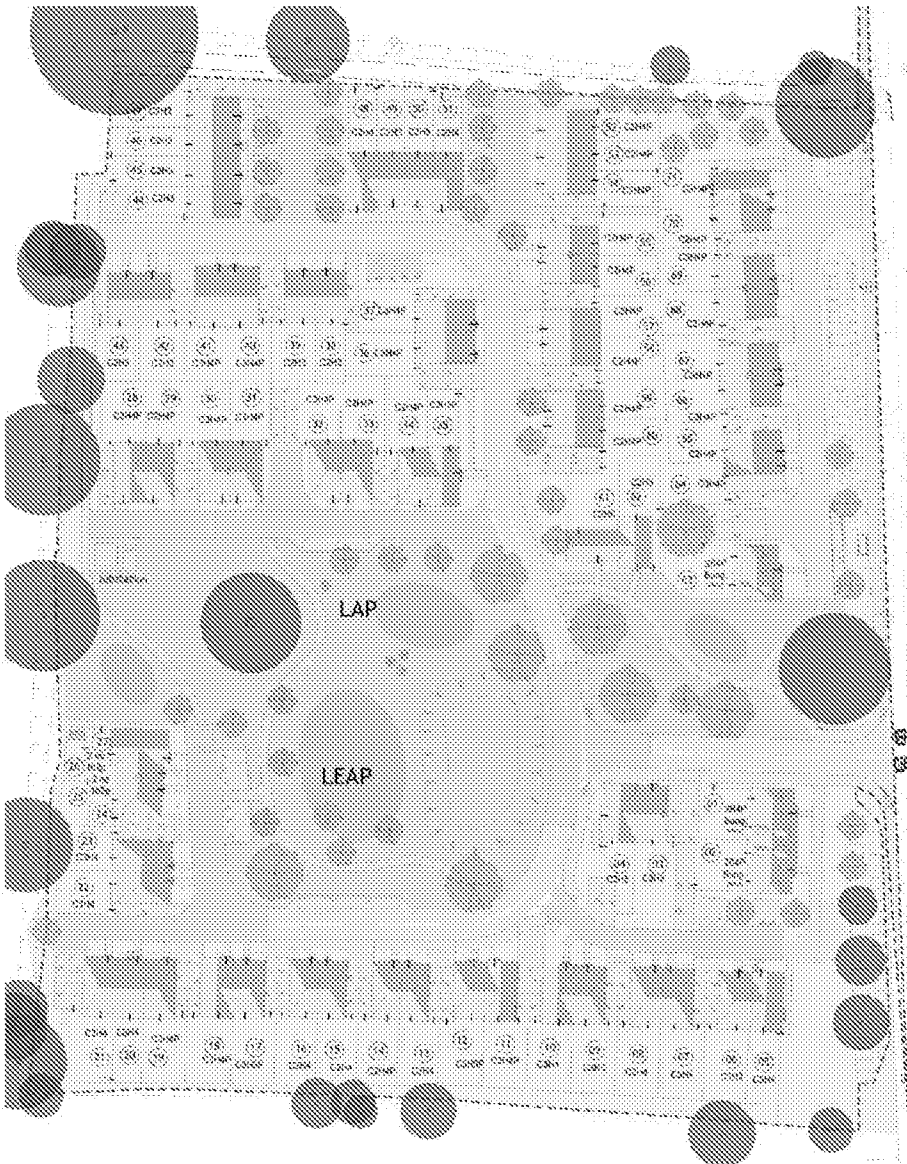




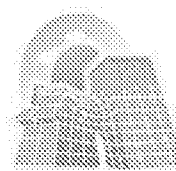
THAKEHAM

LIDSEY ROAD – WOODGATE, WEST SUSSEX



ENERGY STATEMENT

25th January 2021



Southern Energy
Consultants
Energy & Sustainability Solutions

About Southern Energy Consultants Ltd

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

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

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

Report prepared by:
QA:

David Cook
Steve Smith

25th January 2021

Report type:

Planning Application - Supporting Document

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1.0 Introduction and Planning Policy Requirements

Introduction

- 1.1 This Sustainability Statement has been prepared by Southern Energy Consultants and commissioned by Thakeham Client Limited on behalf of Southern Housing Group Limited.
- 1.2 The Statement reviews and reports on the energy efficiency and renewable energy measures proposed for the Applicant's development at Lidsey Road, Woodgate. The proposals include the construction of 71 dwellings of mixed type and tenure, with associated access, car parking, soft landscaping and infrastructure works.

