$$

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.4	0.39	0.39	0.35	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37
-----	------	------	------	------	-----	-----	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (25)

3. Building fabric and openings calculator

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A x U (W/K)	k-value kJ/m²·K	A X k
Doors			1.96	1.1	2.156		(26)
Windows Type 1			1.45	1/[1/(1.2) + 0.04]	1.68		(27)
Windows Type 2			0.67	1/[1/(1.2) + 0.04]	0.77		(27)
Windows Type 3			1.27	1/[1/(1.2) + 0.04]	1.45		(27)
Windows Type 4			3.99	1/[1/(1.2) + 0.04]	4.57		(27)
Windows Type 5			1.82	1/[1/(1.2) + 0.04]	2.08		(27)
Walls Type1	47.29	10.65	36.64	0.17	6.23		(29)
Walls Type2	3.47	1.96	1.51	0.16	0.24		(29)
Roof	52.6	0	52.6	0.1	5.26		(30)
Total area of elements, m²			103.36				(31)
Party wall			17.63	0	0		(32)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)

{(26) ... (30) + (32) = 26.08 (33)

Heat capacity Cm = S(A x k)

{(28) ... (30) + (32) + (32a) ... (32e) = 4701.7 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K

Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K

8.9 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss

{(33) + (36) = 34.97 (37)

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Ventilation heat loss calculated monthly

$$(38)m = 0.33 \times (25)m \times (5)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.27	23.15	23.03	22.45	22.34	21.84	21.84	21.75	22.03	22.34	22.56	22.79	(38)

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	58.25	58.12	58	57.42	57.32	56.81	56.81	56.72	57.01	57.32	57.53	57.76	
Average = Sum(39) _{1..12} / 12 =												57.42	(39)

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.11	1.11	1.1	1.09	1.09	1.08	1.08	1.08	1.08	1.09	1.09	1.1	
Average = Sum(40) _{1..12} / 12 =												1.09	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

1.77

(42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

76.16

(43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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=	83.78	80.73	77.68	74.64	71.59	68.54	68.54	71.59	74.64	77.68	80.73	83.78	
Total = Sum(44) _{1..12} =												913.93	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	124.24	108.66	112.13	97.76	93.8	80.94	75	86.07	87.1	101.5	110.8	120.32	
Total = Sum(45) _{1..12} =												1198.31	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	18.64	16.3	16.82	14.66	14.07	12.14	11.25	12.91	13.06	15.23	16.62	18.05	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

0

(47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

0

(48)

Temperature factor from Table 2b

0

(49)

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

110

(50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

0.02

(51)

If community heating see section 4.3

Volume factor from Table 2a

1.03

(52)

Temperature factor from Table 2b

0.6

(53)

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

1.03

(54)

Enter (50) or (54) in (55)

1.03

(55)

Water storage loss calculated for each month

$$((55)m = (55) \times (41)m$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	179.52	158.59	167.4	151.25	149.08	134.43	130.28	141.34	140.59	156.78	164.29	175.6	(62)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	179.52	158.59	167.4	151.25	149.08	134.43	130.28	141.34	140.59	156.78	164.29	175.6	
Output from water heater (annual) × 1.12												1849.15	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	85.53	76.07	81.5	75.3	75.41	69.71	69.16	72.84	71.75	77.97	79.63	84.23	(65)
--------	-------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	106.01	106.01	106.01	106.01	106.01	106.01	106.01	106.01	106.01	106.01	106.01	106.01	(66)

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

(67)m=	34.52	30.66	24.93	18.88	14.11	11.91	12.87	16.73	22.46	28.51	33.28	35.48	(67)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

(68)m=	229.82	232.21	226.2	213.4	197.25	182.08	171.93	169.55	175.56	188.35	204.5	219.68	(68)
--------	--------	--------	-------	-------	--------	--------	--------	--------	--------	--------	-------	--------	------

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

(69)m=	47.37	47.37	47.37	47.37	47.37	47.37	47.37	47.37	47.37	47.37	47.37	47.37	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	114.96	113.2	109.55	104.58	101.36	96.82	92.96	97.9	99.66	104.8	110.6	113.21	(72)
--------	--------	-------	--------	--------	--------	-------	-------	------	-------	-------	-------	--------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	462	458.77	443.38	419.56	395.42	373.51	360.47	366.89	380.38	404.37	431.09	451.07	(73)
--------	-----	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m ²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
--------------	---------------------------	------------------------	------------------	----------------	----------------	--------------

SAP WorkSheet: New dwelling design stage

North	0.9x	0.77	x	3.99	x	10.63	x	0.63	x	0.7	=	12.97	(74)
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91	(74)
North	0.9x	0.77	x	3.99	x	20.32	x	0.63	x	0.7	=	24.78	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	3.99	x	34.53	x	0.63	x	0.7	=	42.11	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	3.99	x	55.46	x	0.63	x	0.7	=	67.63	(74)
North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)
North	0.9x	0.77	x	3.99	x	74.72	x	0.63	x	0.7	=	91.11	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	3.99	x	79.99	x	0.63	x	0.7	=	97.53	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	3.99	x	74.68	x	0.63	x	0.7	=	91.06	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	3.99	x	59.25	x	0.63	x	0.7	=	72.24	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	3.99	x	41.52	x	0.63	x	0.7	=	50.63	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	3.99	x	24.19	x	0.63	x	0.7	=	29.5	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	3.99	x	13.12	x	0.63	x	0.7	=	16	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	3.99	x	8.86	x	0.63	x	0.7	=	10.91	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
East	0.9x	0.77	x	1.45	x	19.64	x	0.63	x	0.7	=	17.41	(76)
East	0.9x	0.77	x	1.45	x	38.42	x	0.63	x	0.7	=	34.05	(76)
East	0.9x	0.77	x	1.45	x	63.27	x	0.63	x	0.7	=	56.08	(76)
East	0.9x	0.77	x	1.45	x	92.28	x	0.63	x	0.7	=	81.79	(76)
East	0.9x	0.77	x	1.45	x	113.09	x	0.63	x	0.7	=	100.23	(76)
East	0.9x	0.77	x	1.45	x	115.77	x	0.63	x	0.7	=	102.6	(76)
East	0.9x	0.77	x	1.45	x	110.22	x	0.63	x	0.7	=	97.68	(76)
East	0.9x	0.77	x	1.45	x	94.68	x	0.63	x	0.7	=	83.91	(76)
East	0.9x	0.77	x	1.45	x	73.59	x	0.63	x	0.7	=	65.22	(76)
East	0.9x	0.77	x	1.45	x	45.59	x	0.63	x	0.7	=	40.4	(76)
East	0.9x	0.77	x	1.45	x	24.49	x	0.63	x	0.7	=	21.7	(76)
East	0.9x	0.77	x	1.45	x	16.15	x	0.63	x	0.7	=	14.31	(76)
South	0.9x	0.77	x	0.67	x	46.75	x	0.63	x	0.7	=	9.57	(78)
South	0.9x	0.77	x	1.27	x	46.75	x	0.63	x	0.7	=	18.15	(78)
South	0.9x	0.77	x	0.67	x	76.57	x	0.63	x	0.7	=	15.68	(78)
South	0.9x	0.77	x	1.27	x	76.57	x	0.63	x	0.7	=	29.72	(78)
South	0.9x	0.77	x	0.67	x	97.53	x	0.63	x	0.7	=	19.97	(78)

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South	0.9x	0.77	x	1.27	x	97.53	x	0.63	x	0.7	=	37.86	(78)
South	0.9x	0.77	x	0.67	x	110.23	x	0.63	x	0.7	=	22.57	(78)
South	0.9x	0.77	x	1.27	x	110.23	x	0.63	x	0.7	=	42.79	(78)
South	0.9x	0.77	x	0.67	x	114.87	x	0.63	x	0.7	=	23.52	(78)
South	0.9x	0.77	x	1.27	x	114.87	x	0.63	x	0.7	=	44.58	(78)
South	0.9x	0.77	x	0.67	x	110.55	x	0.63	x	0.7	=	22.64	(78)
South	0.9x	0.77	x	1.27	x	110.55	x	0.63	x	0.7	=	42.91	(78)
South	0.9x	0.77	x	0.67	x	108.01	x	0.63	x	0.7	=	22.12	(78)
South	0.9x	0.77	x	1.27	x	108.01	x	0.63	x	0.7	=	41.92	(78)
South	0.9x	0.77	x	0.67	x	104.89	x	0.63	x	0.7	=	21.48	(78)
South	0.9x	0.77	x	1.27	x	104.89	x	0.63	x	0.7	=	40.71	(78)
South	0.9x	0.77	x	0.67	x	101.89	x	0.63	x	0.7	=	20.86	(78)
South	0.9x	0.77	x	1.27	x	101.89	x	0.63	x	0.7	=	39.54	(78)
South	0.9x	0.77	x	0.67	x	82.59	x	0.63	x	0.7	=	16.91	(78)
South	0.9x	0.77	x	1.27	x	82.59	x	0.63	x	0.7	=	32.05	(78)
South	0.9x	0.77	x	0.67	x	55.42	x	0.63	x	0.7	=	11.35	(78)
South	0.9x	0.77	x	1.27	x	55.42	x	0.63	x	0.7	=	21.51	(78)
South	0.9x	0.77	x	0.67	x	40.4	x	0.63	x	0.7	=	8.27	(78)
South	0.9x	0.77	x	1.27	x	40.4	x	0.63	x	0.7	=	15.68	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	64.01	115.53	175.22	245.63	301	310.17	294.32	251.3	189.34	132.32	77.85	54.01	(83)
--------	-------	--------	--------	--------	-----	--------	--------	-------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	526.01	574.3	618.6	665.19	696.43	683.68	654.79	618.18	579.72	535.69	508.94	505.08	(84)
--------	--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.98	0.97	0.94	0.86	0.71	0.52	0.38	0.42	0.65	0.88	0.96	0.98	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	20.18	20.32	20.53	20.78	20.93	20.99	21	21	20.97	20.78	20.44	20.15	(87)
--------	-------	-------	-------	-------	-------	-------	----	----	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.99	20	20	20.01	20.01	20.02	20.02	20.02	20.01	20.01	20.01	20	(88)
--------	-------	----	----	-------	-------	-------	-------	-------	-------	-------	-------	----	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.97	0.96	0.92	0.82	0.65	0.45	0.3	0.33	0.57	0.84	0.95	0.98	(89)
--------	------	------	------	------	------	------	-----	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.94	19.13	19.43	19.77	19.95	20.01	20.02	20.02	19.99	19.78	19.32	18.9	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

fLA = Living area ÷ (4) =

0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.54	19.71	19.97	20.26	20.43	20.49	20.5	20.5	20.47	20.27	19.87	19.51	(92)
--------	-------	-------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.54	19.71	19.97	20.26	20.43	20.49	20.5	20.5	20.47	20.27	19.87	19.51	(93)
--------	-------	-------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.97	0.96	0.92	0.83	0.68	0.48	0.34	0.37	0.61	0.85	0.95	0.98	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	511.19	548.83	568.55	553.05	471.88	330.58	220.86	231.5	350.88	457.8	483.45	493.04	(95)
--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	-------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]$

(97)m=	887.87	860.9	781.2	652.28	500.32	334.53	221.34	232.32	363.04	554.01	734.71	884.21	(97)
--------	--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	280.25	209.71	158.22	71.44	21.15	0	0	0	0	71.58	180.9	291.03	
--------	--------	--------	--------	-------	-------	---	---	---	---	-------	-------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1..12} =$ 1284.29 (98)

Space heating requirement in $kWh/m^2/year$

24.42 (99)

9. Energy requirements: Community heating system

This part is used for space heating, space cooling or water heating provided by a community scheme. Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0 (301)

Fraction of space heat from community system $1 - (301) =$

1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers

1 (303a)

Fraction of total space heat from Community boilers

$(302) \times (303a) =$ 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system

1 (305)

Distribution loss factor (Table 12c) for community heating system

1.05 (306)

Space heating

$kWh/year$

Annual space heating requirement

1284.29

Space heat from Community boilers

$(98) \times (304a) \times (305) \times (306) =$ 1348.5 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0 (308)

Space heating requirement from secondary/supplementary system

$(98) \times (301) \times 100 \div (308) =$ 0 (309)

Water heating

Annual water heating requirement

1849.15

If DHW from community scheme:

Water heat from Community boilers

$(64) \times (303a) \times (305) \times (306) =$ 1941.6 (310a)

Electricity used for heat distribution

$0.01 \times [(307a) \dots (307e) + (310a) \dots (310e)] =$ 32.9 (313)

Cooling System Energy Efficiency Ratio

0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0)

$= (107) \div (314) =$ 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):

mechanical ventilation - balanced, extract or positive input from outside

0 (330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	$= (330a) + (330b) + (330g) =$	0	(331)
Energy for lighting (calculated in Appendix L)		243.84	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-682.26	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

10b. Fuel costs – Community heating scheme

	Fuel kWh/year	Fuel Price (Table 12)	Fuel Cost £/year
Space heating from CHP	(307a) x	4.24	$\times 0.01 = 57.18$ (340a)
Water heating from CHP	(310a) x	4.24	$\times 0.01 = 82.32$ (342a)
Pumps and fans	(331)	13.19	$\times 0.01 = 0$ (349)
Energy for lighting	(332)	13.19	$\times 0.01 = 32.16$ (350)
Additional standing charges (Table 12)			120 (351)
Energy saving/generation technologies			
Total energy cost	$= (340a) + (342a) + (349) + (351) =$		291.66 (355)

11. SAP rating – Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	$[(355) \times (356)] \div [(4) + 45.0] =$	1.26	(357)
SAP rating (section 12)		82.49	(358)

12b. CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		93.4 (367a)
CO2 associated with heat source 1	$[(307b) + (310b)] \times 100 \div (367b) \times$	0.22	$= 760.88$ (367)
Electrical energy for heat distribution	$[(313) \times$	0.52	$= 17.08$ (372)
Total CO2 associated with community systems	$(363) \dots (366) + (368) \dots (372)$		$= 777.96$ (373)
CO2 associated with space heating (secondary)	(309) x	0	$= 0$ (374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	$= 0$ (375)
Total CO2 associated with space and water heating	$(373) + (374) + (375) =$		777.96 (376)
CO2 associated with electricity for pumps and fans within dwelling	(331) x	0.52	$= 0$ (378)
CO2 associated with electricity for lighting	(332) x	0.52	$= 126.55$ (379)
Energy saving/generation technologies (333) to (334) as applicable			
Item 1		0.52	$\times 0.01 = -354.09$ (380)
Total CO2, kg/year	sum of (376) ... (382) =		550.42 (383)

SAP WorkSheet: New dwelling design stage

Dwelling CO2 Emission Rate (383) ÷ (4) =

10.46 (384)

El rating (section 14)

92.44 (385)

3b Primary Energy – Community heating scheme

	Energy kWh/year	Primary factor	P.Energy kWh/year
Energy from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		93.4 (367a)
Energy associated with heat source 1	$[(307b) + (310b)] \times 100 \div (367b) \times$	1.22	4297.57 (367)
Electrical energy for heat distribution	$[(313) \times$		101.01 (372)
Total Energy associated with community systems	$(363) \dots (366) + (368) \dots (372)$		4398.57 (373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)			4398.57 (373)
Energy associated with space heating (secondary)	$(309) \times$	0	0 (374)
Energy associated with water from immersion heater or instantaneous heater	$(312) \times$	1.22	0 (375)
Total Energy associated with space and water heating	$(373) + (374) + (375) =$		4398.57 (376)
Energy associated with space cooling	$(315) \times$	3.07	0 (377)
Energy associated with electricity for pumps and fans within dwelling	$(331) \times$	3.07	0 (378)
Energy associated with electricity for lighting	$(332) \times$	3.07	748.59 (379)
Energy saving/generation technologies Item 1		3.07 × 0.01 =	-2094.34 (380)
Total Primary Energy, kWh/year	sum of (376) (382) =		3052.63 (383)

DER WorkSheet: New dwelling design stage

User Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.25

Property Address: 1BF (S) TF

Address : 1BF (S) TF, Land North of Sefter Road, Bognor Regis, PO21 3FF

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52.6 (1a)	2.31 (2a)	121.51 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	121.51 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	(5)	0.16 (8)
---	----	-----	----------

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns)	0	(9)
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Additional infiltration	[(9)-1]x0.1 =	0 (10)
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Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction	0	(11)
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if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0	0	(12)
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If no draught lobby, enter 0.05, else enter 0	0	(13)
---	---	------

Percentage of windows and doors draught stripped	0	(14)
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Window infiltration	0.25 - [0.2 x (14) ÷ 100] =	0 (15)
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Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =	0 (16)
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Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3	(17)
---	---	------

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.31	(18)
--	------	------

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered	0	(19)
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Shelter factor	(20) = 1 - [0.075 x (19)] =	1 (20)
----------------	-----------------------------	--------

Infiltration rate incorporating shelter factor	(21) = (18) x (20) =	0.31 (21)
--	----------------------	-----------

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
--------	-----	---	-----	-----	-----	-----	-----	-----	---	-----	-----	-----

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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DER WorkSheet: New dwelling design stage

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.4	0.39	0.39	0.35	0.34	0.3	0.3	0.29	0.31	0.34	0.35	0.37
-----	------	------	------	------	-----	-----	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.58 0.58 0.57 0.56 0.56 0.54 0.54 0.54 0.55 0.56 0.56 0.57 (25)

3. Building fabric and openings calculator

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A x U (W/K)	k-value kJ/m²·K	A X k
Doors			1.96	1.1	2.156		(26)
Windows Type 1			1.45	1/[1/(1.2) + 0.04]	1.68		(27)
Windows Type 2			0.67	1/[1/(1.2) + 0.04]	0.77		(27)
Windows Type 3			1.27	1/[1/(1.2) + 0.04]	1.45		(27)
Windows Type 4			3.99	1/[1/(1.2) + 0.04]	4.57		(27)
Windows Type 5			1.82	1/[1/(1.2) + 0.04]	2.08		(27)
Walls Type1	47.29	10.65	36.64	0.17	6.23		(29)
Walls Type2	3.47	1.96	1.51	0.16	0.24		(29)
Roof	52.6	0	52.6	0.1	5.26		(30)
Total area of elements, m²			103.36				(31)
Party wall			17.63	0	0		(32)

* for windows and roof windows, use effective window U-value calculated using formula 1/[(1/U-value)+0.04] as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26) ... (30) + (32) = 26.08 (33)

Heat capacity Cm = S(A x k) ((28) ... (30) + (32) + (32a) ... (32e) = 4701.7 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 8.9 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 34.97 (37)

DER WorkSheet: New dwelling design stage

Ventilation heat loss calculated monthly

$$(38)m = 0.33 \times (25)m \times (5)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	23.27	23.15	23.03	22.45	22.34	21.84	21.84	21.75	22.03	22.34	22.56	22.79	(38)

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	58.25	58.12	58	57.42	57.32	56.81	56.81	56.72	57.01	57.32	57.53	57.76	
Average = Sum(39) _{1..12} / 12 =												57.42	(39)

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.11	1.11	1.1	1.09	1.09	1.08	1.08	1.08	1.08	1.09	1.09	1.1	
Average = Sum(40) _{1..12} / 12 =												1.09	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement (kWh/year)

Assumed occupancy, N

$$\text{if TFA} > 13.9, N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$$

$$\text{if TFA} \leq 13.9, N = 1$$

1.77 (42)

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

76.16 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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=	83.78	80.73	77.68	74.64	71.59	68.54	68.54	71.59	74.64	77.68	80.73	83.78	
Total = Sum(44) _{1..12} =												913.93	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	124.24	108.66	112.13	97.76	93.8	80.94	75	86.07	87.1	101.5	110.8	120.32	
Total = Sum(45) _{1..12} =												1198.31	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	18.64	16.3	16.82	14.66	14.07	12.14	11.25	12.91	13.06	15.23	16.62	18.05	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 0 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