Planning policy requirements

- 1.3 In preparing this Statement in support of the planning application, the applicable policies set out in the National Planning Policy Framework (2019 version) and Arun District Council's Local Plan (2018) are briefly outlined in the following paragraphs.
- 1.4 The **National Planning Policy Framework (2019 version)** includes a 'presumption in favour of sustainable development' and sets out three core objectives that all new developments must meet in order to be considered sustainable. These objectives are interdependent and need to be pursued in mutually supporting ways. They are as follows:
- **Economic** – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity.
 - **Social** – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering a well-designed and safe built environment, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being.
 - **Environmental** – to contribute to protecting and enhancing our natural, built and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

- 1.5 More locally, Policy ECC SP2 (Energy and Climate Change Mitigation) of Arun District Council's Local Plan (2014) requires all major developments of 10 or more dwellings to incorporate decentralised, renewable and low carbon energy supply systems, which must be responsible for producing at least 10% of the total predicted energy requirements from renewable or low carbon energy generation on site.
- 1.6 This Statement will provide the Applicant's response to Policy ECC SP2, paying specific attention to the energy proposals for the site, which will utilise best practice energy efficiency techniques and renewable energy or low carbon technologies to reduce carbon dioxide emissions across the new development by at least 10% per annum.

Structure

- 1.7 Section 2 of this Statement calculates the baseline emissions for the development. These are the carbon dioxide emissions equivalent to the regulatory standard set by Part L1a of 2013 Building Regulations, encompassing the sources of space heating, hot water and fixed electrical items. Section 2 outlines the Applicant's best practice energy efficiency measures that will meet, and for most dwellings, exceed the emissions standard set by Part L1a. A feasibility study is then conducted to determine the most suitable renewable energy or low carbon technologies to deliver the sought-after 10% reduction in site-wide carbon dioxide emissions. In Section 3, a conclusion is provided, summarising projected emissions performance against the policy requirement for a 10% reduction in emissions to be delivered.

2.0 Building Design and Carbon Dioxide Emissions

Objectives of the energy strategy

- 2.1 All dwellings will be designed and built to meet or better the current emissions standard set by Part L1a of Building Regulations (2013) respectively. In order to meet this standard, all dwellings will incorporate enhanced energy efficiency measures. Standard Assessment Procedure (SAP) calculations, as required by Building Regulations, have been carried out by Southern Energy Consultants on all proposed dwelling types. This was carried out with the following aims in mind:

- (a) To first establish a regulatory baseline standard for carbon dioxide emissions in relation to the 71 proposed dwellings;
- (b) To appraise carbon dioxide emissions performance after energy efficiency measures in order to demonstrate the reduction in emissions delivered in comparison to the regulatory baseline standard;
- (c) To assess the residual emissions that must be offset through renewable or low carbon technologies to deliver a site-wide reduction of at least 10% compared to (a).

Carbon dioxide emissions baseline

- 2.2 A summary of the regulatory baseline calculation for the Lidsey Road development is provided in Table 1:

Table 1: Baseline carbon dioxide emissions calculation for Lidsey Road

Dwelling Type	Baseline Carbon Dioxide Emissions (KgCO ₂ /yr)	Number of Dwellings	Total Carbon Dioxide Emissions (KgCO ₂ /yr)
C2H3	1,411	11	15,521
C2H4 / C2H4P	1,422	19	27,018
C2H6	1,418	1	1,418
C3H3 / C3H3P	1,645	5	8,225
C3H4/ C3H4P	1,676	26	43,576
C3H5 / C3H5P	1,643	2	3,286
Chalet	1,699	3	5,097
S1F2.1 / S1F2.2	1,145	2	2,290
S1F5.1 / S1F5.2	1,198	2	2,396
TOTAL		71	108,827
Average per dwelling			1,533

Policy target

- 2.3 Based on the calculation in Table 1, site-wide carbon dioxide emissions are projected to be **108,827 kgCO₂/year**. Thus, in order to comply with the policy requirement to reduce site-wide emissions by at least 10%, this figure must be lowered by at least **10,828 kgCO₂/year**.