Energy lost from water storage, kWh/year $(48) \times (49) =$ 110 (50)

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day) 0.02 (51)

If community heating see section 4.3

Volume factor from Table 2a 1.03 (52)

Temperature factor from Table 2b 0.6 (53)

Energy lost from water storage, kWh/year $(47) \times (51) \times (52) \times (53) =$ 1.03 (54)

Enter (50) or (54) in (55) 1.03 (55)

Water storage loss calculated for each month $((55)m = (55) \times (41)m$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

DER WorkSheet: New dwelling design stage

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Primary circuit loss (annual) from Table 3 0 (58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	179.52	158.59	167.4	151.25	149.08	134.43	130.28	141.34	140.59	156.78	164.29	175.6	(62)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

Output from water heater

(64)m=	179.52	158.59	167.4	151.25	149.08	134.43	130.28	141.34	140.59	156.78	164.29	175.6	
Output from water heater (annual) $\times 12$												1849.15	(64)

Heat gains from water heating, kWh/month $0.25 \times [0.85 \times (45)m + (61)m + 0.8 \times [(46)m + (57)m + (59)m]]$

(65)m=	85.53	76.07	81.5	75.3	75.41	69.71	69.16	72.84	71.75	77.97	79.63	84.23	(65)
--------	-------	-------	------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (Table 5)

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	(66)

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

(67)m=	13.81	12.26	9.97	7.55	5.64	4.76	5.15	6.69	8.98	11.41	13.31	14.19	(67)
--------	-------	-------	------	------	------	------	------	------	------	-------	-------	-------	------

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

(68)m=	153.98	155.58	151.55	142.98	132.16	121.99	115.2	113.6	117.63	126.2	137.02	147.19	(68)
--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	-------	--------	--------	------

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

(69)m=	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	(69)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Pumps and fans gains (Table 5a)

(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
--------	---	---	---	---	---	---	---	---	---	---	---	---	------

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

(71)m=	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	(71)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Water heating gains (Table 5)

(72)m=	114.96	113.2	109.55	104.58	101.36	96.82	92.96	97.9	99.66	104.8	110.6	113.21	(72)
--------	--------	-------	--------	--------	--------	-------	-------	------	-------	-------	-------	--------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	332.25	330.55	320.58	304.61	288.66	273.07	262.8	267.69	275.77	291.9	310.44	324.09	(73)
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6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m ²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
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DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	3.99	x	10.63	x	0.63	x	0.7	=	12.97	(74)
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91	(74)
North	0.9x	0.77	x	3.99	x	20.32	x	0.63	x	0.7	=	24.78	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	3.99	x	34.53	x	0.63	x	0.7	=	42.11	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	3.99	x	55.46	x	0.63	x	0.7	=	67.63	(74)
North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)
North	0.9x	0.77	x	3.99	x	74.72	x	0.63	x	0.7	=	91.11	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	3.99	x	79.99	x	0.63	x	0.7	=	97.53	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	3.99	x	74.68	x	0.63	x	0.7	=	91.06	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	3.99	x	59.25	x	0.63	x	0.7	=	72.24	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	3.99	x	41.52	x	0.63	x	0.7	=	50.63	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	3.99	x	24.19	x	0.63	x	0.7	=	29.5	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	3.99	x	13.12	x	0.63	x	0.7	=	16	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	3.99	x	8.86	x	0.63	x	0.7	=	10.91	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
East	0.9x	0.77	x	1.45	x	19.64	x	0.63	x	0.7	=	17.41	(76)
East	0.9x	0.77	x	1.45	x	38.42	x	0.63	x	0.7	=	34.05	(76)
East	0.9x	0.77	x	1.45	x	63.27	x	0.63	x	0.7	=	56.08	(76)
East	0.9x	0.77	x	1.45	x	92.28	x	0.63	x	0.7	=	81.79	(76)
East	0.9x	0.77	x	1.45	x	113.09	x	0.63	x	0.7	=	100.23	(76)
East	0.9x	0.77	x	1.45	x	115.77	x	0.63	x	0.7	=	102.6	(76)
East	0.9x	0.77	x	1.45	x	110.22	x	0.63	x	0.7	=	97.68	(76)
East	0.9x	0.77	x	1.45	x	94.68	x	0.63	x	0.7	=	83.91	(76)
East	0.9x	0.77	x	1.45	x	73.59	x	0.63	x	0.7	=	65.22	(76)
East	0.9x	0.77	x	1.45	x	45.59	x	0.63	x	0.7	=	40.4	(76)
East	0.9x	0.77	x	1.45	x	24.49	x	0.63	x	0.7	=	21.7	(76)
East	0.9x	0.77	x	1.45	x	16.15	x	0.63	x	0.7	=	14.31	(76)
South	0.9x	0.77	x	0.67	x	46.75	x	0.63	x	0.7	=	9.57	(78)
South	0.9x	0.77	x	1.27	x	46.75	x	0.63	x	0.7	=	18.15	(78)
South	0.9x	0.77	x	0.67	x	76.57	x	0.63	x	0.7	=	15.68	(78)
South	0.9x	0.77	x	1.27	x	76.57	x	0.63	x	0.7	=	29.72	(78)
South	0.9x	0.77	x	0.67	x	97.53	x	0.63	x	0.7	=	19.97	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	1.27	x	97.53	x	0.63	x	0.7	=	37.86	(78)
South	0.9x	0.77	x	0.67	x	110.23	x	0.63	x	0.7	=	22.57	(78)
South	0.9x	0.77	x	1.27	x	110.23	x	0.63	x	0.7	=	42.79	(78)
South	0.9x	0.77	x	0.67	x	114.87	x	0.63	x	0.7	=	23.52	(78)
South	0.9x	0.77	x	1.27	x	114.87	x	0.63	x	0.7	=	44.58	(78)
South	0.9x	0.77	x	0.67	x	110.55	x	0.63	x	0.7	=	22.64	(78)
South	0.9x	0.77	x	1.27	x	110.55	x	0.63	x	0.7	=	42.91	(78)
South	0.9x	0.77	x	0.67	x	108.01	x	0.63	x	0.7	=	22.12	(78)
South	0.9x	0.77	x	1.27	x	108.01	x	0.63	x	0.7	=	41.92	(78)
South	0.9x	0.77	x	0.67	x	104.89	x	0.63	x	0.7	=	21.48	(78)
South	0.9x	0.77	x	1.27	x	104.89	x	0.63	x	0.7	=	40.71	(78)
South	0.9x	0.77	x	0.67	x	101.89	x	0.63	x	0.7	=	20.86	(78)
South	0.9x	0.77	x	1.27	x	101.89	x	0.63	x	0.7	=	39.54	(78)
South	0.9x	0.77	x	0.67	x	82.59	x	0.63	x	0.7	=	16.91	(78)
South	0.9x	0.77	x	1.27	x	82.59	x	0.63	x	0.7	=	32.05	(78)
South	0.9x	0.77	x	0.67	x	55.42	x	0.63	x	0.7	=	11.35	(78)
South	0.9x	0.77	x	1.27	x	55.42	x	0.63	x	0.7	=	21.51	(78)
South	0.9x	0.77	x	0.67	x	40.4	x	0.63	x	0.7	=	8.27	(78)
South	0.9x	0.77	x	1.27	x	40.4	x	0.63	x	0.7	=	15.68	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	64.01	115.53	175.22	245.63	301	310.17	291.32	251.3	189.34	132.32	77.85	54.01	(83)
--------	-------	--------	--------	--------	-----	--------	--------	-------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	396.26	446.06	495.79	550.24	589.67	583.24	557.12	518.99	475.13	424.22	388.29	378.09	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.97	0.92	0.79	0.6	0.45	0.5	0.75	0.95	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.96	20.11	20.35	20.66	20.88	20.98	21	20.99	20.93	20.65	20.25	19.93	(87)
--------	-------	-------	-------	-------	-------	-------	----	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.99	20	20	20.01	20.01	20.02	20.02	20.02	20.01	20.01	20.01	20	(88)
--------	-------	----	----	-------	-------	-------	-------	-------	-------	-------	-------	----	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.96	0.89	0.74	0.52	0.35	0.39	0.67	0.92	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.62	18.84	19.19	19.62	19.9	20	20.02	20.02	19.97	19.62	19.05	18.58	(90)
--------	-------	-------	-------	-------	------	----	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.27	19.46	19.76	20.13	20.38	20.48	20.49	20.49	20.44	20.12	19.64	19.24	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

DER WorkSheet: New dwelling design stage

(93)m=	19.27	19.46	19.76	20.13	20.38	20.48	20.49	20.49	20.44	20.12	19.64	19.24	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, h_m :

(94)m=	0.99	0.98	0.96	0.9	0.76	0.56	0.4	0.44	0.71	0.93	0.98	0.99	(94)
--------	------	------	------	-----	------	------	-----	------	------	------	------	------	------

Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	392.6	438.33	476.55	494.31	448.84	326.32	220.25	230.36	336.45	392.45	381.12	375.29	(95)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times [(93)m - (96)m]$

(97)m=	872.25	846.31	769.1	644.83	497.58	334.05	221.26	232.18	361.37	545.68	721.32	868.82	(97)
--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	356.86	274.17	217.66	108.38	36.26	0	0	0	0	114	244.95	367.19	
--------	--------	--------	--------	--------	-------	---	---	---	---	-----	--------	--------	--

Total per year ($kWh/year$) = $Sum(98)_{1..12} =$

1719.46 (98)

Space heating requirement in $kWh/m^2/year$

32.69 (99)

9. Energy requirements: Community heating system

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0 (301)

Fraction of space heat from community system $1 - (301) =$

1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers

1 (303a)

Fraction of total space heat from Community boilers

$(302) \times (303a) =$

1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system

1 (305)

Distribution loss factor (Table 12c) for community heating system

1.05 (306)

Space heating

kWh/year

Annual space heating requirement

1719.46

Space heat from Community boilers

$(98) \times (304a) \times (305) \times (306) =$

1805.43 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0 (308)

Space heating requirement from secondary/supplementary system

$(98) \times (301) \times 100 \div (308) =$

0 (309)

Water heating

Annual water heating requirement

1849.15

If DHW from community scheme:

Water heat from Community boilers

$(64) \times (303a) \times (305) \times (306) =$

1941.6 (310a)

Electricity used for heat distribution

$0.01 \times [(307a) \dots (307e) + (310a) \dots (310e)] =$

37.47 (313)

Cooling System Energy Efficiency Ratio

0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0)

$= (107) \div (314) =$

0 (315)

Electricity for pumps and fans within dwelling (Table 4f):

mechanical ventilation - balanced, extract or positive input from outside

0 (330a)

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warm air heating system fans		0	(330b)
pump for solar water heating		0	(330g)
Total electricity for the above, kWh/year	$= (330a) + (330b) + (330g) =$	0	(331)
Energy for lighting (calculated in Appendix L)		243.84	(332)
Electricity generated by PVs (Appendix M) (negative quantity)		-682.26	(333)
Electricity generated by wind turbine (Appendix M) (negative quantity)		0	(334)

2b CO2 Emissions – Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		93.4 (367a)
CO2 associated with heat source 1	$[(307b) + (310b)] \times 100 \div (367b) \times$	0.22	= 866.55 (367)
Electrical energy for heat distribution	$[(313) \times$	0.52	= 19.45 (372)
Total CO2 associated with community systems	$(363) \dots (366) + (368) \dots (372)$		= 886 (373)
CO2 associated with space heating (secondary)	$(309) \times$	0	= 0 (374)
CO2 associated with water from immersion heater or instantaneous heater	$(312) \times$	0.22	= 0 (375)
Total CO2 associated with space and water heating	$(373) + (374) + (375) =$		886 (376)
CO2 associated with electricity for pumps and fans within dwelling	$(331) \times$	0.52	= 0 (378)
CO2 associated with electricity for lighting	$(332) \times$	0.52	= 126.58 (379)
Energy saving/generation technologies (333) to (334) as applicable			
Item 1		0.52	$\times 0.01 =$ -354.09 (380)
Total CO2, kg/year	sum of (376) - (382) =		658.46 (383)
Dwelling CO2 Emission Rate	$(383) \div (4) =$		12.52 (384)
EI rating (section 14)			90.96 (385)

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User Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.25

Property Address: 1BF (S) TF

Address : 1BF (S) TF, Land North of Sefter Road, Bognor Regis, PO21 3FF

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	52.6 (1a)	2.31 (2a)	121.51 (3a)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	52.6 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n)	121.51 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0	0 (6a)
Number of open flues	0	0	0	0	0 (6b)
Number of intermittent fans				2	20 (7a)
Number of passive vents				0	0 (7b)
Number of flueless gas fires				0	0 (7c)

	Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - [0.2 x (14) ÷ 100] = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.41 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 0 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 1 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.41 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

0.53	0.52	0.51	0.46	0.45	0.39	0.39	0.38	0.41	0.45	0.47	0.49
------	------	------	------	------	------	------	------	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

0 (23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

0 (23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

0 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m= 0 0 0 0 0 0 0 0 0 0 0 0 (24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m= 0.64 0.63 0.63 0.6 0.6 0.58 0.58 0.57 0.59 0.6 0.61 0.62 (24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m= 0.64 0.63 0.63 0.6 0.6 0.58 0.58 0.57 0.59 0.6 0.61 0.62 (25)

3. Building fabric and openings calculator

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A x U (W/K)	k-value kJ/m²·K	A X k
Doors			1.96	1	1.96		(26)
Windows Type 1			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 2			0.67	$\times 1/[1/(1.4) + 0.04]$	0.89		(27)
Windows Type 3			1.27	$\times 1/[1/(1.4) + 0.04]$	1.68		(27)
Windows Type 4			3.99	$\times 1/[1/(1.4) + 0.04]$	5.29		(27)
Windows Type 5			1.82	$\times 1/[1/(1.4) + 0.04]$	2.41		(27)
Walls Type1	47.29	10.65	36.64	0.18	6.6		(29)
Walls Type2	3.47	1.96	1.51	0.18	0.27		(29)
Roof	52.6	0	52.6	0.13	6.84		(30)
Total area of elements, m²			103.36				(31)
Party wall			17.63	0	0		(32)

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26) ... (30) + (32) = 29.78 (33)

Heat capacity Cm = S(A x k) ((26) ... (30) + (32) + (32a) ... (32e) = 4701.7 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 6.03 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 35.81 (37)

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Ventilation heat loss calculated monthly

$$(38)m = 0.33 \times (25)m \times (5)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	25.65	25.43	25.22	24.22	24.03	23.16	23.16	23	23.49	24.03	24.41	24.81	(38)

Heat transfer coefficient, W/K

$$(39)m = (37) + (38)m$$

(39)m=	61.46	61.25	61.03	60.03	59.84	58.97	58.97	58.81	59.31	59.84	60.22	60.62	
Average = Sum(39) ₁₋₁₂ / 12 =												60.03	(39)

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.17	1.16	1.16	1.14	1.14	1.12	1.12	1.12	1.13	1.14	1.14	1.15	
Average = Sum(40) ₁₋₁₂ / 12 =												1.14	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirement kWh/year

Assumed occupancy, N

if TFA > 13.9, $N = 1 + 1.76 \times [1 - \exp(-0.000349 \times (TFA - 13.9)^2)] + 0.0013 \times (TFA - 13.9)$

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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=	83.78	80.73	77.68	74.64	71.59	68.54	68.54	71.59	74.64	77.68	80.73	83.78	
Total = Sum(44) ₁₋₁₂ =												913.93	(44)

Energy content of hot water used - calculated monthly = $4.190 \times V_{d,m} \times n_m \times DT_m / 3600$ kWh/month (see Tables 1b, 1c, 1d)

(45)m=	124.24	108.66	112.13	97.76	93.8	80.94	75	86.07	87.1	101.5	110.8	120.32	
Total = Sum(45) ₁₋₁₂ =												1198.31	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	18.64	16.3	16.82	14.66	14.07	12.14	11.25	12.91	13.06	15.23	16.62	18.05	(46)
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Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

Temperature factor from Table 2b

Energy lost from water storage, kWh/year

$$(48) \times (49) =$$

b) If manufacturer's declared cylinder loss factor is not known:

Hot water storage loss factor from Table 2 (kWh/litre/day)

If community heating see section 4.3

Volume factor from Table 2a

Temperature factor from Table 2b

Energy lost from water storage, kWh/year

$$(47) \times (51) \times (52) \times (53) =$$

Enter (50) or (54) in (55)

Water storage loss calculated for each month

$$((56)m = (55) \times (41)m$$

(56)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)
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TER WorkSheet: New dwelling design stage

If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H

(57)m=	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)
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Primary circuit loss (annual) from Table 3

0

(58)

Primary circuit loss calculated for each month (59)m = (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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Combi loss calculated for each month (61)m = (60) ÷ 365 × (41)m

(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
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Total heat required for water heating calculated for each month (62)m = 0.85 × (45)m + (46)m + (57)m + (59)m + (61)m

(62)m=	170.83	150.75	158.72	142.85	140.39	126.03	121.6	132.66	132.19	148.1	155.89	166.91	(62)
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Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter '0' if no solar contribution to water heating)

(add additional lines if FGHRs and/or WWHRs applies, see Appendix G)

(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
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Output from water heater

(64)m=	170.83	150.75	158.72	142.85	140.39	126.03	121.6	132.66	132.19	148.1	155.89	166.91	
Output from water heater (annual) × 12												1746.92	(64)

Heat gains from water heating, kWh/month 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]

(65)m=	78.59	69.8	74.56	68.58	68.46	62.99	62.21	65.89	65.03	73.03	72.91	77.28	(65)
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include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (Table 5) Watts

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m=	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	88.34	(66)

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

(67)m=	13.81	12.26	9.97	7.55	5.64	4.76	5.15	6.69	8.98	11.41	13.31	14.19	(67)
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Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

(68)m=	153.98	155.58	151.55	142.98	132.16	121.99	115.2	113.6	117.63	126.2	137.02	147.19	(68)
--------	--------	--------	--------	--------	--------	--------	-------	-------	--------	-------	--------	--------	------

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

(69)m=	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	(69)
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Pumps and fans gains (Table 5a)

(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
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Losses e.g. evaporation (negative values) (Table 5)

(71)m=	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	-70.67	(71)
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Water heating gains (Table 5)

(72)m=	105.63	103.87	100.21	95.25	92.02	87.48	83.62	88.57	90.32	95.46	101.27	103.87	(72)
--------	--------	--------	--------	-------	-------	-------	-------	-------	-------	-------	--------	--------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	325.92	324.21	314.24	298.28	282.33	266.74	256.47	261.36	269.43	285.57	304.1	317.75	(73)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	--------	------

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d	Area m ²	Flux Table 6a	g_ Table 6b	FF Table 6c	Gains (W)
--------------	---------------------------	------------------------	------------------	----------------	----------------	--------------

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North	0.9x	0.77	x	3.99	x	10.63	x	0.63	x	0.7	=	12.97	(74)
North	0.9x	0.77	x	1.82	x	10.63	x	0.63	x	0.7	=	5.91	(74)
North	0.9x	0.77	x	3.99	x	20.32	x	0.63	x	0.7	=	24.78	(74)
North	0.9x	0.77	x	1.82	x	20.32	x	0.63	x	0.7	=	11.3	(74)
North	0.9x	0.77	x	3.99	x	34.53	x	0.63	x	0.7	=	42.11	(74)
North	0.9x	0.77	x	1.82	x	34.53	x	0.63	x	0.7	=	19.21	(74)
North	0.9x	0.77	x	3.99	x	55.46	x	0.63	x	0.7	=	67.63	(74)
North	0.9x	0.77	x	1.82	x	55.46	x	0.63	x	0.7	=	30.85	(74)
North	0.9x	0.77	x	3.99	x	74.72	x	0.63	x	0.7	=	91.11	(74)
North	0.9x	0.77	x	1.82	x	74.72	x	0.63	x	0.7	=	41.56	(74)
North	0.9x	0.77	x	3.99	x	79.99	x	0.63	x	0.7	=	97.53	(74)
North	0.9x	0.77	x	1.82	x	79.99	x	0.63	x	0.7	=	44.49	(74)
North	0.9x	0.77	x	3.99	x	74.68	x	0.63	x	0.7	=	91.06	(74)
North	0.9x	0.77	x	1.82	x	74.68	x	0.63	x	0.7	=	41.54	(74)
North	0.9x	0.77	x	3.99	x	59.25	x	0.63	x	0.7	=	72.24	(74)
North	0.9x	0.77	x	1.82	x	59.25	x	0.63	x	0.7	=	32.95	(74)
North	0.9x	0.77	x	3.99	x	41.52	x	0.63	x	0.7	=	50.63	(74)
North	0.9x	0.77	x	1.82	x	41.52	x	0.63	x	0.7	=	23.09	(74)
North	0.9x	0.77	x	3.99	x	24.19	x	0.63	x	0.7	=	29.5	(74)
North	0.9x	0.77	x	1.82	x	24.19	x	0.63	x	0.7	=	13.45	(74)
North	0.9x	0.77	x	3.99	x	13.12	x	0.63	x	0.7	=	16	(74)
North	0.9x	0.77	x	1.82	x	13.12	x	0.63	x	0.7	=	7.3	(74)
North	0.9x	0.77	x	3.99	x	8.86	x	0.63	x	0.7	=	10.91	(74)
North	0.9x	0.77	x	1.82	x	8.86	x	0.63	x	0.7	=	4.93	(74)
East	0.9x	0.77	x	1.45	x	19.64	x	0.63	x	0.7	=	17.41	(76)
East	0.9x	0.77	x	1.45	x	38.42	x	0.63	x	0.7	=	34.05	(76)
East	0.9x	0.77	x	1.45	x	63.27	x	0.63	x	0.7	=	56.08	(76)
East	0.9x	0.77	x	1.45	x	92.28	x	0.63	x	0.7	=	81.79	(76)
East	0.9x	0.77	x	1.45	x	113.09	x	0.63	x	0.7	=	100.23	(76)
East	0.9x	0.77	x	1.45	x	115.77	x	0.63	x	0.7	=	102.6	(76)
East	0.9x	0.77	x	1.45	x	110.22	x	0.63	x	0.7	=	97.68	(76)
East	0.9x	0.77	x	1.45	x	94.68	x	0.63	x	0.7	=	83.91	(76)
East	0.9x	0.77	x	1.45	x	73.59	x	0.63	x	0.7	=	65.22	(76)
East	0.9x	0.77	x	1.45	x	45.59	x	0.63	x	0.7	=	40.4	(76)
East	0.9x	0.77	x	1.45	x	24.49	x	0.63	x	0.7	=	21.7	(76)
East	0.9x	0.77	x	1.45	x	16.15	x	0.63	x	0.7	=	14.31	(76)
South	0.9x	0.77	x	0.67	x	46.75	x	0.63	x	0.7	=	9.57	(78)
South	0.9x	0.77	x	1.27	x	46.75	x	0.63	x	0.7	=	18.15	(78)
South	0.9x	0.77	x	0.67	x	76.57	x	0.63	x	0.7	=	15.68	(78)
South	0.9x	0.77	x	1.27	x	76.57	x	0.63	x	0.7	=	29.72	(78)
South	0.9x	0.77	x	0.67	x	97.53	x	0.63	x	0.7	=	19.97	(78)

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South	0.9x	0.77	x	1.27	x	97.53	x	0.63	x	0.7	=	37.86	(78)
South	0.9x	0.77	x	0.67	x	110.23	x	0.63	x	0.7	=	22.57	(78)
South	0.9x	0.77	x	1.27	x	110.23	x	0.63	x	0.7	=	42.79	(78)
South	0.9x	0.77	x	0.67	x	114.87	x	0.63	x	0.7	=	23.52	(78)
South	0.9x	0.77	x	1.27	x	114.87	x	0.63	x	0.7	=	44.58	(78)
South	0.9x	0.77	x	0.67	x	110.55	x	0.63	x	0.7	=	22.64	(78)
South	0.9x	0.77	x	1.27	x	110.55	x	0.63	x	0.7	=	42.91	(78)
South	0.9x	0.77	x	0.67	x	108.01	x	0.63	x	0.7	=	22.12	(78)
South	0.9x	0.77	x	1.27	x	108.01	x	0.63	x	0.7	=	41.92	(78)
South	0.9x	0.77	x	0.67	x	104.89	x	0.63	x	0.7	=	21.48	(78)
South	0.9x	0.77	x	1.27	x	104.89	x	0.63	x	0.7	=	40.71	(78)
South	0.9x	0.77	x	0.67	x	101.89	x	0.63	x	0.7	=	20.86	(78)
South	0.9x	0.77	x	1.27	x	101.89	x	0.63	x	0.7	=	39.54	(78)
South	0.9x	0.77	x	0.67	x	82.59	x	0.63	x	0.7	=	16.91	(78)
South	0.9x	0.77	x	1.27	x	82.59	x	0.63	x	0.7	=	32.05	(78)
South	0.9x	0.77	x	0.67	x	55.42	x	0.63	x	0.7	=	11.35	(78)
South	0.9x	0.77	x	1.27	x	55.42	x	0.63	x	0.7	=	21.51	(78)
South	0.9x	0.77	x	0.67	x	40.4	x	0.63	x	0.7	=	8.27	(78)
South	0.9x	0.77	x	1.27	x	40.4	x	0.63	x	0.7	=	15.68	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	64.01	115.53	175.22	245.63	301	310.17	294.32	251.3	189.34	132.32	77.85	54.01	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	389.32	439.74	489.46	543.9	583.33	576.91	550.79	512.66	468.78	417.89	381.95	371.76	(84)
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7. Mean internal temperature (heating season)

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

21 (85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.93	0.82	0.63	0.47	0.52	0.77	0.95	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.86	20.02	20.27	20.61	20.85	20.97	20.99	20.99	20.92	20.6	20.18	19.84	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.95	19.95	19.95	19.97	19.97	19.98	19.98	19.99	19.98	19.97	19.96	19.96	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.99	0.97	0.91	0.76	0.54	0.36	0.41	0.69	0.93	0.99	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.45	18.68	19.05	19.52	19.83	19.97	19.98	19.98	19.92	19.52	18.92	18.43	(90)
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fLA = Living area ÷ (4) =

0.49 (91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	19.14	19.33	19.65	20.05	20.33	20.46	20.48	20.48	20.41	20.05	19.54	19.12	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

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(93)m=	19.14	19.33	19.65	20.05	20.33	20.46	20.48	20.48	20.41	20.05	19.54	19.12	(93)
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8. Space heating calculation

Set T_i to the mean internal temperature obtained at step 11 of Table 9b, so that $T_{i,m}=(76)m$ and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, h_m :

(94)m=	0.99	0.98	0.97	0.91	0.78	0.58	0.41	0.46	0.73	0.93	0.98	0.99	(94)
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Useful gains, $h_m G_m$, $W = (94)m \times (84)m$

(95)m=	386.61	432.79	472.36	494	455.41	334.95	227.12	237.07	342.07	389.85	375.57	369.22	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	912.08	883.9	802.3	669.28	516.62	345.37	228.59	239.66	373.95	565.32	748.92	904.37	(97)
--------	--------	-------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Space heating requirement for each month, $kWh/month = 0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	390.95	303.15	245.48	126.2	45.54	0	0	0	0	130.55	268.81	398.16	
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Total per year ($kWh/year$) = $Sum(98)_{1..12} =$ 1908.83 (98)

Space heating requirement in $kWh/m^2/year$

36.29	(99)
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9. Energy requirements - individual heating systems (adjusting micro-climate)

Space heating:

Fraction of space heat from secondary/supplementary system

0	(201)
---	-------

Fraction of space heat from main system(s)

$$(202) = 1 - (201) =$$

1	(202)
---	-------

Fraction of total heating from main system 1

$$(204) = (202) \times [1 - (203)] =$$

1	(204)
---	-------

Efficiency of main space heating system 1

93.5	(206)
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Efficiency of secondary/supplementary heating system, %

0	(208)
---	-------

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

390.95	303.15	245.48	126.2	45.54	0	0	0	0	130.55	268.81	398.16	
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(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

418.13	324.23	262.54	134.97	48.71	0	0	0	0	139.62	287.5	425.83	
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Total ($kWh/year$) = $Sum(211)_{1..12} =$ 2041.53 (211)

Space heating fuel (secondary), $kWh/month$

$$= \{[(98)m \times (201)]\} \times 100 \div (208)$$

(215)m=	0	0	0	0	0	0	0	0	0	0	0		
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Total ($kWh/year$) = $Sum(215)_{1..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

170.83	150.75	158.72	142.85	140.39	126.03	121.6	132.66	132.19	148.1	155.89	166.91	
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Efficiency of water heater

79.8	(216)
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(217)m=	86.95	86.64	85.97	84.49	82.18	79.8	79.8	79.8	79.8	84.48	86.25	87.05	(217)
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Fuel for water heating, $kWh/month$

$$(219)m = (64)m \times 100 \div (217)m$$

(219)m=	196.46	173.99	184.62	169.08	170.84	157.94	152.38	166.24	165.65	175.3	180.73	191.74	
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Total = $Sum(219a)_{1..12} =$ 2084.97 (219)

Annual totals

kWh/year

Space heating fuel used, main system 1

kWh/year	2041.53
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Water heating fuel used			2084.97	
Electricity for pumps, fans and electric keep-hot				
central heating pump:		30		(230c)
boiler with a fan-assisted flue		45		(230e)
Total electricity for the above, kWh/year	sum of (230a)...(230g) =		75	(231)
Electricity for lighting			243.84	(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)	(211) x	0.216	440.97 (261)
Space heating (secondary)	(215) x	0.519	0 (263)
Water heating	(219) x	0.216	450.35 (264)
Space and water heating	(261) + (262) + (263) + (264) =		891.32 (265)
Electricity for pumps, fans and electric keep-hot	(231) x	0.519	38.93 (267)
Electricity for lighting	(232) x	0.519	126.55 (268)
Total CO2, kg/year	sum of (265) ... (271) =		1056.8 (272)
TER =			29.09 (273)

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name:

Software Name: Stroma FSAP 2012

Stroma Number:

Software Version:

Version: 1.0.4.25

Property Address: 2BCH (N) detached

Address : 2BCH (N) detached, Land North of Sefter Road, Bognor Regis, PO21 3FF

1. General dwelling dimensions

	Area(m ²)	Av. Height(m)	Volume(m ³)
Ground floor	6.23 (1a) x	2.59 (2a) =	16.14 (3a)
First floor	64.65 (1b) x	2.33 (2b) =	150.63 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.88 (4)		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	166.77 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	0	0	0 x 40 =	0 (6a)
Number of open flues	0	0	0	0 x 20 =	0 (6b)
Number of intermittent fans				2 x 10 =	20 (7a)
Number of passive vents				0 x 10 =	0 (7b)
Number of flueless gas fires				0 x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.12 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.37 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.37 (21)
Infiltration rate modified for monthly wind speed			

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.47	0.46	0.45	0.41	0.4	0.35	0.35	0.34	0.37	0.4	0.42	0.43
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
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b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
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c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
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d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m x 0.5]

(24d)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59
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ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors Type 1			2.12	1.1	2.332		(26)
Doors Type 2			2.12	1.1	2.332		(26)
Windows Type 1			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 2			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 3			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 4			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Windows Type 5			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Windows Type 6			1.27	$\times 1/[1/(1.4) + 0.04]$	1.68		(27)
Windows Type 7			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Floor Type 1			6.23	0.12	0.7476		(28)
Floor Type 2			58.42	0.12	7.0104		(28)
Walls Type1	19.81	4.24	15.57	0.17	2.65		(29)
Walls Type2	15.49	0	15.49	0.15	2.36		(29)
Walls Type3	64.33	8.5	55.83	0.17	9.49		(29)
Walls Type4	16.34	0	16.34	0.15	2.52		(29)
Roof	64.65	0	64.65	0.1	6.47		(30)
Total area of elements, m²			245.27				(31)

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* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 47.18 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 8629.35 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.28 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 66.46 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	33.64	33.4	33.17	32.07	31.87	30.92	30.92	30.74	31.28	31.87	32.28	32.72	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	100.1	99.86	99.63	98.53	98.33	97.38	97.38	97.2	97.74	98.33	98.74	99.18	
Average = Sum(39) _{1...12} / 12 =												98.53	(39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.41	1.41	1.41	1.39	1.39	1.37	1.37	1.37	1.38	1.39	1.39	1.4	
Average = Sum(40) _{1...12} / 12 =												1.39	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

Annual average hot water usage in litres per day (see Table 1c)

Assumed occupancy, N 2.27 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 88.05 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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=	96.85	93.33	89.81	86.29	82.77	79.24	79.24	82.77	86.29	89.81	93.33	96.85	
Total = Sum(44) _{1...12} =												1056.58	(44)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	143.63	125.62	129.63	113.01	108.44	93.57	86.71	99.5	100.69	117.34	128.09	139.1	
Total = Sum(45) _{1...12} =												1385.34	(45)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	21.54	18.84	19.44	16.95	16.27	14.04	13.01	14.93	15.1	17.6	19.21	20.86	(46)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	110	(50)											
b) If manufacturer's declared cylinder loss factor is not known:														
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)											
If community heating see section 4.3														
Volume factor from Table 2a		1.03	(52)											
Temperature factor from Table 2b		0.6	(53)											
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)											
Enter (50) or (54) in (55)		1.03	(55)											
Water storage loss calculated for each month	((56)m = (55) x (41)m													
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)	
If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H														
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)	
Primary circuit loss (annual) from Table 3		0	(58)											
Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m	(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)													
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)	
Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m														
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)	
Total heat required for water heating calculated for each month (62)m = 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m														
(62)m=	198.91	175.55	184.91	166.51	163.72	147.07	141.99	154.78	154.18	172.62	181.58	194.38	(62)	
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)														
(add additional lines if FCHRS and/or WWHRS applies, see Appendix G)														
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)	
Output from water heater														
(64)m=	198.91	175.55	184.91	166.51	163.72	147.07	141.99	154.78	154.18	172.62	181.58	194.38		
												Output from water heater (annual) 1...12	2036.18	(64)
Heat gains from water heating, kWh/month 0.25 x [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]														
(65)m=	91.98	81.71	87.32	80.37	80.28	73.91	73.05	77.31	76.27	83.24	85.39	90.47	(65)	
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating														
5. Internal gains (see Table 5 and 6a)														
Metabolic gains (Table 5), Watts														
(66)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	136.04	136.04	136.04	136.04	136.04	136.04	136.04	136.04	136.04	136.04	136.04	136.04	(66)	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5														
(67)m=	49.32	43.81	35.63	26.97	20.16	17.02	18.39	23.91	32.09	40.74	47.55	50.69	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5														
(68)m=	297.53	300.61	292.83	276.27	255.36	235.71	222.58	219.5	227.28	243.84	264.75	284.4	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5														
(69)m=	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	(69)	
Pumps and fans gains (Table 5a)														
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)	
Losses e.g. evaporation (negative values) (Table 5)														
(71)m=	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	(71)	

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Water heating gains (Table 5)

(72)m=	123.63	121.59	117.37	111.63	107.9	102.65	98.19	103.91	105.94	111.88	118.59	121.6	(72)
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Total internal gains =

(66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m=	566.69	562.23	542.05	511.09	479.64	451.6	435.38	443.53	461.52	492.68	527.11	552.91	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:		Access Factor Table 6d		Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	=	4.71	(74)
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	=	4.71	(74)
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	=	4.71	(74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	=	9.01	(74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	=	9.01	(74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	=	9.01	(74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	=	15.3	(74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	=	15.3	(74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	=	15.3	(74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	=	24.58	(74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	=	24.58	(74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	=	24.58	(74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	=	33.11	(74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	=	33.11	(74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	=	33.11	(74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	=	35.44	(74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	=	35.44	(74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	=	35.44	(74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	=	33.09	(74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	=	33.09	(74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	=	33.09	(74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	=	26.25	(74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	=	26.25	(74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	=	26.25	(74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	=	10.72	(74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	=	10.72	(74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	=	10.72	(74)
North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	=	5.81	(74)
North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	=	5.81	(74)

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North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	=	5.81	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
East	0.9x	0.77	x	0.96	x	19.64	x	0.63	x	0.7	=	5.76	(76)
East	0.9x	0.77	x	0.96	x	38.42	x	0.63	x	0.7	=	11.27	(76)
East	0.9x	0.77	x	0.96	x	63.27	x	0.63	x	0.7	=	18.56	(76)
East	0.9x	0.77	x	0.96	x	92.28	x	0.63	x	0.7	=	27.07	(76)
East	0.9x	0.77	x	0.96	x	113.09	x	0.63	x	0.7	=	33.18	(76)
East	0.9x	0.77	x	0.96	x	115.77	x	0.63	x	0.7	=	33.97	(76)
East	0.9x	0.77	x	0.96	x	110.22	x	0.63	x	0.7	=	32.34	(76)
East	0.9x	0.77	x	0.96	x	94.68	x	0.63	x	0.7	=	27.78	(76)
East	0.9x	0.77	x	0.96	x	73.59	x	0.63	x	0.7	=	21.59	(76)
East	0.9x	0.77	x	0.96	x	45.59	x	0.63	x	0.7	=	13.38	(76)
East	0.9x	0.77	x	0.96	x	24.49	x	0.63	x	0.7	=	7.18	(76)
East	0.9x	0.77	x	0.96	x	16.15	x	0.63	x	0.7	=	4.74	(76)
South	0.9x	0.77	x	0.96	x	46.75	x	0.63	x	0.7	=	13.72	(78)
South	0.9x	0.77	x	0.96	x	46.75	x	0.63	x	0.7	=	13.72	(78)
South	0.9x	0.77	x	1.27	x	46.75	x	0.63	x	0.7	=	18.15	(78)
South	0.9x	0.77	x	0.96	x	76.57	x	0.63	x	0.7	=	22.46	(78)
South	0.9x	0.77	x	0.96	x	76.57	x	0.63	x	0.7	=	22.46	(78)
South	0.9x	0.77	x	1.27	x	76.57	x	0.63	x	0.7	=	29.72	(78)
South	0.9x	0.77	x	0.96	x	97.53	x	0.63	x	0.7	=	28.62	(78)
South	0.9x	0.77	x	0.96	x	97.53	x	0.63	x	0.7	=	28.62	(78)
South	0.9x	0.77	x	1.27	x	97.53	x	0.63	x	0.7	=	37.86	(78)
South	0.9x	0.77	x	0.96	x	110.23	x	0.63	x	0.7	=	32.34	(78)
South	0.9x	0.77	x	0.96	x	110.23	x	0.63	x	0.7	=	32.34	(78)
South	0.9x	0.77	x	1.27	x	110.23	x	0.63	x	0.7	=	42.79	(78)
South	0.9x	0.77	x	0.96	x	114.87	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	0.96	x	114.87	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	1.27	x	114.87	x	0.63	x	0.7	=	44.58	(78)
South	0.9x	0.77	x	0.96	x	110.55	x	0.63	x	0.7	=	32.43	(78)
South	0.9x	0.77	x	0.96	x	110.55	x	0.63	x	0.7	=	32.43	(78)
South	0.9x	0.77	x	1.27	x	110.55	x	0.63	x	0.7	=	42.91	(78)
South	0.9x	0.77	x	0.96	x	108.01	x	0.63	x	0.7	=	31.69	(78)
South	0.9x	0.77	x	0.96	x	108.01	x	0.63	x	0.7	=	31.69	(78)
South	0.9x	0.77	x	1.27	x	108.01	x	0.63	x	0.7	=	41.92	(78)
South	0.9x	0.77	x	0.96	x	104.89	x	0.63	x	0.7	=	30.77	(78)
South	0.9x	0.77	x	0.96	x	104.89	x	0.63	x	0.7	=	30.77	(78)
South	0.9x	0.77	x	1.27	x	104.89	x	0.63	x	0.7	=	40.71	(78)
South	0.9x	0.77	x	0.96	x	101.89	x	0.63	x	0.7	=	29.89	(78)