Best practice energy efficiency measures

- 2.4 Even at this early stage, it is possible to set out the majority of the Applicant's commitments to ensure the fabric and energy efficiency of the new timber-framed dwellings at their Lidsey Road development. A variety of robust energy efficiency measures will be implemented by the Applicant to deliver the performance shown in the third column of Table 2 below. The build specification will incorporate enhanced insulation standards throughout the building envelope (walls, roofs, floors and glazing), for example, by incorporating 100mm of Xtratherm or equivalent insulation under screed in the ground floor, specifying 400mm mineral wool insulation at roof joist level, and using enhanced double glazing to achieve average U-values considerably better than those required by Part L1A of 2013 Building Regulations.

Table 2: Insulation Enhancement Proposals at Lidsey Road

Thermal Element	Maximum Area-Weighted U-value (W/m ² K) Allowable Under 2013 Building Regulations	Applicant's Proposed U-value (W/m ² K) required to Meet 2013 Building Regulations Baseline	% Improvement on 2013 Allowable U-Value Standard
Main external walls	0.30	0.24	20.00
Dormer walls	0.30	0.20	33.33
Roof (joists)	0.20	0.11	45.00
Roof (sloping)	0.20	0.20	0.00
Ground floor	0.25	0.14-0.17	32.00-44.00
Windows	2.00	1.40	30.00

- 2.5 The space heating demand of the development will be reduced by the fabric measures detailed above and the considerable passive gains associated with the appropriate sizing of window openings in cases where an optimal southerly orientation applies for main living areas. All dwellings will also benefit from efficient heating controls, to include programmers, room thermostats, and thermostatic radiator valves. A-rated gas combi boilers will be specified with SEDBUK (2009) efficiency of greater than 89%. The installed boilers will also meet Class 5 for Nitrous Oxide emissions, ensuring they have the lowest possible impact on local air pollution levels.

- 2.6 Air tightness standards will be improved by the Applicant adopting a combination of Pinewood (Quantum) and Accredited Construction Details psi values for non-repeating thermal bridges, all of which demonstrate heat transmission considerably lower than SAP default values. The specified details will incorporate an improvement over Building Regulations (2013) requirements by reducing air leakage loss and convective bypass of insulation. The Applicant will reduce the design air permeability for all dwellings from 10 m³/hm² to not more than 5 m³/hm² to further reduce space heating requirements.
- 2.7 All of the internal lighting throughout the development will be of the dedicated low energy type. Although not assessed within the Building Regulations calculation, external lighting will also be low energy and some will be controlled through PIR sensors or daylight cut-off devices to minimise use and promote the security of the development.
- 2.8 It is not proposed to provide any mechanical cooling to the proposed dwellings in the form of air conditioning. Instead it is the intention of the Applicant to reduce the need for active cooling as far as possible. This will be achieved through the specification of mainly non-mechanical measures such as good thermal insulation and an air tight build. In addition, and although these issues are not calculated within a Building Regulations Assessment, the development proposals incorporate extensive areas of landscaped space. These measures facilitate localised cooling through evapotranspiration – energy which would otherwise heat the local Woodgate atmosphere is instead used evaporating water, thus helping to reduce the urban heat island effect. Deciduous trees provide shading in the summer and facilitate solar gains in the winter. Openable windows will be installed as necessary to facilitate natural ventilation. These will help facilitate cross-ventilation, convective-ventilation and night purging. Mechanical ventilation will be provided via either decentralised Vent Axia dMEV Response or centralised Vent Axia MVDC MS fans.
- 2.9 All insulating materials specified at the Lidsey Road development will have an Ozone Depleting Potential of Zero and a Global Warming Potential of less than 5. It is intended that the development will utilise low Volatile Organic Compounds. These are usually solvents that have the capacity to rapidly evaporate. Once airborne they cause chemical or photochemical reactions in the atmosphere leading to the formation of smog containing, amongst other things, ground level ozone and can produce a number of physical problems such as eye and skin irritation, lung and breathing

problems, headaches, nausea and muscle weakness. Preference will also be given to the specification of inert materials as they are non-toxic and easily re-used or recycled.

Outcome after best practice energy efficiency measures

- 2.10 Following the adoption of the measures above, site-wide emissions will be reduced from the baseline case of **108,827 kgCO₂/year** to **101,753 kgCO₂/year**, as set out in Table 2 below.