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South	0.9x	0.77	x	0.96	x	101.89	x	0.63	x	0.7	=	29.89	(78)
South	0.9x	0.77	x	1.27	x	101.89	x	0.63	x	0.7	=	39.54	(78)
South	0.9x	0.77	x	0.96	x	82.59	x	0.63	x	0.7	=	24.23	(78)
South	0.9x	0.77	x	0.96	x	82.59	x	0.63	x	0.7	=	24.23	(78)
South	0.9x	0.77	x	1.27	x	82.59	x	0.63	x	0.7	=	32.05	(78)
South	0.9x	0.77	x	0.96	x	55.42	x	0.63	x	0.7	=	16.26	(78)
South	0.9x	0.77	x	0.96	x	55.42	x	0.63	x	0.7	=	16.26	(78)
South	0.9x	0.77	x	1.27	x	55.42	x	0.63	x	0.7	=	21.51	(78)
South	0.9x	0.77	x	0.96	x	40.4	x	0.63	x	0.7	=	11.85	(78)
South	0.9x	0.77	x	0.96	x	40.4	x	0.63	x	0.7	=	11.85	(78)
South	0.9x	0.77	x	1.27	x	40.4	x	0.63	x	0.7	=	15.68	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	65.48	112.93	159.55	208.28	244.5	248.07	236.91	208.8	176.11	126.05	78.65	55.91	(83)
--------	-------	--------	--------	--------	-------	--------	--------	-------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	632.17	675.16	701.6	719.36	724.14	699.67	672.3	652.33	637.63	618.73	605.76	608.82	(84)
--------	--------	--------	-------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.89	0.76	0.6	0.64	0.84	0.95	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.68	19.81	20.04	20.36	20.66	20.89	20.97	20.96	20.82	20.45	20.01	19.65	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.75	19.76	19.76	19.77	19.77	19.78	19.78	19.79	19.78	19.77	19.77	19.76	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.93	0.85	0.66	0.45	0.49	0.75	0.93	0.98	0.99	(89)
--------	------	------	------	------	------	------	------	------	------	------	------	------	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.04	18.23	18.57	19.03	19.44	19.71	19.77	19.77	19.64	19.16	18.54	18.02	(90)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.3

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.53	18.71	19.01	19.43	19.81	20.06	20.13	20.13	19.99	19.55	18.98	18.51	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.53	18.71	19.01	19.43	19.81	20.06	20.13	20.13	19.99	19.55	18.98	18.51	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.98	0.98	0.96	0.93	0.85	0.69	0.5	0.54	0.77	0.92	0.97	0.98	(94)
--------	------	------	------	------	------	------	-----	------	------	------	------	------	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	621.15	658.63	674.28	666.66	615.07	481.87	334.66	349.42	490.89	571.69	588.44	599.64	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

SAP WorkSheet: New dwelling design stage

Heat loss rate for mean internal temperature, L_m , $W = [(93)m - (96)m]$

(97)m=	1424.81	1378.7	1246.28	1037.17	796.95	531.77	343.89	362.24	576.05	880.03	1173.53	1418.91	(97)
--------	---------	--------	---------	---------	--------	--------	--------	--------	--------	--------	---------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	597.93	483.89	425.56	266.76	135.32	0	0	0	0	229.41	421.26	609.54	(98)
--------	--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------	------

Total per year (kWh/year) = $\text{Sum}(98)_{1..12} =$ 3169.68 (98)

Space heating requirement in kWh/m²/year

44.72 (99)

10. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0 (301)

Fraction of space heat from community system 1 – (301) =

1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers

1 (303a)

Fraction of total space heat from Community boilers

(302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system

1 (305)

Distribution loss factor (Table 12c) for community heating system

1.05 (306)

Space heating

Annual space heating requirement

kWh/year

3169.68

Space heat from Community boilers

(98) x (304a) x (305) x (306) = 3328.16 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0 (308)

Space heating requirement from secondary/supplementary system

(98) x (301) x 100 - (308) = 0 (309)

Water heating

Annual water heating requirement

2036.18

If DHW from community scheme:

Water heat from Community boilers

(64) x (303a) x (305) x (306) = 2137.99 (310a)

Electricity used for heat distribution

$0.01 \times [(307a) \dots (307e) + (310a) \dots (310e)] =$ 54.66 (313)

Cooling System Energy Efficiency Ratio

0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0)

$= (107) \div (314) =$ 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):

mechanical ventilation - balanced, extract or positive input from outside

0 (330a)

warm air heating system fans

0 (330b)

pump for solar water heating

0 (330g)

Total electricity for the above, kWh/year

$= (330a) + (330b) + (330g) =$ 0 (331)

Energy for lighting (calculated in Appendix L)

348.41 (332)

Electricity generated by PVs (Appendix M) (negative quantity)

-682.26 (333)

Electricity generated by wind turbine (Appendix M) (negative quantity)

0 (334)

10b. Fuel costs – Community heating scheme

Fuel
kWh/year

Fuel Price
(Table 12)

Fuel Cost
£/year

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Space heating from CHP	(307a) x	4.24	x 0.01 =	141.11	(340a)
Water heating from CHP	(310a) x	4.24	x 0.01 =	90.65	(342a)
Fuel Price					
Pumps and fans	(331)	13.19	x 0.01 =	0	(349)
Energy for lighting	(332)	13.19	x 0.01 =	45.96	(350)
Additional standing charges (Table 12)				120	(351)
Energy saving/generation technologies					
Total energy cost	= (340a) ... (342e) + (345) ... (354) =				397.72 (355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =		1.44 (357)
SAP rating (section12)		79.89	(358)

12b. CO2 Emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		94.3 (367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x	0.22	1252.06 (367)
Electrical energy for heat distribution	[(313) x	0.52	25.37 (372)
Total CO2 associated with community systems	(363) ... (366) + (368) ... (372)		1280.43 (373)
CO2 associated with space heating (secondary)	(369) x	0	0 (374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x	0.22	0 (375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =		1280.43 (376)
CO2 associated with electricity for pumps and fans within dwelling	(331) x	0.52	0 (378)
CO2 associated with electricity for lighting	(332) x	0.52	180.83 (379)
Energy saving/generation technologies (333) to (334) as applicable Item 1		0.52	-354.09 (380)
Total CO2, kg/year	sum of (376) ... (382) =		1107.16 (383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =		15.62 (384)
EI rating (section 14)			87.2 (385)

13b. Primary Energy - Community heating scheme

	Energy kWh/year	Primary factor	P.Energy kWh/year
Energy from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	if there is CHP using two fuels repeat (363) to (366) for the second fuel		94.3 (367a)
Energy associated with heat source 1	$[(307b)+(310b)] \times 100 \div (367b) \times$	1.22	7071.8 (367)
Electrical energy for heat distribution	$[(313) \times$		167.81 (372)
Total Energy associated with community systems	$(363) \dots (366) + (368) \dots (372)$		7239.61 (373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)			7239.61 (373)

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Energy associated with space heating (secondary)	{309} x	0	=	0	{374}
Energy associated with water from immersion heater or instantaneous heater	{312} x	1.22	=	0	{375}
Total Energy associated with space and water heating	{373} + {374} + {375} =			7239.61	{376}
Energy associated with space cooling	{315} x	3.07	=	0	{377}
Energy associated with electricity for pumps and fans within dwelling	{331} x	3.07	=	0	{378}
Energy associated with electricity for lighting	{332} x	3.07	=	1069.63	{379}
Energy saving/generation technologies Item 1		3.07	x 0.01 =	-2094.54	{380}
Total Primary Energy, kWh/year	sum of {376}...{382} =			6214.7	{383}

DRAFT

DER WorkSheet: New dwelling design stage

User Details

Assessor Name:

Software Name: Stroma FSAP 2012

Stroma Number:

Software Version:

Version: 1.0.4.25

Property Address: 2BCH (N) detached

Address : 2BCH (N) detached, Land North of Sefter Road, Bognor Regis, PO21 3FF

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	6.23 (1a)	x	2.59 (2a)	=	16.14 (3a)
First floor	64.65 (1b)	x	2.33 (2b)	=	150.63 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.88 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	166.77 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							2	x 10 =	20 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.12 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (16), otherwise (18) = (16)			0.37 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.37 (21)
Infiltration rate modified for monthly wind speed			

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.47	0.46	0.45	0.41	0.4	0.35	0.35	0.34	0.37	0.4	0.42	0.43
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
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b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
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c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m x 0.5]

(24d)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59
--------	------	------	-----	------	------	------	------	------	------	------	------	------

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors Type 1			2.12	1.1	2.332		(26)
Doors Type 2			2.12	1.1	2.332		(26)
Windows Type 1			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 2			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 3			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 4			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Windows Type 5			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Windows Type 6			1.27	$\times 1/[1/(1.4) + 0.04]$	1.68		(27)
Windows Type 7			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Floor Type 1			6.23	0.12	0.7476		(28)
Floor Type 2			58.42	0.12	7.0104		(28)
Walls Type1	19.81	4.24	15.57	0.17	2.65		(29)
Walls Type2	15.49	0	15.49	0.15	2.36		(29)
Walls Type3	64.33	8.5	55.83	0.17	9.49		(29)
Walls Type4	16.34	0	16.34	0.15	2.52		(29)
Roof	64.65	0	64.65	0.1	6.47		(30)
Total area of elements, m²			245.27				(31)

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* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 47.18 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 8629.35 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 19.28 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 66.46 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	33.64	33.4	33.17	32.07	31.87	30.92	30.92	30.74	31.28	31.87	32.28	32.72	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	100.1	99.86	99.63	98.53	98.33	97.38	97.38	97.2	97.74	98.33	98.74	99.18	
Average = Sum(39) _{1...12} / 12 =												98.53	(39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.41	1.41	1.41	1.39	1.39	1.37	1.37	1.37	1.38	1.39	1.39	1.4	
Average = Sum(40) _{1...12} / 12 =												1.39	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

Assumed occupancy, N 2.27 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)
if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 88.05 (43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(44)m=	96.85	93.33	89.81	86.29	82.77	79.24	79.24	82.77	86.29	89.81	93.33	96.85	
Total = Sum(44) _{1...12} =												1056.58	(44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	143.63	125.62	129.63	113.01	108.44	93.57	86.71	99.5	100.69	117.34	128.09	139.1	
Total = Sum(45) _{1...12} =												1385.34	(45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	21.54	18.84	19.44	16.95	16.27	14.04	13.01	14.93	15.1	17.6	19.21	20.86	(46)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 180 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 0 (48)

Temperature factor from Table 2b 0 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	110	(50)										
b) If manufacturer's declared cylinder loss factor is not known:													
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)										
If community heating see section 4.3													
Volume factor from Table 2a		1.03	(52)										
Temperature factor from Table 2b		0.6	(53)										
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)										
Enter (50) or (54) in (55)		1.03	(55)										
Water storage loss calculated for each month	((56)m = (55) x (41)m												
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)
Primary circuit loss (annual) from Table 3	0												(58)
Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m													
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)													
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m													
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
Total heat required for water heating calculated for each month (62)m = 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m													
(62)m=	198.91	175.55	184.91	166.51	163.72	147.07	141.99	154.78	154.18	172.62	181.58	194.38	(62)
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)													
(add additional lines if FCHRS and/or WWHRS applies, see Appendix G)													
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
Output from water heater													
(64)m=	198.91	175.55	184.91	166.51	163.72	147.07	141.99	154.78	154.18	172.62	181.58	194.38	(64)
												Output from water heater (annual) 1...12	2036.18
Heat gains from water heating, kWh/month 0.25 x [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]													
(65)m=	91.98	81.71	87.32	80.37	80.28	73.91	73.05	77.31	76.27	83.24	85.39	90.47	(65)
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating													
5. Internal gains (see Table 5 and Part 5)													
Metabolic gains (Table 5), Watts													
(66)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	19.73	17.52	14.25	10.79	8.06	6.81	7.36	9.56	12.83	16.3	19.02	20.28	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	199.34	201.41	196.2	185.1	171.09	157.93	149.13	147.06	152.28	163.37	177.38	190.55	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	(71)

DER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

(72)m=	123.63	121.59	117.37	111.63	107.9	102.65	98.19	103.91	105.94	111.88	118.59	121.6	(72)
--------	--------	--------	--------	--------	-------	--------	-------	--------	--------	--------	--------	-------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	399.71	397.54	384.83	364.53	344.07	324.4	311.69	317.54	328.06	348.56	372	389.43	(73)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	-----	--------	------

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d			Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	=	4.71	(74)
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	=	4.71	(74)
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	=	4.71	(74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	=	9.01	(74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	=	9.01	(74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	=	9.01	(74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	=	15.3	(74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	=	15.3	(74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	=	15.3	(74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	=	24.58	(74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	=	24.58	(74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	=	24.58	(74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	=	33.11	(74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	=	33.11	(74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	=	33.11	(74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	=	35.44	(74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	=	35.44	(74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	=	35.44	(74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	=	33.09	(74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	=	33.09	(74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	=	33.09	(74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	=	26.25	(74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	=	26.25	(74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	=	26.25	(74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	=	10.72	(74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	=	10.72	(74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	=	10.72	(74)
North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	=	5.81	(74)
North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	=	5.81	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	=	5.81	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
East	0.9x	0.77	x	0.96	x	19.64	x	0.63	x	0.7	=	5.76	(76)
East	0.9x	0.77	x	0.96	x	38.42	x	0.63	x	0.7	=	11.27	(76)
East	0.9x	0.77	x	0.96	x	63.27	x	0.63	x	0.7	=	18.56	(76)
East	0.9x	0.77	x	0.96	x	92.28	x	0.63	x	0.7	=	27.07	(76)
East	0.9x	0.77	x	0.96	x	113.09	x	0.63	x	0.7	=	33.18	(76)
East	0.9x	0.77	x	0.96	x	115.77	x	0.63	x	0.7	=	33.97	(76)
East	0.9x	0.77	x	0.96	x	110.22	x	0.63	x	0.7	=	32.34	(76)
East	0.9x	0.77	x	0.96	x	94.68	x	0.63	x	0.7	=	27.78	(76)
East	0.9x	0.77	x	0.96	x	73.59	x	0.63	x	0.7	=	21.59	(76)
East	0.9x	0.77	x	0.96	x	45.59	x	0.63	x	0.7	=	13.38	(76)
East	0.9x	0.77	x	0.96	x	24.49	x	0.63	x	0.7	=	7.18	(76)
East	0.9x	0.77	x	0.96	x	16.15	x	0.63	x	0.7	=	4.74	(76)
South	0.9x	0.77	x	0.96	x	46.75	x	0.63	x	0.7	=	13.72	(78)
South	0.9x	0.77	x	0.96	x	46.75	x	0.63	x	0.7	=	13.72	(78)
South	0.9x	0.77	x	1.27	x	46.75	x	0.63	x	0.7	=	18.15	(78)
South	0.9x	0.77	x	0.96	x	76.57	x	0.63	x	0.7	=	22.46	(78)
South	0.9x	0.77	x	0.96	x	76.57	x	0.63	x	0.7	=	22.46	(78)
South	0.9x	0.77	x	1.27	x	76.57	x	0.63	x	0.7	=	29.72	(78)
South	0.9x	0.77	x	0.96	x	97.53	x	0.63	x	0.7	=	28.62	(78)
South	0.9x	0.77	x	0.96	x	97.53	x	0.63	x	0.7	=	28.62	(78)
South	0.9x	0.77	x	1.27	x	97.53	x	0.63	x	0.7	=	37.86	(78)
South	0.9x	0.77	x	0.96	x	110.23	x	0.63	x	0.7	=	32.34	(78)
South	0.9x	0.77	x	0.96	x	110.23	x	0.63	x	0.7	=	32.34	(78)
South	0.9x	0.77	x	1.27	x	110.23	x	0.63	x	0.7	=	42.79	(78)
South	0.9x	0.77	x	0.96	x	114.87	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	0.96	x	114.87	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	1.27	x	114.87	x	0.63	x	0.7	=	44.58	(78)
South	0.9x	0.77	x	0.96	x	110.55	x	0.63	x	0.7	=	32.43	(78)
South	0.9x	0.77	x	0.96	x	110.55	x	0.63	x	0.7	=	32.43	(78)
South	0.9x	0.77	x	1.27	x	110.55	x	0.63	x	0.7	=	42.91	(78)
South	0.9x	0.77	x	0.96	x	108.01	x	0.63	x	0.7	=	31.69	(78)
South	0.9x	0.77	x	0.96	x	108.01	x	0.63	x	0.7	=	31.69	(78)
South	0.9x	0.77	x	1.27	x	108.01	x	0.63	x	0.7	=	41.92	(78)
South	0.9x	0.77	x	0.96	x	104.89	x	0.63	x	0.7	=	30.77	(78)
South	0.9x	0.77	x	0.96	x	104.89	x	0.63	x	0.7	=	30.77	(78)
South	0.9x	0.77	x	1.27	x	104.89	x	0.63	x	0.7	=	40.71	(78)
South	0.9x	0.77	x	0.96	x	101.89	x	0.63	x	0.7	=	29.89	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	0.96	x	101.89	x	0.63	x	0.7	=	29.89	(78)
South	0.9x	0.77	x	1.27	x	101.89	x	0.63	x	0.7	=	39.54	(78)
South	0.9x	0.77	x	0.96	x	82.59	x	0.63	x	0.7	=	24.23	(78)
South	0.9x	0.77	x	0.96	x	82.59	x	0.63	x	0.7	=	24.23	(78)
South	0.9x	0.77	x	1.27	x	82.59	x	0.63	x	0.7	=	32.05	(78)
South	0.9x	0.77	x	0.96	x	55.42	x	0.63	x	0.7	=	16.26	(78)
South	0.9x	0.77	x	0.96	x	55.42	x	0.63	x	0.7	=	16.26	(78)
South	0.9x	0.77	x	1.27	x	55.42	x	0.63	x	0.7	=	21.51	(78)
South	0.9x	0.77	x	0.96	x	40.4	x	0.63	x	0.7	=	11.85	(78)
South	0.9x	0.77	x	0.96	x	40.4	x	0.63	x	0.7	=	11.85	(78)
South	0.9x	0.77	x	1.27	x	40.4	x	0.63	x	0.7	=	15.68	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	65.48	112.93	159.55	208.28	244.5	248.07	236.91	208.8	176.11	126.05	78.65	55.91	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	465.18	510.47	544.38	572.8	588.56	572.47	548.6	526.34	504.17	474.61	450.65	445.34	(84)
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7. Mean internal temperature (heating season)

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

21

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.98	0.91	0.85	0.7	0.74	0.91	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.47	19.61	19.85	20.2	20.54	20.82	20.94	20.93	20.73	20.29	19.83	19.45	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.75	19.76	19.76	19.77	19.77	19.78	19.78	19.79	19.78	19.77	19.77	19.76	(88)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.97	0.91	0.76	0.54	0.59	0.85	0.97	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.75	17.95	18.31	18.81	19.29	19.65	19.76	19.75	19.54	18.95	18.27	17.72	(90)
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fLA = Living area ÷ (4) =