Table 1: Carbon dioxide emissions calculation for Lidsey Road – after energy efficiency measures

Dwelling Type	Baseline Carbon Dioxide Emissions (KgCO ₂ /yr)	Number of Dwellings	Total Carbon Dioxide Emissions (KgCO ₂ /yr)
C2H3	1,319	11	14,512
C2H4 / C2H4P	1,330	19	25,262
C2H6	1,326	1	1,326
C3H3 / C3H3P	1,538	5	7,690
C3H4/ C3H4P	1,567	26	40,744
C3H5 / C3H5P	1,536	2	3,072
Chalet	1,589	3	4,766
S1F2.1 / S1F2.2	1,071	2	2,141
S1F5.1 / S1F5.2	1,120	2	2,240
TOTAL		71	101,753
Average per dwelling			1,433

- 2.11 The reduction against the baseline is **7,074 kgCO₂/year**, or **6.50%** in percentage terms. In order to deliver a reduction in site-wide emissions of at least **10,828 kgCO₂/year**, a further reduction of at least **3,754 kgCO₂/year** must now be delivered through either renewable energy or low carbon technologies.

Feasibility of renewable energy or low carbon technologies

2.12 The technologies to be evaluated in this Statement are as follows:

- District Heating / CHP
- Biomass
- Heat pumps (ground source and air source)
- Hydroelectric power
- Wind energy
- Solar thermal panels
- Solar photovoltaic panels

2.13 The Applicant has conducted a detailed review of the feasibility of installing Combined Heat and Power infrastructure (CHP) to serve the Lidsey Road development. CHP is a form of district heating that generally uses gas to generate electricity for local consumption, reducing the need for grid electricity and its associated high carbon dioxide emissions. As the CHP system is close to the point of energy demand, it is possible to use the heat that is generated during the electricity generation process. While CHP would enable reductions in carbon dioxide emissions beyond the baseline case, the following reasons make it unsuited to this development:

- **Diversity and extent of heat demand** – CHP is best suited to developments where there is a diversity of energy demand. A mixed-use scheme built out in a single phase, or a very large residential scheme (>1,000 homes) will have extended periods of the day in which there is a continuous demand for heat. In these circumstances, the district heating network and CHP engine can operate consistently to generate electricity, with heat as a by-product. On a relatively small-sized residential scheme such as this, heat demand would be low and not continuous, especially during the working day, leading to an over-generation and subsequent dumping of heat.
- **Distributional heat losses** – thermal stores are a source of standing heat losses, as are even the best insulated distribution networks. When communal systems satisfy only a small and intermittent demand, these standing losses will represent a large part (>30%) of total demand. Carbon dioxide emissions savings gained within the dwellings through association with CHP may be considerably reduced by the additional heat losses associated with the network.

- **Plant room size and location** – to incorporate a central plant room would require a considerable amount of space. The most suitable location in terms of space would be one of the proposed areas of public open space, but the installation of such infrastructure would be in conflict with the Applicant's objective to deliver a vibrant and ecologically prosperous development with land uses suitable for children and young families. The noise emissions generated from plant infrastructure would also be high.
- **Minimised heat demands** – the Applicant's proposed energy strategy is based on the adoption of best practice standards for energy efficiency, an approach resulting in reduced space heating demands, which reduces the suitability of any district heating scheme.
- **Installed costs** – the installed cost of any CHP / district heating network benefit from economies of scale. However, pipe run costs remain approximately £1,000 per metre, and total costs for CHP infrastructure across the site – predominantly from the plant room, CHP engine and pipe runs – would likely extend beyond £2 million for a scheme of this scale.
- **Running costs** – the fixed costs associated with the management and operation of a communal plant room would need to be shared by future occupants as part of an energy standing charge. The smaller the scheme, the greater the cost for the individual occupant, a particularly unfair situation in the light of the Applicant's commitment to provide very high levels of affordable housing. In addition, CHP engines impose additional running costs as contracts for maintenance and replacement costs are typically handled by specialist companies.
- **Absence of other local infrastructure** – there are no other CHP / district heating networks in the vicinity of the development with which to forge a connection to serve the development.