0.3

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.26	18.44	18.77	19.23	19.67	20	20.12	20.11	19.9	19.35	18.74	18.24	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.26	18.44	18.77	19.23	19.67	20	20.12	20.11	19.9	19.35	18.74	18.24	(93)
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8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.98	0.96	0.91	0.78	0.59	0.64	0.86	0.96	0.99	0.99	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	462.37	505.56	534.89	550.98	534.48	445.36	324.59	335.33	432.37	457.8	445.84	443.11	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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DER WorkSheet: New dwelling design stage

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	1397.8	1352.6	1222.41	1017.46	783.53	526.2	342.41	360.18	566.73	860.71	1149.39	1392.5	(97)
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Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	695.96	569.21	511.52	335.87	185.3	0	0	0	0	299.76	506.56	706.35	(98)
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Total per year (kWh/year) = $\text{Sum}((98)_{1..12}) =$ 3810.51 (98)

Space heating requirement in kWh/m²/year

53.76 (99)

2c Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0 (301)

Fraction of space heat from community system 1 – (301) =

1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers

1 (303a)

Fraction of total space heat from Community boilers

(302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system

1 (305)

Distribution loss factor (Table 12c) for community heating system

1.05 (306)

Space heating

Annual space heating requirement

kWh/year

3810.51

Space heat from Community boilers

(98) x (304a) x (305) x (306) = 4001.04 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0 (308)

Space heating requirement from secondary/supplementary system (98) x (301) x 100 - (308) =

0 (309)

Water heating

Annual water heating requirement

2036.18

If DHW from community scheme:

Water heat from Community boilers

(64) x (303a) x (305) x (306) = 2137.99 (310a)

Electricity used for heat distribution

$0.01 \times [(307a) \dots (307e) + (310a) \dots (310e)] =$ 61.39 (313)

Cooling System Energy Efficiency Ratio

0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0)

$= (107) \div (314) =$ 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):

mechanical ventilation - balanced, extract or positive input from outside

0 (330a)

warm air heating system fans

0 (330b)

pump for solar water heating

0 (330g)

Total electricity for the above, kWh/year

$= (330a) + (330b) + (330g) =$ 0 (331)

Energy for lighting (calculated in Appendix L)

348.41 (332)

Electricity generated by PVs (Appendix M) (negative quantity)

-682.26 (333)

Electricity generated by wind turbine (Appendix M) (negative quantity)

0 (334)

2b CO2 Emissions – Community heating scheme

Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
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DER WorkSheet: New dwelling design stage

CO2 from other sources of space and water heating (not CHP)

Efficiency of heat source 1 (%) If there is CHP using two fuels repeat (363) to (366) for the second fuel

94.3 (367a)

CO2 associated with heat source 1 $[(307b)+(310b)] \times 100 \div (367b) \times$ 0.22 = 1406.18 (367)

Electrical energy for heat distribution (313) x 0.52 = 31.86 (372)

Total CO2 associated with community systems (363)...(366) + (368)...(372) = 1438.04 (373)

CO2 associated with space heating (secondary) (309) x 0 = 0 (374)

CO2 associated with water from immersion heater or instantaneous heater (312) x 0.22 = 0 (375)

Total CO2 associated with space and water heating (373) + (374) + (375) = 1438.04 (376)

CO2 associated with electricity for pumps and fans within dwelling (331) x 0.52 = 0 (378)

CO2 associated with electricity for lighting (332) x 0.52 = 180.83 (379)

Energy saving/generation technologies (333) to (334) as applicable
Item 1

0.52 x 0.01 = -354.09 (380)

Total CO2, kg/year sum of (376)...(382) = 1264.78 (383)

Dwelling CO2 Emission Rate (383) ÷ (4) = 17.84 (384)

EI rating (section 14) 85.37 (385)

DRAFT

TER WorkSheet: New dwelling design stage

User Details

Assessor Name:

Software Name: Stroma FSAP 2012

Stroma Number:

Software Version:

Version: 1.0.4.25

Property Address: 2BCH (N) detached

Address : 2BCH (N) detached, Land North of Sefter Road, Bognor Regis, PO21 3FF

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	6.23 (1a)	x	2.59 (2a)	=	16.14 (3a)
First floor	64.65 (1b)	x	2.33 (2b)	=	150.63 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.88 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	166.77 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							3	x 10 =	30 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.18 (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
<i>if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35</i>			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - [0.2 x (14) ÷ 100] =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (16), otherwise (18) = (16)			0.43 (18)
<i>Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used</i>			
Number of sides sheltered			0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		1 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.43 (21)
Infiltration rate modified for monthly wind speed			

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.55	0.54	0.53	0.47	0.46	0.41	0.41	0.4	0.43	0.46	0.48	0.51
--	------	------	------	------	------	------	------	-----	------	------	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.65	0.64	0.64	0.61	0.61	0.58	0.58	0.58	0.59	0.61	0.62	0.63
---------	------	------	------	------	------	------	------	------	------	------	------	------

(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.65	0.64	0.64	0.61	0.61	0.58	0.58	0.58	0.59	0.61	0.62	0.63
--------	------	------	------	------	------	------	------	------	------	------	------	------

(25)

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors Type 1			2.12	1	2.12		(26)
Doors Type 2			2.12	1	2.12		(26)
Windows Type 1			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 2			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 3			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 4			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Windows Type 5			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Windows Type 6			1.27	$\times 1/[1/(1.4) + 0.04]$	1.68		(27)
Windows Type 7			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Floor Type 1			6.23	0.13	0.8099		(28)
Floor Type 2			58.42	0.13	7.594599		(28)
Walls Type1	19.81	4.24	15.57	0.18	2.8		(29)
Walls Type2	15.49	0	15.49	0.18	2.79		(29)
Walls Type3	64.33	8.5	55.83	0.18	10.05		(29)
Walls Type4	16.34	0	16.34	0.18	2.94		(29)
Roof	64.65	0	64.65	0.13	8.4		(30)
Total area of elements, m²			245.27				(31)

TER WorkSheet: New dwelling design stage

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U) (26)...(30) + (32) = 50.9 (33)

Heat capacity Cm = S(A x k) ((28)...(30) + (32) + (32a)...(32e) = 8629.35 (34)

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K 22.03 (36)

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss (33) + (36) = 72.93 (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=	35.78	35.46	35.15	33.67	33.39	32.11	32.11	31.87	32.6	33.39	33.95	34.54	(38)

Heat transfer coefficient, W/K (39)m = (37) + (38)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(39)m=	108.71	108.39	108.08	106.6	106.32	105.04	105.04	104.8	105.53	106.32	106.88	107.47	
Average = Sum(39) _{1...12} / 12 =												106.6	(39)

Heat loss parameter (HLP), W/m²K (40)m = (39)m ÷ (4)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(40)m=	1.53	1.53	1.52	1.5	1.5	1.48	1.48	1.48	1.49	1.5	1.51	1.52	
Average = Sum(40) _{1...12} / 12 =												1.5	(40)

Number of days in month (Table 1a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(41)m=	31	28	31	30	31	30	31	31	30	31	30	31	(41)

Annual average hot water usage in litres per day (see Table 1c)

Assumed occupancy, N 2.27 (42)

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 88.05 (43)

Reduce the annual average hot water usage by 5% if the dwelling is designed to achieve a water use target of not more than 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=	96.85	93.33	89.81	86.29	82.77	79.24	79.24	82.77	86.29	89.81	93.33	96.85	
Total = Sum(44) _{1...12} =												1056.58	(44)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(45)m=	143.63	125.62	129.63	113.01	108.44	93.57	86.71	99.5	100.69	117.34	128.09	139.1	
Total = Sum(45) _{1...12} =												1385.34	(45)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(46)m=	21.54	18.84	19.44	16.95	16.27	14.04	13.01	14.93	15.1	17.6	19.21	20.86	(46)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel 150 (47)

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.55 (48)

Temperature factor from Table 2b 0.54 (49)

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Energy lost from water storage, kWh/year	(48) x (49) =	0.84	(50)										
b) If manufacturer's declared cylinder loss factor is not known:													
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)										
If community heating see section 4.3													
Volume factor from Table 2a		0	(52)										
Temperature factor from Table 2b		0	(53)										
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)										
Enter (50) or (54) in (55)		0.84	(55)										
Water storage loss calculated for each month	((56)m = (55) x (41)m												
(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(57)
Primary circuit loss (annual) from Table 3		0	(58)										
Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m	(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)												
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m													
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
Total heat required for water heating calculated for each month (62)m = 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m													
(62)m=	192.87	170.1	178.87	160.67	157.68	141.23	135.95	148.74	148.34	166.59	175.75	188.34	(62)
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)													
(add additional lines if FCHRS and/or WWHRS applies, see Appendix G)													
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
Output from water heater													
(64)m=	192.87	170.1	178.87	160.67	157.68	141.23	135.95	148.74	148.34	166.59	175.75	188.34	
Output from water heater (annual) 1...12												1965.14	(64)
Heat gains from water heating, kWh/month 0.25 x [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]													
(65)m=	87.15	77.35	82.5	75.7	75.45	69.24	68.23	72.48	71.6	78.41	80.71	85.64	(65)
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating													
5. Internal gains (see Table 5 and Part 5)													
Metabolic gains (Table 5), Watts													
(66)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	19.73	17.52	14.25	10.79	8.06	6.81	7.36	9.56	12.83	16.3	19.02	20.28	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	199.34	201.41	196.2	185.1	171.09	157.93	149.13	147.06	152.28	163.37	177.38	190.55	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	(71)

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Water heating gains (Table 5)

(72)m=	117.14	115.1	110.88	105.14	101.41	96.16	91.7	97.42	99.45	105.39	112.1	115.11	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	396.22	394.05	381.34	361.04	340.58	320.91	308.2	314.05	324.57	345.07	368.51	385.95	(73)
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6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d			Area m ²	Flux Table 6a			g_ Table 6b	FF Table 6c	Gains (W)	
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	= 4.71 (74)
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	= 4.71 (74)
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	= 4.71 (74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	= 9.01 (74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	= 9.01 (74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	= 9.01 (74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	= 15.3 (74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	= 15.3 (74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	= 15.3 (74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	= 24.58 (74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	= 24.58 (74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	= 24.58 (74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	= 33.11 (74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	= 33.11 (74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	= 33.11 (74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	= 35.44 (74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	= 35.44 (74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	= 35.44 (74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	= 33.09 (74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	= 33.09 (74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	= 33.09 (74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	= 26.25 (74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	= 26.25 (74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	= 26.25 (74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	= 18.4 (74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	= 18.4 (74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	= 18.4 (74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	= 10.72 (74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	= 10.72 (74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	= 10.72 (74)
North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	= 5.81 (74)
North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	= 5.81 (74)

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North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	=	5.81	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
East	0.9x	0.77	x	0.96	x	19.64	x	0.63	x	0.7	=	5.76	(76)
East	0.9x	0.77	x	0.96	x	38.42	x	0.63	x	0.7	=	11.27	(76)
East	0.9x	0.77	x	0.96	x	63.27	x	0.63	x	0.7	=	18.56	(76)
East	0.9x	0.77	x	0.96	x	92.28	x	0.63	x	0.7	=	27.07	(76)
East	0.9x	0.77	x	0.96	x	113.09	x	0.63	x	0.7	=	33.18	(76)
East	0.9x	0.77	x	0.96	x	115.77	x	0.63	x	0.7	=	33.97	(76)
East	0.9x	0.77	x	0.96	x	110.22	x	0.63	x	0.7	=	32.34	(76)
East	0.9x	0.77	x	0.96	x	94.68	x	0.63	x	0.7	=	27.78	(76)
East	0.9x	0.77	x	0.96	x	73.59	x	0.63	x	0.7	=	21.59	(76)
East	0.9x	0.77	x	0.96	x	45.59	x	0.63	x	0.7	=	13.38	(76)
East	0.9x	0.77	x	0.96	x	24.49	x	0.63	x	0.7	=	7.18	(76)
East	0.9x	0.77	x	0.96	x	16.15	x	0.63	x	0.7	=	4.74	(76)
South	0.9x	0.77	x	0.96	x	46.75	x	0.63	x	0.7	=	13.72	(78)
South	0.9x	0.77	x	0.96	x	46.75	x	0.63	x	0.7	=	13.72	(78)
South	0.9x	0.77	x	1.27	x	46.75	x	0.63	x	0.7	=	18.15	(78)
South	0.9x	0.77	x	0.96	x	76.57	x	0.63	x	0.7	=	22.46	(78)
South	0.9x	0.77	x	0.96	x	76.57	x	0.63	x	0.7	=	22.46	(78)
South	0.9x	0.77	x	1.27	x	76.57	x	0.63	x	0.7	=	29.72	(78)
South	0.9x	0.77	x	0.96	x	97.53	x	0.63	x	0.7	=	28.62	(78)
South	0.9x	0.77	x	0.96	x	97.53	x	0.63	x	0.7	=	28.62	(78)
South	0.9x	0.77	x	1.27	x	97.53	x	0.63	x	0.7	=	37.86	(78)
South	0.9x	0.77	x	0.96	x	110.23	x	0.63	x	0.7	=	32.34	(78)
South	0.9x	0.77	x	0.96	x	110.23	x	0.63	x	0.7	=	32.34	(78)
South	0.9x	0.77	x	1.27	x	110.23	x	0.63	x	0.7	=	42.79	(78)
South	0.9x	0.77	x	0.96	x	114.87	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	0.96	x	114.87	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	1.27	x	114.87	x	0.63	x	0.7	=	44.58	(78)
South	0.9x	0.77	x	0.96	x	110.55	x	0.63	x	0.7	=	32.43	(78)
South	0.9x	0.77	x	0.96	x	110.55	x	0.63	x	0.7	=	32.43	(78)
South	0.9x	0.77	x	1.27	x	110.55	x	0.63	x	0.7	=	42.91	(78)
South	0.9x	0.77	x	0.96	x	108.01	x	0.63	x	0.7	=	31.69	(78)
South	0.9x	0.77	x	0.96	x	108.01	x	0.63	x	0.7	=	31.69	(78)
South	0.9x	0.77	x	1.27	x	108.01	x	0.63	x	0.7	=	41.92	(78)
South	0.9x	0.77	x	0.96	x	104.89	x	0.63	x	0.7	=	30.77	(78)
South	0.9x	0.77	x	0.96	x	104.89	x	0.63	x	0.7	=	30.77	(78)
South	0.9x	0.77	x	1.27	x	104.89	x	0.63	x	0.7	=	40.71	(78)
South	0.9x	0.77	x	0.96	x	101.89	x	0.63	x	0.7	=	29.89	(78)

TER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	0.96	x	101.89	x	0.63	x	0.7	=	29.89	(78)
South	0.9x	0.77	x	1.27	x	101.89	x	0.63	x	0.7	=	39.54	(78)
South	0.9x	0.77	x	0.96	x	82.59	x	0.63	x	0.7	=	24.23	(78)
South	0.9x	0.77	x	0.96	x	82.59	x	0.63	x	0.7	=	24.23	(78)
South	0.9x	0.77	x	1.27	x	82.59	x	0.63	x	0.7	=	32.05	(78)
South	0.9x	0.77	x	0.96	x	55.42	x	0.63	x	0.7	=	16.26	(78)
South	0.9x	0.77	x	0.96	x	55.42	x	0.63	x	0.7	=	16.26	(78)
South	0.9x	0.77	x	1.27	x	55.42	x	0.63	x	0.7	=	21.51	(78)
South	0.9x	0.77	x	0.96	x	40.4	x	0.63	x	0.7	=	11.85	(78)
South	0.9x	0.77	x	0.96	x	40.4	x	0.63	x	0.7	=	11.85	(78)
South	0.9x	0.77	x	1.27	x	40.4	x	0.63	x	0.7	=	15.68	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	65.48	112.93	159.55	208.28	244.5	248.07	236.91	208.8	176.11	126.05	78.65	55.91	(83)
--------	-------	--------	--------	--------	-------	--------	--------	-------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	461.7	506.98	540.89	569.32	585.08	568.98	545.11	522.85	500.68	471.12	447.16	441.85	(84)
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21

(85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.95	0.87	0.73	0.77	0.92	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.32	19.46	19.72	20.09	20.46	20.78	20.92	20.9	20.67	20.2	19.71	19.3	(87)
--------	-------	-------	-------	-------	-------	-------	-------	------	-------	------	-------	------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.66	19.67	19.67	19.68	19.69	19.7	19.7	19.7	19.7	19.69	19.68	19.68	(88)
--------	-------	-------	-------	-------	-------	------	------	------	------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.97	0.92	0.78	0.57	0.62	0.86	0.97	0.99	1	(89)
--------	---	------	------	------	------	------	------	------	------	------	------	---	------

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.47	17.67	18.05	18.6	19.12	19.53	19.67	19.66	19.41	18.76	18.04	17.45	(90)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------

fLA = Living area ÷ (4) =

0.3

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.02	18.21	18.55	19.04	19.52	19.91	20.05	20.03	19.79	19.19	18.54	18.01	(92)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.02	18.21	18.55	19.04	19.52	19.91	20.05	20.03	19.79	19.19	18.54	18.01	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.98	0.96	0.92	0.8	0.62	0.66	0.87	0.97	0.99	0.99	(94)
--------	------	------	------	------	------	-----	------	------	------	------	------	------	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	458.83	502.08	531.68	548.83	535.58	453.12	336.31	345.91	435.37	455.33	442.41	439.56	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
--------	-----	-----	-----	-----	------	------	------	------	------	------	-----	-----	------

TER WorkSheet: New dwelling design stage

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	1491.89	1442.77	1302.73	1081.3	831.65	557.25	361.91	380.6	599.97	913.5	1222.68	1483.78	(97)
--------	---------	---------	---------	--------	--------	--------	--------	-------	--------	-------	---------	---------	------

Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	768.6	632.14	573.67	383.38	220.28	0	0	0	0	340.88	561.8	776.9	
--------	-------	--------	--------	--------	--------	---	---	---	---	--------	-------	-------	--

Total per year (kWh/year) = $\text{Sum}((98))_{1..12} =$ 4257.64 (98)

Space heating requirement in kWh/m²/year

60.07 (99)

12a Energy requirements – individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

93.5 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

768.6	632.14	573.67	383.38	220.28	0	0	0	0	340.88	561.8	776.9
-------	--------	--------	--------	--------	---	---	---	---	--------	-------	-------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

822.03	676.09	613.55	410.03	235.59	0	0	0	0	364.57	600.85	830.91
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

Total (kWh/year) = $\text{Sum}((211))_{1..12} =$ 4553.63 (211)

Space heating fuel (secondary), kWh/month

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	
---------	---	---	---	---	---	---	---	---	---	---	---	--

Total (kWh/year) = $\text{Sum}((215))_{1..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

192.87	170.1	178.87	160.67	157.68	141.23	135.95	148.74	148.34	166.59	175.75	188.34
--------	-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

Efficiency of water heater

79.8 (216)

(217)m=	88.13	88	87.7	87.05	85.71	79.8	79.8	79.8	79.8	86.68	87.7	88.19	(217)
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Fuel for water heating, kWh/month

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	218.85	193.3	203.95	184.56	183.98	176.98	170.37	186.4	185.9	192.18	200.4	213.56
---------	--------	-------	--------	--------	--------	--------	--------	-------	-------	--------	-------	--------

Total = $\text{Sum}((219a))_{1..12} =$ 2310.41 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year

4553.63

Water heating fuel used

2310.41

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

348.41 (232)

12a CO2 emissions – individual heating systems including micro-CHP

TER WorkSheet: New dwelling design stage

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	{211} x	0.216	=	983.58	{261}
Space heating (secondary)	{215} x	0.519	=	0	{263}
Water heating	{219} x	0.216	=	499.05	{264}
Space and water heating	{261} + {262} + {263} + {264} =			1482.63	{265}
Electricity for pumps, fans and electric keep-hot	{231} x	0.519	=	38.93	{267}
Electricity for lighting	{232} x	0.519	=	180.83	{268}
Total CO2, kg/year		sum of {265}...{271} =		1702.38	{272}
TER =				24.02	{273}

DRAFT

SAP WorkSheet: New dwelling design stage

User Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.25

Property Address: 2BCH (N) semi detached

Address : 2BCH (N) semi detached, Land North of Sefter Road, Bognor Regis, PO21 3FF

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	6.23 (1a)	x	2.59 (2a)	=	16.14 (3a)
First floor	64.65 (1b)	x	2.33 (2b)	=	150.63 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.88 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	166.77 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							2	x 10 =	20 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) = 20 ÷ (5) = 0.12 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Number of storeys in the dwelling (ns) 0 (9)

Additional infiltration [(9)-1]x0.1 = 0 (10)

Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction 0 (11)

if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35

If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0 0 (12)

If no draught lobby, enter 0.05, else enter 0 0 (13)

Percentage of windows and doors draught stripped 0 (14)

Window infiltration 0.25 - {0.2 x (14) ÷ 100} = 0 (15)

Infiltration rate (8) + (10) + (11) + (12) + (13) + (15) = 0 (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 5 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) 0.37 (18)

Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used

Number of sides sheltered 0 (19)

Shelter factor (20) = 1 - {0.075 x (19)} = 1 (20)

Infiltration rate incorporating shelter factor (21) = (18) x (20) = 0.37 (21)

Infiltration rate modified for monthly wind speed

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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SAP WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.47	0.46	0.45	0.41	0.4	0.35	0.35	0.34	0.37	0.4	0.42	0.43
--	------	------	------	------	-----	------	------	------	------	-----	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m x 0.5]

(24d)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59
---------	------	------	-----	------	------	------	------	------	------	------	------	------

(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59
--------	------	------	-----	------	------	------	------	------	------	------	------	------

(25)

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors Type 1			2.12	1.1	2.332		(26)
Doors Type 2			2.12	1.1	2.332		(26)
Windows Type 1			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 2			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 3			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 4			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Windows Type 5			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Windows Type 6			1.27	$\times 1/[1/(1.4) + 0.04]$	1.68		(27)
Windows Type 7			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Floor Type 1			6.23	0.12	0.7476		(28)
Floor Type 2			58.42	0.12	7.0104		(28)
Walls Type1	5.88	4.24	1.64	0.17	0.28		(29)
Walls Type2	15.49	0	15.49	0.15	2.36		(29)
Walls Type3	64.33	8.5	55.83	0.17	9.49		(29)
Walls Type4	16.34	0	16.34	0.15	2.52		(29)
Roof	64.65	0	64.65	0.1	6.47		(30)
Total area of elements, m²			231.34				(31)

SAP WorkSheet: New dwelling design stage

Party wall

$$13.93 \times 0 = 0 \quad (32)$$

* for windows and roof windows, use effective window U-value calculated using formula $1/[(1/U\text{-value})+0.04]$ as given in paragraph 3.2

** include the areas on both sides of internal walls and partitions

Fabric heat loss, W/K = S (A x U)

$$(26) \dots (30) + (32) = 44.81 \quad (33)$$

Heat capacity Cm = S(A x k)

$$((28) \dots (30) + (32) + (32a) \dots (32e) = 9325.85 \quad (34)$$

Thermal mass parameter (TMP = Cm ÷ TFA) in kJ/m²K

Indicative Value: Medium 250 (35)

For design assessments where the details of the construction are not known precisely the indicative values of TMP in Table 1f can be used instead of a detailed calculation.

Thermal bridges : S (L x Y) calculated using Appendix K

$$19.23 \quad (36)$$

if details of thermal bridging are not known (36) = 0.05 x (31)

Total fabric heat loss

$$(33) + (36) = 64.04 \quad (37)$$

Ventilation heat loss calculated monthly

$$(38)m = 0.33 \times (25)m \times (5)$$

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m=	33.64	33.4	33.17	32.07	31.87	30.92	30.92	30.74	31.28	31.87	32.28	32.72	(38)

Heat transfer coefficient, W/K

$$(39)m = (37) \div (38)m$$

(39)m=	97.68	97.44	97.21	96.11	95.91	94.95	94.95	94.78	95.32	95.91	96.32	96.76	
													Average = Sum(39) / 12 = 96.11 (39)

Heat loss parameter (HLP), W/m²K

$$(40)m = (39)m \div (4)$$

(40)m=	1.38	1.37	1.37	1.36	1.35	1.34	1.34	1.34	1.34	1.35	1.36	1.37	
													Average = Sum(40) / 12 = 1.36 (40)

Number of days in month (Table 1a)

(41)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	31	28	31	30	31	30	31	31	30	31	30	31	(41)

Assumed occupancy, N

if TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

if TFA ≤ 13.9, N = 1

$$2.27 \quad (42)$$

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36

$$88.05 \quad (43)$$

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)													
(44)m=	96.85	93.33	89.81	86.29	82.77	79.24	79.24	82.77	86.29	89.81	93.33	96.85	
													Total = Sum(44) / 12 = 1056.58 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x DTm / 3600 kWh/month (see Tables 1b, 1c, 1d)

(45)m=	143.63	125.62	129.63	113.01	108.44	93.57	86.71	99.5	100.69	117.34	128.09	139.1	
													Total = Sum(45) / 12 = 1385.34 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

(46)m=	21.54	18.84	19.44	16.95	16.27	14.04	13.01	14.93	15.1	17.6	19.21	20.86	(46)
--------	-------	-------	-------	-------	-------	-------	-------	-------	------	------	-------	-------	------

Water storage loss:

Storage volume (litres) including any solar or WWHRS storage within same vessel

$$180 \quad (47)$$

If community heating and no tank in dwelling, enter 110 litres in (47)

Otherwise if no stored hot water (this includes instantaneous combi boilers) enter '0' in (47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):

$$0 \quad (48)$$

Temperature factor from Table 2b

$$0 \quad (49)$$

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Energy lost from water storage, kWh/year	(48) x (49) =	110	(50)											
b) If manufacturer's declared cylinder loss factor is not known:														
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)											
If community heating see section 4.3														
Volume factor from Table 2a		1.03	(52)											
Temperature factor from Table 2b		0.6	(53)											
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)											
Enter (50) or (54) in (55)		1.03	(55)											
Water storage loss calculated for each month	((56)m = (55) x (41)m													
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)	
If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H														
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)	
Primary circuit loss (annual) from Table 3		0	(58)											
Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m	(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)													
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)	
Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m														
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)	
Total heat required for water heating calculated for each month (62)m = 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m														
(62)m=	198.91	175.55	184.91	166.51	163.72	147.07	141.99	154.78	154.18	172.62	181.58	194.38	(62)	
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)														
(add additional lines if FCHRS and/or WWHRS applies, see Appendix G)														
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)	
Output from water heater														
(64)m=	198.91	175.55	184.91	166.51	163.72	147.07	141.99	154.78	154.18	172.62	181.58	194.38		
												Output from water heater (annual) 1...12	2036.18	(64)
Heat gains from water heating, kWh/month 0.25 x [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]														
(65)m=	91.98	81.71	87.32	80.37	80.28	73.91	73.05	77.31	76.27	83.24	85.39	90.47	(65)	
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating														
5. Internal gains (see Table 5 and Part 5)														
Metabolic gains (Table 5), Watts														
(66)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
	136.04	136.04	136.04	136.04	136.04	136.04	136.04	136.04	136.04	136.04	136.04	136.04	(66)	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5														
(67)m=	49.32	43.81	35.63	26.97	20.16	17.02	18.39	23.91	32.09	40.74	47.55	50.69	(67)	
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5														
(68)m=	297.53	300.61	292.83	276.27	255.36	235.71	222.58	219.5	227.28	243.84	264.75	284.4	(68)	
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5														
(69)m=	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	50.87	(69)	
Pumps and fans gains (Table 5a)														
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)	
Losses e.g. evaporation (negative values) (Table 5)														
(71)m=	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	(71)	

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Water heating gains (Table 5)

(72)m=	123.63	121.59	117.37	111.63	107.9	102.65	98.19	103.91	105.94	111.88	118.59	121.6	(72)
--------	--------	--------	--------	--------	-------	--------	-------	--------	--------	--------	--------	-------	------

Total internal gains =

{66)m + {67)m + {68)m + {69)m + {70)m + {71)m + {72)m

(73)m=	566.69	562.23	542.05	511.09	479.64	451.6	435.38	443.53	461.52	492.68	527.11	552.91	(73)
--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	--------	------

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d			Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	=	4.71	(74)
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	=	4.71	(74)
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	=	4.71	(74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	=	9.01	(74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	=	9.01	(74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	=	9.01	(74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	=	15.3	(74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	=	15.3	(74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	=	15.3	(74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	=	24.58	(74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	=	24.58	(74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	=	24.58	(74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	=	33.11	(74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	=	33.11	(74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	=	33.11	(74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	=	35.44	(74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	=	35.44	(74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	=	35.44	(74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	=	33.09	(74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	=	33.09	(74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	=	33.09	(74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	=	26.25	(74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	=	26.25	(74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	=	26.25	(74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	=	10.72	(74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	=	10.72	(74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	=	10.72	(74)
North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	=	5.81	(74)
North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	=	5.81	(74)

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North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	=	5.81	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
East	0.9x	0.77	x	0.96	x	19.64	x	0.63	x	0.7	=	5.76	(76)
East	0.9x	0.77	x	0.96	x	38.42	x	0.63	x	0.7	=	11.27	(76)
East	0.9x	0.77	x	0.96	x	63.27	x	0.63	x	0.7	=	18.56	(76)
East	0.9x	0.77	x	0.96	x	92.28	x	0.63	x	0.7	=	27.07	(76)
East	0.9x	0.77	x	0.96	x	113.09	x	0.63	x	0.7	=	33.18	(76)
East	0.9x	0.77	x	0.96	x	115.77	x	0.63	x	0.7	=	33.97	(76)
East	0.9x	0.77	x	0.96	x	110.22	x	0.63	x	0.7	=	32.34	(76)
East	0.9x	0.77	x	0.96	x	94.68	x	0.63	x	0.7	=	27.78	(76)
East	0.9x	0.77	x	0.96	x	73.59	x	0.63	x	0.7	=	21.59	(76)
East	0.9x	0.77	x	0.96	x	45.59	x	0.63	x	0.7	=	13.38	(76)
East	0.9x	0.77	x	0.96	x	24.49	x	0.63	x	0.7	=	7.18	(76)
East	0.9x	0.77	x	0.96	x	16.15	x	0.63	x	0.7	=	4.74	(76)
South	0.9x	0.77	x	0.96	x	46.75	x	0.63	x	0.7	=	13.72	(78)
South	0.9x	0.77	x	0.96	x	46.75	x	0.63	x	0.7	=	13.72	(78)
South	0.9x	0.77	x	1.27	x	46.75	x	0.63	x	0.7	=	18.15	(78)
South	0.9x	0.77	x	0.96	x	76.57	x	0.63	x	0.7	=	22.46	(78)
South	0.9x	0.77	x	0.96	x	76.57	x	0.63	x	0.7	=	22.46	(78)
South	0.9x	0.77	x	1.27	x	76.57	x	0.63	x	0.7	=	29.72	(78)
South	0.9x	0.77	x	0.96	x	97.53	x	0.63	x	0.7	=	28.62	(78)
South	0.9x	0.77	x	0.96	x	97.53	x	0.63	x	0.7	=	28.62	(78)
South	0.9x	0.77	x	1.27	x	97.53	x	0.63	x	0.7	=	37.86	(78)
South	0.9x	0.77	x	0.96	x	110.23	x	0.63	x	0.7	=	32.34	(78)
South	0.9x	0.77	x	0.96	x	110.23	x	0.63	x	0.7	=	32.34	(78)
South	0.9x	0.77	x	1.27	x	110.23	x	0.63	x	0.7	=	42.79	(78)
South	0.9x	0.77	x	0.96	x	114.87	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	0.96	x	114.87	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	1.27	x	114.87	x	0.63	x	0.7	=	44.58	(78)
South	0.9x	0.77	x	0.96	x	110.55	x	0.63	x	0.7	=	32.43	(78)
South	0.9x	0.77	x	0.96	x	110.55	x	0.63	x	0.7	=	32.43	(78)
South	0.9x	0.77	x	1.27	x	110.55	x	0.63	x	0.7	=	42.91	(78)
South	0.9x	0.77	x	0.96	x	108.01	x	0.63	x	0.7	=	31.69	(78)
South	0.9x	0.77	x	0.96	x	108.01	x	0.63	x	0.7	=	31.69	(78)
South	0.9x	0.77	x	1.27	x	108.01	x	0.63	x	0.7	=	41.92	(78)
South	0.9x	0.77	x	0.96	x	104.89	x	0.63	x	0.7	=	30.77	(78)
South	0.9x	0.77	x	0.96	x	104.89	x	0.63	x	0.7	=	30.77	(78)
South	0.9x	0.77	x	1.27	x	104.89	x	0.63	x	0.7	=	40.71	(78)
South	0.9x	0.77	x	0.96	x	101.89	x	0.63	x	0.7	=	29.89	(78)

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South	0.9x	0.77	x	0.96	x	101.89	x	0.63	x	0.7	=	29.89	(78)
South	0.9x	0.77	x	1.27	x	101.89	x	0.63	x	0.7	=	39.54	(78)
South	0.9x	0.77	x	0.96	x	82.59	x	0.63	x	0.7	=	24.23	(78)
South	0.9x	0.77	x	0.96	x	82.59	x	0.63	x	0.7	=	24.23	(78)
South	0.9x	0.77	x	1.27	x	82.59	x	0.63	x	0.7	=	32.05	(78)
South	0.9x	0.77	x	0.96	x	55.42	x	0.63	x	0.7	=	16.26	(78)
South	0.9x	0.77	x	0.96	x	55.42	x	0.63	x	0.7	=	16.26	(78)
South	0.9x	0.77	x	1.27	x	55.42	x	0.63	x	0.7	=	21.51	(78)
South	0.9x	0.77	x	0.96	x	40.4	x	0.63	x	0.7	=	11.85	(78)
South	0.9x	0.77	x	0.96	x	40.4	x	0.63	x	0.7	=	11.85	(78)
South	0.9x	0.77	x	1.27	x	40.4	x	0.63	x	0.7	=	15.68	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	65.48	112.93	159.55	208.28	244.5	248.07	236.91	208.8	176.11	126.05	78.65	55.91	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	632.17	675.16	701.6	719.36	724.14	699.67	672.3	652.33	637.63	618.73	605.76	608.82	(84)
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7. Mean internal temperature (heating season)

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

21

(85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	0.99	0.99	0.98	0.95	0.89	0.75	0.59	0.63	0.83	0.95	0.98	0.99	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.72	19.85	20.08	20.39	20.68	20.9	20.97	20.97	20.83	20.48	20.05	19.7	(87)
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Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.78	19.78	19.79	19.8	19.8	19.81	19.81	19.81	19.81	19.8	19.79	19.79	(88)
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Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	0.99	0.98	0.97	0.93	0.84	0.65	0.45	0.48	0.75	0.93	0.98	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	18.13	18.31	18.64	19.09	19.49	19.74	19.8	19.8	19.68	19.22	18.61	18.1	(90)
--------	-------	-------	-------	-------	-------	-------	------	------	-------	-------	-------	------	------

fLA = Living area ÷ (4) =

0.3

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.6	18.77	19.07	19.48	19.85	20.09	20.15	20.15	20.02	19.6	19.05	18.58	(92)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.6	18.77	19.07	19.48	19.85	20.09	20.15	20.15	20.02	19.6	19.05	18.58	(93)
--------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	-------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Utilisation factor for gains, hm:

(94)m=	0.98	0.98	0.96	0.92	0.85	0.68	0.49	0.53	0.76	0.92	0.97	0.98	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	621.1	658.47	673.85	665.41	611.99	476.39	329.34	344.1	486.89	570.58	588.24	599.62	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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Heat loss rate for mean internal temperature, L_m , $W = [(93)m - (96)m]$

(97)m=	1397.15	1351.91	1222.1	1016.88	781.31	521.14	337.31	355.24	564.77	862.99	1150.62	1391.05	(97)
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Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	577.38	465.99	407.9	253.06	125.97	0	0	0	0	217.55	404.91	588.83	(98)
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Total per year (kWh/year) = $\text{Sum}(98)_{1..12} =$ 3041.59 (98)

Space heating requirement in kWh/m²/year

42.91 (99)

10. Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0 (301)

Fraction of space heat from community system 1 – (301) =

1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers

1 (303a)

Fraction of total space heat from Community boilers

(302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system

1 (305)

Distribution loss factor (Table 12c) for community heating system

1.05 (306)

Space heating

Annual space heating requirement

kWh/year

3041.59

Space heat from Community boilers

(98) x (304a) x (305) x (306) = 3193.67 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0 (308)

Space heating requirement from secondary/supplementary system

(98) x (301) x 100 - (308) = 0 (309)

Water heating

Annual water heating requirement

2036.18

If DHW from community scheme:

Water heat from Community boilers

(64) x (303a) x (305) x (306) = 2137.99 (310a)

Electricity used for heat distribution

$0.01 \times [(307a) \dots (307e) + (310a) \dots (310e)] =$ 53.32 (313)

Cooling System Energy Efficiency Ratio

0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0)

$= (107) \div (314) =$ 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):

mechanical ventilation - balanced, extract or positive input from outside

0 (330a)

warm air heating system fans

0 (330b)

pump for solar water heating

0 (330g)

Total electricity for the above, kWh/year

$= (330a) + (330b) + (330g) =$ 0 (331)

Energy for lighting (calculated in Appendix L)

348.41 (332)

Electricity generated by PVs (Appendix M) (negative quantity)

-682.26 (333)

Electricity generated by wind turbine (Appendix M) (negative quantity)

0 (334)

10b. Fuel costs – Community heating scheme

Fuel
kWh/year

Fuel Price
(Table 12)

Fuel Cost
£/year

SAP WorkSheet: New dwelling design stage

Space heating from CHP	(307a) x	4.24	x 0.01 =	135.41	(340a)
Water heating from CHP	(310a) x	4.24	x 0.01 =	90.65	(342a)
Fuel Price					
Pumps and fans	(331)	13.19	x 0.01 =	0	(349)
Energy for lighting	(332)	13.19	x 0.01 =	45.96	(350)
Additional standing charges (Table 12)				120	(351)
Energy saving/generation technologies					
Total energy cost	= (340a) ... (342e) + (345) ... (354) =			392.02	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12)		0.42	(356)
Energy cost factor (ECF)	[(355) x (356)] ÷ [(4) + 45.0] =		1.42 (357)
SAP rating (section12)		80.18	(358)

12b. CO2 Emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
CO2 from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	If there is CHP using two fuels repeat (363) to (366) for the second fuel		
			94.3 (367a)
CO2 associated with heat source 1	[(307b)+(310b)] x 100 ÷ (367b) x		0.22 = 1321.35 (367)
Electrical energy for heat distribution	[(313) x		0.52 = 27.67 (372)
Total CO2 associated with community systems	(363) ... (366) + (368) ... (372)		= 1248.92 (373)
CO2 associated with space heating (secondary)	(369) x		0 = 0 (374)
CO2 associated with water from immersion heater or instantaneous heater	(312) x		0.22 = 0 (375)
Total CO2 associated with space and water heating	(373) + (374) + (375) =		1248.92 (376)
CO2 associated with electricity for pumps and fans within dwelling	(331) x		0.52 = 0 (378)
CO2 associated with electricity for lighting	(332) x		0.52 = 180.83 (379)
Energy saving/generation technologies (333) to (334) as applicable			
Item 1	0.52		x 0.01 = -354.09 (380)
Total CO2, kg/year	sum of (376) ... (382) =		1075.66 (383)
Dwelling CO2 Emission Rate	(383) ÷ (4) =		15.18 (384)
EI rating (section 14)			87.56 (385)