2.14 Biomass community heating is an alternative to conventional fossil fuel heating but, as per the reasons used against the installation of gas-fuelled CHP or district heating, should be discounted as an option at Lidsey Road for the proposed dwellings. Biomass boilers within individual dwellings are usually installed with a standard gas boiler as back-up in case the occupier runs out of fuel. Although they are reducing in size, they are still large enough to require a dedicated room with additional space for the fuel – there is insufficient space available for such infrastructure in the majority of proposed dwelling types, especially the apartments and two bedroom houses. The management of fuel deliveries and ash dispersal is also complex, necessitating a dedicated operative as opposed to residents of the future dwellings at Lidsey Road. Furthermore, the emissions of Nitrous Oxide and

particulate matter that are associated with biomass installations would have the capacity to worsen local air pollution.

Ground and Air Source Heat Pumps (GSHPs and ASHPs)

- 2.15 ASHPs are a potential technology that could be deployed but have not been considered by the Applicant for implementation across the site due to the potential for both noise and visually related impacts on the residents and surroundings. There is insufficient land available for sufficient boreholes to be drilled for GSHPs to represent a viable heating option for the apartments.

Hydroelectric power

- 2.16 Hydroelectric power plants generate electricity using the gravitational force of flowing or falling water. However, there are no rivers of sufficient scale in the vicinity of the Lidsey Road development to facilitate a hydroelectric power installation.

Wind Turbines

- 2.17 Wind turbines are a modern, high-technology descendant of the windmills that have been around for centuries. In modern windmills the kinetic energy of the wind is used to turn a turbine to generate electricity as opposed to moving water or turning a grist mill wheel. A site with an average wind speed of 5m/s or more is generally considered to be suitable for installing a wind turbine. The average wind speed at the Lidsey Road development is 4.6m/s at 10m AOD and is below the level required to generate significant carbon dioxide reductions or commercial take-up. The installation of a single, large wind turbine to serve the development would also be controversial due to the nature of the locality. Even if space could be found within the development to accommodate a very high (15-20m) turbine, their installation would then present a significant visual blight to neighbours and the rural surrounds. Furthermore, this technology could only generate significant reductions in carbon dioxide emissions for a small proportion of the 71 dwellings associated with the development.

Solar thermal and photovoltaic panels

- 2.18 Solar thermal heating panels contribute to the hot water demand of a dwelling. Water or glycol (heat transfer liquid) is circulated to roof level where it is heated using solar energy before being returned to a thermal store where heat is exchanged with water from the conventional system. The

proposed dwellings generally contain suitable attributes (orientation, available roof-space and limited shadowing) for solar photovoltaic installations to be designed-in, although solar thermal installations are unsuitable in some cases. This is because the smaller dwelling types, such as the various apartment types or two bedroom houses, have very little space to accommodate a large hot water cylinder incorporating dedicated solar storage. In contrast, there are few constraints on the capacity for solar photovoltaic panels to deliver reductions in carbon dioxide emissions. For nearly all of the dwellings on the site, roof-space is available at no worse than a west-east orientation and there is sufficient roof-space available to accommodate up to 4-6 panels.

Impacts of strategy

- 2.19 Further SAP calculations have been undertaken which have verified that a total of 8.50 kWp of solar photovoltaic output is necessary for the Lidsey Road development to deliver site-wide reductions in carbon dioxide emissions of at least 10%. This is equivalent to approximately 34 panels across the site. At this stage, the Applicant has not determined the location of panels, however, when consulting with their solar engineer, preference will be given to maximising installations on roof-space of optimal, southerly orientation. Examples of the impact of providing installations of 0.50 kWp (2 panels) to plots 6 (Type C3H3) and 33 (Type C2H4) are provided in the Appendix to this Statement. Across the site, 8.50 kWp of solar photovoltaic output will reduce site-wide emissions by a further **3,825 kgCO₂/year**. As Table 4 depicts, in combination with the reductions in emissions of **7,074 kgCO₂/year** secured via best practice energy efficiency measures, the Applicant's proposed strategy is projected to deliver overall reductions of **10,899 kgCO₂/year**, which are equal to a **10.01%** decline compared to baseline emissions of **108,827 kgCO₂/year**.