13b. Primary Energy - Community heating scheme

	Energy kWh/year	Primary factor	P.Energy kWh/year
Energy from other sources of space and water heating (not CHP)			
Efficiency of heat source 1 (%)	if there is CHP using two fuels repeat (363) to (366) for the second fuel		94.3 (367a)
Energy associated with heat source 1	$[(307b)+(310b)] \times 100 \div (367b) \times$	1.22	= 6897.81 (367)
Electrical energy for heat distribution	$[(313) \times$		= 163.68 (372)
Total Energy associated with community systems	$(363) \dots (366) + (368) \dots (372)$		= 7061.49 (373)
if it is negative set (373) to zero (unless specified otherwise, see C7 in Appendix C)			7061.49 (373)

SAP WorkSheet: New dwelling design stage

Energy associated with space heating (secondary)	{309} x	0	=	0	{374}
Energy associated with water from immersion heater or instantaneous heater	{312} x	1.22	=	0	{375}
Total Energy associated with space and water heating	{373} + {374} + {375} =			7061.49	{376}
Energy associated with space cooling	{315} x	3.07	=	0	{377}
Energy associated with electricity for pumps and fans within dwelling	{331} x	3.07	=	0	{378}
Energy associated with electricity for lighting	{332} x	3.07	=	1069.63	{379}
Energy saving/generation technologies Item 1		3.07	x 0.01 =	-2094.54	{380}
Total Primary Energy, kWh/year	sum of {376}...{382} =			6036.58	{383}

DRAFT

DER WorkSheet: New dwelling design stage

User Details

Assessor Name:

Software Name: Stroma FSAP 2012

Stroma Number:

Software Version:

Version: 1.0.4.25

Property Address: 2BCH (N) semi detached

Address : 2BCH (N) semi detached, Land North of Sefter Road, Bognor Regis, PO21 3FF

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	6.23 (1a)	x	2.59 (2a)	=	16.14 (3a)
First floor	64.65 (1b)	x	2.33 (2b)	=	150.63 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.88 (4)				
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	166.77 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							2	x 10 =	20 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20	÷ (5) =	0.12 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - {0.2 x (14) ÷ 100} =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (16), otherwise (18) = (16)			0.37 (18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered			0 (19)
Shelter factor	(20) = 1 - {0.075 x (19)} =		1 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.37 (21)
Infiltration rate modified for monthly wind speed			

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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DER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
---------	------	------	------	-----	------	------	------	------	---	------	------	------

Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.47	0.46	0.45	0.41	0.4	0.35	0.35	0.34	0.37	0.4	0.42	0.43
--	------	------	------	------	-----	------	------	------	------	-----	------	------

Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
---------	---	---	---	---	---	---	---	---	---	---	---	---

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m x 0.5]

(24d)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.61	0.61	0.6	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.59	0.59
--------	------	------	-----	------	------	------	------	------	------	------	------	------

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors Type 1			2.12	1.1	2.332		(26)
Doors Type 2			2.12	1.1	2.332		(26)
Windows Type 1			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 2			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 3			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 4			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Windows Type 5			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Windows Type 6			1.27	$\times 1/[1/(1.4) + 0.04]$	1.68		(27)
Windows Type 7			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Floor Type 1			6.23	0.12	0.7476		(28)
Floor Type 2			58.42	0.12	7.0104		(28)
Walls Type1	5.88	4.24	1.64	0.17	0.28		(29)
Walls Type2	15.49	0	15.49	0.15	2.36		(29)
Walls Type3	64.33	8.5	55.83	0.17	9.49		(29)
Walls Type4	16.34	0	16.34	0.15	2.52		(29)
Roof	64.65	0	64.65	0.1	6.47		(30)
Total area of elements, m²			231.34				(31)

DER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(48) x (49) =	110	(50)										
b) If manufacturer's declared cylinder loss factor is not known:													
Hot water storage loss factor from Table 2 (kWh/litre/day)		0.02	(51)										
If community heating see section 4.3													
Volume factor from Table 2a		1.03	(52)										
Temperature factor from Table 2b		0.6	(53)										
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	1.03	(54)										
Enter (50) or (54) in (55)		1.03	(55)										
Water storage loss calculated for each month	((56)m = (55) x (41)m												
(56)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)
Primary circuit loss (annual) from Table 3	0												(58)
Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m													
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)													
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m													
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
Total heat required for water heating calculated for each month (62)m = 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m													
(62)m=	198.91	175.55	184.91	166.51	163.72	147.07	141.99	154.78	154.18	172.62	181.58	194.38	(62)
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)													
(add additional lines if FCHRS and/or WWHRS applies, see Appendix G)													
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
Output from water heater													
(64)m=	198.91	175.55	184.91	166.51	163.72	147.07	141.99	154.78	154.18	172.62	181.58	194.38	(64)
												Output from water heater (annual) 1...12	2036.18
Heat gains from water heating, kWh/month 0.25 x [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]													
(65)m=	91.98	81.71	87.32	80.37	80.28	73.91	73.05	77.31	76.27	83.24	85.39	90.47	(65)
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating													
5. Internal gains (see Table 5 and Part 5)													
Metabolic gains (Table 5), Watts													
(66)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	19.73	17.52	14.25	10.79	8.06	6.81	7.36	9.56	12.83	16.3	19.02	20.28	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	199.34	201.41	196.2	185.1	171.09	157.93	149.13	147.06	152.28	163.37	177.38	190.55	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	(69)
Pumps and fans gains (Table 5a)													
(70)m=	0	0	0	0	0	0	0	0	0	0	0	0	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	(71)

DER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

(72)m=	123.63	121.59	117.37	111.63	107.9	102.65	98.19	103.91	105.94	111.88	118.59	121.6	(72)
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Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	399.71	397.54	384.83	364.53	344.07	324.4	311.69	317.54	328.06	348.56	372	389.43	(73)
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6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d			Area m ²		Flux Table 6a		g_ Table 6b		FF Table 6c		Gains (W)	
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	=	4.71	(74)
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	=	4.71	(74)
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	=	4.71	(74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	=	9.01	(74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	=	9.01	(74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	=	9.01	(74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	=	15.3	(74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	=	15.3	(74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	=	15.3	(74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	=	24.58	(74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	=	24.58	(74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	=	24.58	(74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	=	33.11	(74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	=	33.11	(74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	=	33.11	(74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	=	35.44	(74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	=	35.44	(74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	=	35.44	(74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	=	33.09	(74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	=	33.09	(74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	=	33.09	(74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	=	26.25	(74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	=	26.25	(74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	=	26.25	(74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	=	18.4	(74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	=	10.72	(74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	=	10.72	(74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	=	10.72	(74)
North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	=	5.81	(74)
North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	=	5.81	(74)

DER WorkSheet: New dwelling design stage

North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	=	5.81	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
East	0.9x	0.77	x	0.96	x	19.64	x	0.63	x	0.7	=	5.76	(76)
East	0.9x	0.77	x	0.96	x	38.42	x	0.63	x	0.7	=	11.27	(76)
East	0.9x	0.77	x	0.96	x	63.27	x	0.63	x	0.7	=	18.56	(76)
East	0.9x	0.77	x	0.96	x	92.28	x	0.63	x	0.7	=	27.07	(76)
East	0.9x	0.77	x	0.96	x	113.09	x	0.63	x	0.7	=	33.18	(76)
East	0.9x	0.77	x	0.96	x	115.77	x	0.63	x	0.7	=	33.97	(76)
East	0.9x	0.77	x	0.96	x	110.22	x	0.63	x	0.7	=	32.34	(76)
East	0.9x	0.77	x	0.96	x	94.68	x	0.63	x	0.7	=	27.78	(76)
East	0.9x	0.77	x	0.96	x	73.59	x	0.63	x	0.7	=	21.59	(76)
East	0.9x	0.77	x	0.96	x	45.59	x	0.63	x	0.7	=	13.38	(76)
East	0.9x	0.77	x	0.96	x	24.49	x	0.63	x	0.7	=	7.18	(76)
East	0.9x	0.77	x	0.96	x	16.15	x	0.63	x	0.7	=	4.74	(76)
South	0.9x	0.77	x	0.96	x	46.75	x	0.63	x	0.7	=	13.72	(78)
South	0.9x	0.77	x	0.96	x	46.75	x	0.63	x	0.7	=	13.72	(78)
South	0.9x	0.77	x	1.27	x	46.75	x	0.63	x	0.7	=	18.15	(78)
South	0.9x	0.77	x	0.96	x	76.57	x	0.63	x	0.7	=	22.46	(78)
South	0.9x	0.77	x	0.96	x	76.57	x	0.63	x	0.7	=	22.46	(78)
South	0.9x	0.77	x	1.27	x	76.57	x	0.63	x	0.7	=	29.72	(78)
South	0.9x	0.77	x	0.96	x	97.53	x	0.63	x	0.7	=	28.62	(78)
South	0.9x	0.77	x	0.96	x	97.53	x	0.63	x	0.7	=	28.62	(78)
South	0.9x	0.77	x	1.27	x	97.53	x	0.63	x	0.7	=	37.86	(78)
South	0.9x	0.77	x	0.96	x	110.23	x	0.63	x	0.7	=	32.34	(78)
South	0.9x	0.77	x	0.96	x	110.23	x	0.63	x	0.7	=	32.34	(78)
South	0.9x	0.77	x	1.27	x	110.23	x	0.63	x	0.7	=	42.79	(78)
South	0.9x	0.77	x	0.96	x	114.87	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	0.96	x	114.87	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	1.27	x	114.87	x	0.63	x	0.7	=	44.58	(78)
South	0.9x	0.77	x	0.96	x	110.55	x	0.63	x	0.7	=	32.43	(78)
South	0.9x	0.77	x	0.96	x	110.55	x	0.63	x	0.7	=	32.43	(78)
South	0.9x	0.77	x	1.27	x	110.55	x	0.63	x	0.7	=	42.91	(78)
South	0.9x	0.77	x	0.96	x	108.01	x	0.63	x	0.7	=	31.69	(78)
South	0.9x	0.77	x	0.96	x	108.01	x	0.63	x	0.7	=	31.69	(78)
South	0.9x	0.77	x	1.27	x	108.01	x	0.63	x	0.7	=	41.92	(78)
South	0.9x	0.77	x	0.96	x	104.89	x	0.63	x	0.7	=	30.77	(78)
South	0.9x	0.77	x	0.96	x	104.89	x	0.63	x	0.7	=	30.77	(78)
South	0.9x	0.77	x	1.27	x	104.89	x	0.63	x	0.7	=	40.71	(78)
South	0.9x	0.77	x	0.96	x	101.89	x	0.63	x	0.7	=	29.89	(78)

DER WorkSheet: New dwelling design stage

South	0.9x	0.77	x	0.96	x	101.89	x	0.63	x	0.7	=	29.89	(78)
South	0.9x	0.77	x	1.27	x	101.89	x	0.63	x	0.7	=	39.54	(78)
South	0.9x	0.77	x	0.96	x	82.59	x	0.63	x	0.7	=	24.23	(78)
South	0.9x	0.77	x	0.96	x	82.59	x	0.63	x	0.7	=	24.23	(78)
South	0.9x	0.77	x	1.27	x	82.59	x	0.63	x	0.7	=	32.05	(78)
South	0.9x	0.77	x	0.96	x	55.42	x	0.63	x	0.7	=	16.26	(78)
South	0.9x	0.77	x	0.96	x	55.42	x	0.63	x	0.7	=	16.26	(78)
South	0.9x	0.77	x	1.27	x	55.42	x	0.63	x	0.7	=	21.51	(78)
South	0.9x	0.77	x	0.96	x	40.4	x	0.63	x	0.7	=	11.85	(78)
South	0.9x	0.77	x	0.96	x	40.4	x	0.63	x	0.7	=	11.85	(78)
South	0.9x	0.77	x	1.27	x	40.4	x	0.63	x	0.7	=	15.68	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	65.48	112.93	159.55	208.28	244.5	248.07	236.91	208.8	176.11	126.05	78.65	55.91	(83)
--------	-------	--------	--------	--------	-------	--------	--------	-------	--------	--------	-------	-------	------

Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	465.18	510.47	544.38	572.8	588.56	572.47	548.6	526.34	504.17	474.61	450.65	445.34	(84)
--------	--------	--------	--------	-------	--------	--------	-------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

21

(85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	0.99	0.99	0.98	0.91	0.84	0.69	0.73	0.91	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.51	19.65	19.89	20.23	20.57	20.84	20.95	20.94	20.74	20.32	19.86	19.49	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.78	19.78	19.79	19.8	19.8	19.81	19.81	19.81	19.81	19.8	19.79	19.79	(88)
--------	-------	-------	-------	------	------	-------	-------	-------	-------	------	-------	-------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.97	0.91	0.75	0.54	0.59	0.85	0.97	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.83	18.02	18.38	18.87	19.35	19.69	19.79	19.78	19.59	19.01	18.34	17.8	(90)
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fLA = Living area ÷ (4) =

0.3

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.33	18.51	18.83	19.28	19.71	20.03	20.14	20.13	19.93	19.4	18.8	18.31	(92)
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Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.33	18.51	18.83	19.28	19.71	20.03	20.14	20.13	19.93	19.4	18.8	18.31	(93)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------	------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.98	0.96	0.91	0.77	0.58	0.63	0.85	0.96	0.99	1	(94)
--------	------	------	------	------	------	------	------	------	------	------	------	---	------

Useful gains, hmGm , W = (94)m x (84)m

(95)m=	462.41	505.59	534.85	550.65	533.14	441.92	320.26	331.26	430.47	457.57	445.86	443.15	(95)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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DER WorkSheet: New dwelling design stage

Heat loss rate for mean internal temperature, L_m , $W = [(93)m - (96)m]$

(97)m=	1370.65	1326.32	1198.75	997.72	768.46	516	336	353.4	555.98	844.19	1126.97	1365.15	(97)
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Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	675.73	551.53	493.94	321.89	175.08	0	0	0	0	287.64	490.4	685.97	(98)
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Total per year (kWh/year) = $\text{Sum}(98)_{1..12} =$ 3682.18 (98)

Space heating requirement in kWh/m²/year

51.95 (99)

2c Energy requirements – Community heating scheme

This part is used for space heating, space cooling or water heating provided by a community scheme.

Fraction of space heat from secondary/supplementary heating (Table 11) '0' if none

0 (301)

Fraction of space heat from community system 1 – (301) =

1 (302)

The community scheme may obtain heat from several sources. The procedure allows for CHP and up to four other heat sources; the latter includes boilers, heat pumps, geothermal and waste heat from power stations. See Appendix C.

Fraction of heat from Community boilers

1 (303a)

Fraction of total space heat from Community boilers

(302) x (303a) = 1 (304a)

Factor for control and charging method (Table 4c(3)) for community heating system

1 (305)

Distribution loss factor (Table 12c) for community heating system

1.05 (306)

Space heating

Annual space heating requirement

kWh/year

3682.18

Space heat from Community boilers

(98) x (304a) x (305) x (306) = 3682.18 (307a)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)

0 (308)

Space heating requirement from secondary/supplementary system

(98) x (301) x 100 - (308) = 0 (309)

Water heating

Annual water heating requirement

2036.18

If DHW from community scheme:

Water heat from Community boilers

(64) x (303a) x (305) x (306) = 2137.99 (310a)

Electricity used for heat distribution

$0.01 \times [(307a) \dots (307e) + (310a) \dots (310e)] =$ 60.04 (313)

Cooling System Energy Efficiency Ratio

0 (314)

Space cooling (if there is a fixed cooling system, if not enter 0)

$= (107) + (314) =$ 0 (315)

Electricity for pumps and fans within dwelling (Table 4f):

mechanical ventilation - balanced, extract or positive input from outside

0 (330a)

warm air heating system fans

0 (330b)

pump for solar water heating

0 (330g)

Total electricity for the above, kWh/year

$= (330a) + (330b) + (330g) =$ 0 (331)

Energy for lighting (calculated in Appendix L)

348.41 (332)

Electricity generated by PVs (Appendix M) (negative quantity)

-682.26 (333)

Electricity generated by wind turbine (Appendix M) (negative quantity)

0 (334)

2b CO2 Emissions – Community heating scheme

Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
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DER WorkSheet: New dwelling design stage

CO2 from other sources of space and water heating (not CHP)

Efficiency of heat source 1 (%) If there is CHP using two fuels repeat (363) to (366) for the second fuel 94.3 (367a)

CO2 associated with heat source 1 $[(307b)+(310b)] \times 100 \div (367b) \times$ 0.22 = 1375.32 (367)

Electrical energy for heat distribution $[(313) \times$ 0.52 = 31.16 (372)

Total CO2 associated with community systems $(363)...(366) + (368)...(372)$ = 1406.48 (373)

CO2 associated with space heating (secondary) $(309) \times$ 0 = 0 (374)

CO2 associated with water from immersion heater or instantaneous heater $(312) \times$ 0.22 = 0 (375)

Total CO2 associated with space and water heating $(373) + (374) + (375) =$ 1406.48 (376)

CO2 associated with electricity for pumps and fans within dwelling $(331)) \times$ 0.52 = 0 (378)

CO2 associated with electricity for lighting $(332))) \times$ 0.52 = 180.83 (379)

Energy saving/generation technologies (333) to (334) as applicable
Item 1 0.52 $\times 0.01 =$ -354.09 (380)

Total CO2, kg/year $\text{sum of (376)...(382) =}$ 1233.21 (383)

Dwelling CO2 Emission Rate $(383) \div (4) =$ 17.4 (384)

EI rating (section 14) 85.74 (385)

DRAFT

TER WorkSheet: New dwelling design stage

User Details

Assessor Name:

Stroma Number:

Software Name: Stroma FSAP 2012

Software Version:

Version: 1.0.4.25

Property Address: 2BCH (N) semi detached

Address : 2BCH (N) semi detached, Land North of Sefter Road, Bognor Regis, PO21 3FF

1. General dwelling dimensions

	Area(m ²)		Av. Height(m)		Volume(m ³)
Ground floor	6.23	(1a) x	2.59	(2a) =	16.14 (3a)
First floor	64.65	(1b) x	2.33	(2b) =	150.63 (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)+.....(1n)	70.88	(4)			
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)+.....(3n) =	166.77 (5)

2. Ventilation rate

	main heating		secondary heating		other		total		m ³ per hour
Number of chimneys	0	+	0	+	0	=	0	x 40 =	0 (6a)
Number of open flues	0	+	0	+	0	=	0	x 20 =	0 (6b)
Number of intermittent fans							3	x 10 =	30 (7a)
Number of passive vents							0	x 10 =	0 (7b)
Number of flueless gas fires							0	x 40 =	0 (7c)

Air changes per hour

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30	÷ (5) =	0.18 (8)
If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)			
Number of storeys in the dwelling (ns)			0 (9)
Additional infiltration		[(9)-1]x0.1 =	0 (10)
Structural infiltration: 0.25 for steel or timber frame or 0.35 for masonry construction			0 (11)
if both types of wall are present, use the value corresponding to the greater wall area (after deducting areas of openings); if equal user 0.35			
If suspended wooden floor, enter 0.2 (unsealed) or 0.1 (sealed), else enter 0			0 (12)
If no draught lobby, enter 0.05, else enter 0			0 (13)
Percentage of windows and doors draught stripped			0 (14)
Window infiltration	0.25 - {0.2 x (14) ÷ 100} =		0 (15)
Infiltration rate	(8) + (10) + (11) + (12) + (13) + (15) =		0 (16)
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area			5 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)			0.43 (18)
Air permeability value applies if a pressurisation test has been done or a degree air permeability is being used			
Number of sides sheltered			0 (19)
Shelter factor	(20) = 1 - {0.075 x (19)} =		1 (20)
Infiltration rate incorporating shelter factor	(21) = (18) x (20) =		0.43 (21)
Infiltration rate modified for monthly wind speed			

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Monthly average wind speed from Table 7

(22)m=	5.1	5	4.9	4.4	4.3	3.8	3.8	3.7	4	4.3	4.5	4.7
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TER WorkSheet: New dwelling design stage

Wind Factor (22a)m = (22)m ÷ 4

(22a)m=	1.27	1.25	1.23	1.1	1.08	0.95	0.95	0.92	1	1.08	1.12	1.18
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Adjusted infiltration rate (allowing for shelter and wind speed) = (21a) x (22a)m

	0.55	0.54	0.53	0.47	0.46	0.41	0.41	0.4	0.43	0.46	0.48	0.51
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Calculate effective air change rate for the applicable case

If mechanical ventilation:

(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)) , otherwise (23b) = (23a)

(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =

(23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (24a)m = (22b)m + (23b) x [1 - (23c) ÷ 100]

(24a)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(24a)

b) If balanced mechanical ventilation without heat recovery (MV) (24b)m = (22b)m + (23b)

(24b)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(24b)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b) m + 0.5 x (23b)

(24c)m=	0	0	0	0	0	0	0	0	0	0	0	0
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(24c)

d) If natural ventilation or whole house positive input ventilation from loft

if (22b)m = 1, then (24d)m = (22b)m otherwise (24d)m = 0.5 + [(22b)m² x 0.5]

(24d)m=	0.65	0.64	0.64	0.61	0.61	0.58	0.58	0.58	0.59	0.61	0.62	0.63
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(24d)

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in box (25)

(25)m=	0.65	0.64	0.64	0.61	0.61	0.58	0.58	0.58	0.59	0.61	0.62	0.63
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(25)

ELEMENT	Gross area (m²)	Openings m²	Net Area A ,m²	U-value W/m²K	A X U (W/K)	k-value kJ/m²·K	A X k kJ/K
Doors Type 1			2.12	1	2.12		(26)
Doors Type 2			2.12	1	2.12		(26)
Windows Type 1			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 2			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 3			1.45	$\times 1/[1/(1.4) + 0.04]$	1.92		(27)
Windows Type 4			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Windows Type 5			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Windows Type 6			1.27	$\times 1/[1/(1.4) + 0.04]$	1.68		(27)
Windows Type 7			0.96	$\times 1/[1/(1.4) + 0.04]$	1.27		(27)
Floor Type 1			6.23	0.13	0.8099		(28)
Floor Type 2			58.42	0.13	7.594599		(28)
Walls Type1	5.88	4.24	1.64	0.18	0.3		(29)
Walls Type2	15.49	0	15.49	0.18	2.79		(29)
Walls Type3	64.33	8.5	55.83	0.18	10.05		(29)
Walls Type4	16.34	0	16.34	0.18	2.94		(29)
Roof	64.65	0	64.65	0.13	8.4		(30)
Total area of elements, m²			231.34				(31)

TER WorkSheet: New dwelling design stage

Energy lost from water storage, kWh/year	(48) x (49) =	0.84	(50)										
b) If manufacturer's declared cylinder loss factor is not known:													
Hot water storage loss factor from Table 2 (kWh/litre/day)		0	(51)										
If community heating see section 4.3													
Volume factor from Table 2a		0	(52)										
Temperature factor from Table 2b		0	(53)										
Energy lost from water storage, kWh/year	(47) x (51) x (52) x (53) =	0	(54)										
Enter (50) or (54) in (55)		0.84	(55)										
Water storage loss calculated for each month	((56)m = (55) x (41)m												
(56)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(56)
If cylinder contains dedicated solar storage, (57)m = (56)m x [(50) - (H11)] ÷ (50), else (57)m = (56)m where (H11) is from Appendix H													
(57)m=	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(57)
Primary circuit loss (annual) from Table 3		0	(58)										
Primary circuit loss calculated for each month (59)m = (58) ÷ 365 x (41)m													
(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)													
(59)m=	23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
Combi loss calculated for each month (61)m = (60) ÷ 365 x (41)m													
(61)m=	0	0	0	0	0	0	0	0	0	0	0	0	(61)
Total heat required for water heating calculated for each month (62)m = 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m													
(62)m=	192.87	170.1	178.87	160.67	157.68	141.23	135.95	148.74	148.34	166.59	175.75	188.34	(62)
Solar DHW input calculated using Appendix G or Appendix H (negative quantity) (enter 0 if no solar contribution to water heating)													
(add additional lines if FCHRS and/or WWHRS applies, see Appendix G)													
(63)m=	0	0	0	0	0	0	0	0	0	0	0	0	(63)
Output from water heater													
(64)m=	192.87	170.1	178.87	160.67	157.68	141.23	135.95	148.74	148.34	166.59	175.75	188.34	(64)
												Output from water heater (annual) 1965.14	(64)
Heat gains from water heating, kWh/month 0.25 x [0.85 x (45)m + (61)m] + 0.8 x [(46)m + (57)m + (59)m]													
(65)m=	87.15	77.35	82.5	75.7	75.45	69.24	68.23	72.48	71.6	78.41	80.71	85.64	(65)
include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating													
5. Internal gains (see Table 5 and Part 5)													
Metabolic gains (Table 5), Watts													
(66)m=	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	(66)
	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	113.36	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m=	19.73	17.52	14.25	10.79	8.06	6.81	7.36	9.56	12.83	16.3	19.02	20.28	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m=	199.34	201.41	196.2	185.1	171.09	157.93	149.13	147.06	152.28	163.37	177.38	190.55	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m=	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	34.34	(69)
Pumps and fans gains (Table 5a)													
(70)m=	3	3	3	3	3	3	3	3	3	3	3	3	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m=	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	-90.69	(71)

TER WorkSheet: New dwelling design stage

Water heating gains (Table 5)

(72)m=	117.14	115.1	110.88	105.14	101.41	96.16	91.7	97.42	99.45	105.39	112.1	115.11	(72)
--------	--------	-------	--------	--------	--------	-------	------	-------	-------	--------	-------	--------	------

Total internal gains = (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

(73)m=	396.22	394.05	381.34	361.04	340.58	320.91	308.2	314.05	324.57	345.07	368.51	385.95	(73)
--------	--------	--------	--------	--------	--------	--------	-------	--------	--------	--------	--------	--------	------

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Orientation:	Access Factor Table 6d			Area m ²	Flux Table 6a			g_ Table 6b	FF Table 6c	Gains (W)	
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	= 4.71 (74)
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	= 4.71 (74)
North	0.9x	0.77	x	1.45	x	10.63	x	0.63	x	0.7	= 4.71 (74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	= 9.01 (74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	= 9.01 (74)
North	0.9x	0.77	x	1.45	x	20.32	x	0.63	x	0.7	= 9.01 (74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	= 15.3 (74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	= 15.3 (74)
North	0.9x	0.77	x	1.45	x	34.53	x	0.63	x	0.7	= 15.3 (74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	= 24.58 (74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	= 24.58 (74)
North	0.9x	0.77	x	1.45	x	55.46	x	0.63	x	0.7	= 24.58 (74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	= 33.11 (74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	= 33.11 (74)
North	0.9x	0.77	x	1.45	x	74.72	x	0.63	x	0.7	= 33.11 (74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	= 35.44 (74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	= 35.44 (74)
North	0.9x	0.77	x	1.45	x	79.99	x	0.63	x	0.7	= 35.44 (74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	= 33.09 (74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	= 33.09 (74)
North	0.9x	0.77	x	1.45	x	74.68	x	0.63	x	0.7	= 33.09 (74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	= 26.25 (74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	= 26.25 (74)
North	0.9x	0.77	x	1.45	x	59.25	x	0.63	x	0.7	= 26.25 (74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	= 18.4 (74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	= 18.4 (74)
North	0.9x	0.77	x	1.45	x	41.52	x	0.63	x	0.7	= 18.4 (74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	= 10.72 (74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	= 10.72 (74)
North	0.9x	0.77	x	1.45	x	24.19	x	0.63	x	0.7	= 10.72 (74)
North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	= 5.81 (74)
North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	= 5.81 (74)

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North	0.9x	0.77	x	1.45	x	13.12	x	0.63	x	0.7	=	5.81	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
North	0.9x	0.77	x	1.45	x	8.86	x	0.63	x	0.7	=	3.93	(74)
East	0.9x	0.77	x	0.96	x	19.64	x	0.63	x	0.7	=	5.76	(76)
East	0.9x	0.77	x	0.96	x	38.42	x	0.63	x	0.7	=	11.27	(76)
East	0.9x	0.77	x	0.96	x	63.27	x	0.63	x	0.7	=	18.56	(76)
East	0.9x	0.77	x	0.96	x	92.28	x	0.63	x	0.7	=	27.07	(76)
East	0.9x	0.77	x	0.96	x	113.09	x	0.63	x	0.7	=	33.18	(76)
East	0.9x	0.77	x	0.96	x	115.77	x	0.63	x	0.7	=	33.97	(76)
East	0.9x	0.77	x	0.96	x	110.22	x	0.63	x	0.7	=	32.34	(76)
East	0.9x	0.77	x	0.96	x	94.68	x	0.63	x	0.7	=	27.78	(76)
East	0.9x	0.77	x	0.96	x	73.59	x	0.63	x	0.7	=	21.59	(76)
East	0.9x	0.77	x	0.96	x	45.59	x	0.63	x	0.7	=	13.38	(76)
East	0.9x	0.77	x	0.96	x	24.49	x	0.63	x	0.7	=	7.18	(76)
East	0.9x	0.77	x	0.96	x	16.15	x	0.63	x	0.7	=	4.74	(76)
South	0.9x	0.77	x	0.96	x	46.75	x	0.63	x	0.7	=	13.72	(78)
South	0.9x	0.77	x	0.96	x	46.75	x	0.63	x	0.7	=	13.72	(78)
South	0.9x	0.77	x	1.27	x	46.75	x	0.63	x	0.7	=	18.15	(78)
South	0.9x	0.77	x	0.96	x	76.57	x	0.63	x	0.7	=	22.46	(78)
South	0.9x	0.77	x	0.96	x	76.57	x	0.63	x	0.7	=	22.46	(78)
South	0.9x	0.77	x	1.27	x	76.57	x	0.63	x	0.7	=	29.72	(78)
South	0.9x	0.77	x	0.96	x	97.53	x	0.63	x	0.7	=	28.62	(78)
South	0.9x	0.77	x	0.96	x	97.53	x	0.63	x	0.7	=	28.62	(78)
South	0.9x	0.77	x	1.27	x	97.53	x	0.63	x	0.7	=	37.86	(78)
South	0.9x	0.77	x	0.96	x	110.23	x	0.63	x	0.7	=	32.34	(78)
South	0.9x	0.77	x	0.96	x	110.23	x	0.63	x	0.7	=	32.34	(78)
South	0.9x	0.77	x	1.27	x	110.23	x	0.63	x	0.7	=	42.79	(78)
South	0.9x	0.77	x	0.96	x	114.87	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	0.96	x	114.87	x	0.63	x	0.7	=	33.7	(78)
South	0.9x	0.77	x	1.27	x	114.87	x	0.63	x	0.7	=	44.58	(78)
South	0.9x	0.77	x	0.96	x	110.55	x	0.63	x	0.7	=	32.43	(78)
South	0.9x	0.77	x	0.96	x	110.55	x	0.63	x	0.7	=	32.43	(78)
South	0.9x	0.77	x	1.27	x	110.55	x	0.63	x	0.7	=	42.91	(78)
South	0.9x	0.77	x	0.96	x	108.01	x	0.63	x	0.7	=	31.69	(78)
South	0.9x	0.77	x	0.96	x	108.01	x	0.63	x	0.7	=	31.69	(78)
South	0.9x	0.77	x	1.27	x	108.01	x	0.63	x	0.7	=	41.92	(78)
South	0.9x	0.77	x	0.96	x	104.89	x	0.63	x	0.7	=	30.77	(78)
South	0.9x	0.77	x	0.96	x	104.89	x	0.63	x	0.7	=	30.77	(78)
South	0.9x	0.77	x	1.27	x	104.89	x	0.63	x	0.7	=	40.71	(78)
South	0.9x	0.77	x	0.96	x	101.89	x	0.63	x	0.7	=	29.89	(78)

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South	0.9x	0.77	x	0.96	x	101.89	x	0.63	x	0.7	=	29.89	(78)
South	0.9x	0.77	x	1.27	x	101.89	x	0.63	x	0.7	=	39.54	(78)
South	0.9x	0.77	x	0.96	x	82.59	x	0.63	x	0.7	=	24.23	(78)
South	0.9x	0.77	x	0.96	x	82.59	x	0.63	x	0.7	=	24.23	(78)
South	0.9x	0.77	x	1.27	x	82.59	x	0.63	x	0.7	=	32.05	(78)
South	0.9x	0.77	x	0.96	x	55.42	x	0.63	x	0.7	=	16.26	(78)
South	0.9x	0.77	x	0.96	x	55.42	x	0.63	x	0.7	=	16.26	(78)
South	0.9x	0.77	x	1.27	x	55.42	x	0.63	x	0.7	=	21.51	(78)
South	0.9x	0.77	x	0.96	x	40.4	x	0.63	x	0.7	=	11.85	(78)
South	0.9x	0.77	x	0.96	x	40.4	x	0.63	x	0.7	=	11.85	(78)
South	0.9x	0.77	x	1.27	x	40.4	x	0.63	x	0.7	=	15.68	(78)

Solar gains in watts, calculated for each month

(83)m = Sum(74)m ... (82)m

(83)m=	65.48	112.93	159.55	208.28	244.5	248.07	236.91	208.8	176.11	126.05	78.65	55.91	(83)
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Total gains – internal and solar (84)m = (73)m + (83)m , watts

(84)m=	461.7	506.98	540.89	569.32	585.08	568.98	545.11	522.85	500.68	471.12	447.16	441.85	(84)
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7. Mean internal temperature (heating season)

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

21

(85)

Utilisation factor for gains for living area, h1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(86)m=	1	1	0.99	0.98	0.95	0.86	0.72	0.76	0.92	0.98	0.99	1	(86)

Mean internal temperature in living area T1 (follow steps 3 to 7 in Table 9c)

(87)m=	19.37	19.51	19.76	20.12	20.49	20.79	20.93	20.91	20.69	20.23	19.74	19.35	(87)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Temperature during heating periods in rest of dwelling from Table 9, Th2 (°C)

(88)m=	19.69	19.69	19.7	19.71	19.72	19.73	19.73	19.73	19.72	19.72	19.71	19.7	(88)
--------	-------	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	------	------

Utilisation factor for gains for rest of dwelling, h2,m (see Table 9a)

(89)m=	1	0.99	0.99	0.97	0.92	0.77	0.56	0.61	0.86	0.97	0.99	1	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

(90)m=	17.55	17.76	18.13	18.66	19.18	19.57	19.7	19.69	19.45	18.82	18.11	17.53	(90)
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fLA = Living area ÷ (4) =

0.3

(91)

Mean internal temperature (for the whole dwelling) = fLA × T1 + (1 – fLA) × T2

(92)m=	18.09	18.28	18.62	19.1	19.57	19.94	20.07	20.06	19.82	19.24	18.6	18.08	(92)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------	-------	------

Apply adjustment to the mean internal temperature from Table 4e, where appropriate

(93)m=	18.09	18.28	18.62	19.1	19.57	19.94	20.07	20.06	19.82	19.24	18.6	18.08	(93)
--------	-------	-------	-------	------	-------	-------	-------	-------	-------	-------	------	-------	------

8. Space heating requirement

Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that Ti,m=(76)m and re-calculate the utilisation factor for gains using Table 9a

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, hm:

(94)m=	0.99	0.99	0.98	0.96	0.91	0.79	0.61	0.65	0.87	0.97	0.99	0.99	(94)
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Useful gains, hmGm , W = (94)m x (84)m

(95)m=	458.88	502.13	531.69	548.61	534.57	450.28	332.39	342.3	433.89	455.19	442.45	439.61	(95)
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Monthly average external temperature from Table 8

(96)m=	4.3	4.9	6.5	8.9	11.7	14.6	16.6	16.4	14.1	10.6	7.1	4.2	(96)
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TER WorkSheet: New dwelling design stage

Heat loss rate for mean internal temperature, L_m , $W = [(39)m \times ((93)m - (96)m)]$

(97)m=	1463.34	1415.14	1277.87	1060.59	815.92	546.7	355.33	373.64	588.83	896.19	1199.1	1454.98	(97)
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Space heating requirement for each month, kWh/month = $0.024 \times [(97)m - (95)m] \times (41)m$

(98)m=	747.32	613.54	555.17	368.62	209.32	0	0	0	0	328.11	544.79	755.44	
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Total per year (kWh/year) = $\text{Sum}(98)_{1..12} =$ 4122.31 (98)

Space heating requirement in kWh/m²/year

58.16 (99)

11 Energy components – Individual heating systems including micro-CHP

Space heating:

Fraction of space heat from secondary/supplementary system

0 (201)

Fraction of space heat from main system(s)

(202) = $1 - (201) =$

1 (202)

Fraction of total heating from main system 1

(204) = $(202) \times [1 - (203)] =$

1 (204)

Efficiency of main space heating system 1

93.5 (206)

Efficiency of secondary/supplementary heating system, %

0 (208)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	kWh/year
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	----------

Space heating requirement (calculated above)

747.32	613.54	555.17	368.62	209.32	0	0	0	0	328.11	544.79	755.44
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

(211)m = $\{[(98)m \times (204)]\} \times 100 \div (206)$ (211)

799.27	656.19	593.76	394.25	223.87	0	0	0	0	350.92	582.67	807.96
--------	--------	--------	--------	--------	---	---	---	---	--------	--------	--------

Total (kWh/year) = $\text{Sum}(211)_{1..12} =$ 4408.89 (211)

Space heating fuel (secondary), kWh/month

= $\{[(98)m \times (201)]\} \times 100 \div (208)$

(215)m=	0	0	0	0	0	0	0	0	0	0	0	
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Total (kWh/year) = $\text{Sum}(215)_{1..12} =$ 0 (215)

Water heating

Output from water heater (calculated above)

192.87	170.1	178.87	160.67	157.68	141.23	135.95	148.74	148.34	166.59	175.75	188.34
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Efficiency of water heater

79.8 (216)

(217)m=	88.08	87.94	87.64	86.96	85.57	79.8	79.8	79.8	79.8	86.59	87.63	88.14	(217)
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Fuel for water heating, kWh/month

(219)m = $(64)m \times 100 \div (217)m$

(219)m=	218.98	193.42	204.11	184.76	184.27	176.98	170.37	186.4	185.9	192.39	200.54	213.68
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Total = $\text{Sum}(219a)_{1..12} =$ 2311.79 (219)

Annual totals

Space heating fuel used, main system 1

kWh/year

4408.89

Water heating fuel used

2311.79

Electricity for pumps, fans and electric keep-hot

central heating pump:

30 (230c)

boiler with a fan-assisted flue

45 (230e)

Total electricity for the above, kWh/year

sum of (230a)...(230g) =

75 (231)

Electricity for lighting

348.41 (232)

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

TER WorkSheet: New dwelling design stage

	Energy kWh/year	Emission factor kg CO2/kWh		Emissions kg CO2/year	
Space heating (main system 1)	{211} x	0.216	=	952.32	{261}
Space heating (secondary)	{215} x	0.519	=	0	{263}
Water heating	{219} x	0.216	=	499.35	{264}
Space and water heating	{261} + {262} + {263} + {264} =			1451.67	{265}
Electricity for pumps, fans and electric keep-hot	{231} x	0.519	=	38.93	{267}
Electricity for lighting	{232} x	0.519	=	180.83	{268}
Total CO2, kg/year		sum of {265}...{271} =		1671.42	{272}

TER = 23.58 {273}

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