Table 4: Emissions Reduction from Energy Efficiency Measures and Solar PV Installations – Lidsey Road

	Emissions (kgCO ₂ /year)
Baseline	108,827
Reduction from energy efficiency measures	(7,704)
Reduction from 8.50 kWp solar PV output	(3,825)
Total reduction	(10,899)
Emissions after reductions	97,928
Overall percentage reduction from baseline	10.01

3. Conclusion

- 3.1 This Statement has set out the Applicant's energy strategy which has been developed to comply with the requirements of Policy ECC SP2 (Energy and Climate Change Mitigation) of Arun District Council's Local Plan (2014). These required the Applicant to deliver a 10% reduction in carbon dioxide emissions compared to the current standard set by Part L1a of Building Regulations.
- 3.2 The Applicant's priority was to minimise energy consumption at the point of demand through best practice fabric and energy efficiency measures, thus ensuring that reductions in emissions will persist over the lifetime of the development rather than lapse after a period of around 25-30 years when rooftop renewable technologies reach the end of their useful life. The Applicant's strategy will be delivered through the installation of highly efficient fabric, ventilation and heating systems, together with the benefits of passive solar gains and an air-tight build, all features which will help to lower the fuel bills of future occupants. In addition, 8.50 kWp of solar photovoltaic output will be installed to dwellings with optimal, south-facing roof-space. Overall, the Applicant's strategy of best practice energy efficiency measures and strategically located renewable energy installations will reduce carbon dioxide emissions by **10.01%** across the Lidsey Road development.

Appendix

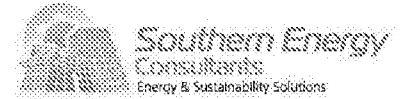
SAP example calculations:

Type C3H3 (Plot 6) with energy efficiency measures and 0.50 kWp of solar PV

Type C2H4 (Plot 13) with energy efficiency measures and 0.50 kWp of solar PV

FULL SAP CALCULATION PRINTOUT

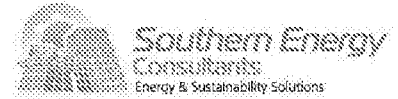
Calculation Type: New Build (As Designed)



Property Reference	SECLID006				Issued on Date	23/01/2021
Assessment Reference	With solar PV	Prop Type Ref	Type C3H3			
Property	Plot 33, Lidsey Road, Woodgate, West Sussex, PO20					
SAP Rating	87 B	DER	13.79	TER	17.46	
Environmental	89 B	% DER<TER	21.00			
CO ₂ Emissions (t/year)	0.99	DFEE	44.97	TREE	51.60	
General Requirements Compliance	Pass	% DFEE<TFEE	12.85			
Assessor Details	Mr. Stephen Smith, Southern Energy Consultants Limited, Tel: 01635261582, info@southernenergyconsultants.co.uk				Assessor ID	d168-0001
Client	Thakeham Homes, THA001					

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

DWELLING AS DESIGNED

End-Terrace House, total floor area 95 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.46 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.79 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)51.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.0 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.38 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

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

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoTEC exclusive 835 VUW 356/5-7 (H-GB)
Combi boiler
Efficiency: 89.7% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system:

None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls:

No cylinder

Boiler interlock

Yes

OK

7 Low energy lights

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

8 Mechanical ventilation

Continuous extract system
Specific fan power: 0.17
Maximum 0.7 OK

9 Summertime temperature

Overheating risk (South East England): Not significant OK

Based on:

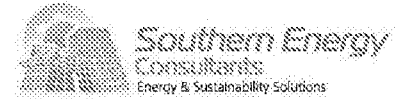
Overshading: Average
Windows facing North: 11.85 m², No overhang
Windows facing South: 6.42 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Photovoltaic array 0.50 kW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.5000 (1b)	x 2.3500 (2b)	= 111.6250 (1b) - (3b)
First floor	47.5000 (1c)	x 2.6500 (2c)	= 125.8750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 237.5000 (5)

2. Ventilation rate

					main heating	secondary heating	other		total	m3 per hour			
Number of chimneys					0	+	0	+	0	=	0 * 40 =	0.0000 (6a)	
Number of open flues					0	+	0	+	0	=	0 * 20 =	0.0000 (6b)	
Number of intermittent fans											0 * 10 =	0.0000 (7a)	
Number of passive vents											0 * 10 =	0.0000 (7b)	
Number of flueless gas fires											0 * 40 =	0.0000 (7c)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =											Air changes per hour		
Pressure test											0.0000 / (5) =		0.0000 (8)
Measured/design AP50											Yes		
Infiltration rate											5.0000		
Number of sides sheltered											0.2500 (18)		
											2 (19)		
Shelter factor											(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =		0.2125 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)	
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)	
	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497 (22b)	
Mechanical extract ventilation - centralised													
If mechanical ventilation:													0.5000 (23a)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)	

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			1.9500	1.2000	2.3400		(26)
Opening Type 2 (Uw = 1.40)			18.2700	1.3258	24.2216		(27)
Heat Loss Floor 1			47.5000	0.1500	7.1250		(28a)
External Wall 1	98.5000	20.2200	78.2800	0.2400	18.7872		(29a)
External Roof 1	47.5000		47.5000	0.1100	5.2250		(30)
Total net area of external elements Aum(A, m ²)			193.5000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	57.6988			(33)
Party Wall 1			42.0000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.7797 (36)
Total fabric heat loss						(33) + (36) =	67.4785 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

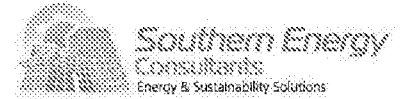
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	40.8285	40.4121	39.9957	39.1875	39.1875	39.1875	39.1875	39.1875	39.1875	39.1875	39.1875	39.1875 (38)
Heat transfer coeff	108.3070	107.8906	107.4743	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660 (39)
Average = Sum(39)m / 12 =												106.9722 (39)
HLP	Jan 1.1401	Feb 1.1357	Mar 1.1313	Apr 1.1228	May 1.1228	Jun 1.1228	Jul 1.1228	Aug 1.1228	Sep 1.1228	Oct 1.1228	Nov 1.1228	Dec 1.1228 (40)
HLP (average)												1.1260 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6882 (42)
Average daily hot water use (litres/day)												98.0440 (43)
Daily hot water use	Jan 107.8484	Feb 103.9267	Mar 100.0049	Apr 96.0831	May 92.1614	Jun 88.2396	Jul 88.2396	Aug 92.1614	Sep 96.0831	Oct 100.0049	Nov 103.9267	Dec 107.8484 (44)
Energy conte	159.9361	139.8811	144.3448	125.8433	120.7496	104.1977	96.5545	110.7977	112.1210	130.6662	142.6324	154.8896 (45)
Energy content (annual)										Total = Sum(45)m =		1542.6141 (45)
Distribution loss (46)m = 0.15 x (45)m	23.9904	20.9822	21.6517	18.8765	18.1124	15.6297	14.4832	16.6197	16.8182	19.5999	21.3949	23.2334 (46)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	4.2507	3.8394	4.2507	4.1136	4.2507	4.1136	4.2507	4.2507	4.1136	4.2507	4.1136	4.2507	(61)
Total heat required for water heating calculated for each month	164.1868	143.7205	148.5955	129.9569	125.0003	108.3113	100.8053	115.0485	116.2346	134.9170	146.7460	159.1403	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Output from w/h	164.1868	143.7205	148.5955	129.9569	125.0003	108.3113	100.8053	115.0485	116.2346	134.9170	146.7460	159.1403	(64)
Heat gains from water heating, kWh/month	54.2414	47.4703	49.0573	42.8713	41.2119	35.6742	33.1671	37.9029	38.3086	44.5092	48.4537	52.5635	(65)
Total per year (kWh/year) = Sum(63)m =													

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

Metabolic gains (Table 5), Watts													
(66)m	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.3652	19.8645	16.1549	12.2303	9.1423	7.7183	8.3399	10.8405	14.5502	18.4748	21.5628	22.9868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	247.9820	250.5553	244.0707	230.2658	212.8396	196.4615	185.5198	182.9466	189.4311	203.2360	220.6622	237.0404	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	(71)
Water heating gains (Table 5)	72.9051	70.6403	65.9373	59.5435	55.3924	49.5474	44.5794	50.9448	53.2064	59.8242	67.2968	70.6498	(72)
Total internal gains	409.5749	407.3827	392.4855	368.3622	343.6969	320.0498	304.7617	311.0544	323.5103	347.8575	375.8443	396.9995	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					11.8500	10.6334	0.7200	0.7000	0.7700		44.0103 (74)	
South					6.4200	46.7521	0.7200	0.7000	0.7700		104.8334 (78)	
Solar gains	148.8436	255.7959	361.6191	476.7419	566.8173	578.9336	551.2749	480.4209	400.2926	285.3009	178.5556	127.2748 (83)
Total gains	558.4185	663.1787	754.1046	845.1041	910.5142	898.9834	856.0365	791.4753	723.8029	633.1584	554.4000	524.2743 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	24.3649	24.4589	24.5537	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	
alpha	2.6243	2.6306	2.6369	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	
util living area	0.9679	0.9494	0.9180	0.8571	0.7563	0.6203	0.4915	0.5395	0.7320	0.8884	0.9525	0.9724 (86)	
MIT	18.6067	18.9070	19.3606	19.9248	20.4241	20.7627	20.9078	20.8791	20.6086	19.9619	19.1877	18.5658 (87)	
Th 2	19.9682	19.9718	19.9753	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823 (88)	
util rest of house	0.9630	0.9418	0.9054	0.8341	0.7149	0.5513	0.3956	0.4438	0.6723	0.8655	0.9441	0.9682 (89)	
MIT 2	17.7807	18.0790	18.5264	19.0762	19.5409	19.8332	19.9403	19.9236	19.7149	19.1226	18.3672	17.7500 (90)	
Living area fraction													
MIT	17.9798	18.2785	18.7275	19.2808	19.7538	20.0572	20.1735	20.1540	19.9304	19.3249	18.5650	17.9466 (92)	
Temperature adjustment													
adjusted MIT	17.8298	18.1285	18.5775	19.1308	19.6038	19.9072	20.0235	20.0040	19.7804	19.1749	18.4150	17.7966 (93)	

8. Space heating requirement

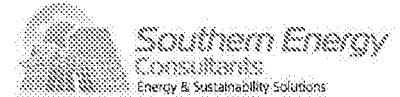
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9493	0.9240	0.8838	0.8111	0.6975	0.5457	0.3998	0.4460	0.6588	0.8428	0.9269	0.9558 (94)
Useful gains	530.0788	612.7862	666.4779	685.4523	635.0700	490.5749	342.2348	352.9853	476.8141	533.6155	513.8657	501.1153 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1465.3761	1427.2363	1298.0222	1091.2777	843.0647	566.1026	365.1739	384.4211	605.9009	914.6549	1206.9260	1450.3001 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	695.8612	547.3105	469.8689	292.1942	154.7481	0.0000	0.0000	0.0000	0.0000	283.4933	499.0034	706.1935 (98)
Space heating												3648.6732 (98)
Space heating per m2										(98) / (4) =		38.4071 (99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.6000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4027.2331 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	695.8612	547.3105	469.8689	292.1942	154.7481	0.0000	0.0000	0.0000	0.0000	283.4933	499.0034	706.1935	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	768.0588	604.0954	518.6191	322.5102	170.8036	0.0000	0.0000	0.0000	0.0000	312.9065	550.7764	779.4630	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	164.1868	143.7205	148.5955	129.9569	125.0003	108.3113	100.8053	115.0485	116.2346	134.9170	146.7460	159.1403	(64)
Efficiency of water heater (217)m	89.9103	89.8491	89.7336	89.4929	89.0019	87.1000	87.1000	87.1000	87.1000	89.4411	89.7802	87.1000	(216)
Fuel for water heating, kWh/month	182.6118	159.9576	165.5962	145.2147	140.4468	124.3529	115.7351	132.0878	133.4496	150.8445	163.4504	176.9496	(219)
Water heating fuel used												1790.6969	(219)
Annual totals kWh/year													
Space heating fuel - main system												4027.2331	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEV)Centralised, Database: in-use factor = 1.3000, SFP = 0.2210)													
mechanical ventilation fans (SFP = 0.2210)													64.0348 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													139.0348 (231)
Electricity for lighting (calculated in Appendix L)													394.9758 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.50 * 1080 * 1.00) =													-431.8098 (233)
Total delivered energy for all uses													5920.1307 (238)

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

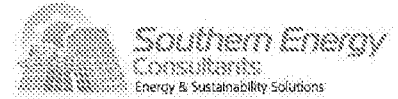
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4027.2331	0.2160	869.8823 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1790.6969	0.2160	386.7905 (264)
Space and water heating			1256.6729 (265)
Pumps and fans	139.0348	0.5190	72.1590 (267)
Energy for lighting	394.9758	0.5190	204.9924 (268)
Energy saving/generation technologies			
PV Unit	-431.8098	0.5190	-224.1093 (269)
Total CO2, kg/year			1309.7151 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.7900 (273)

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

DER			13.7900 ZC1
Total Floor Area		TFA	95.0000
Assumed number of occupants		N	2.6882
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			15.4683 ZC2
CO2 emissions from cooking, equation (L16)			1.9317 ZC3
Total CO2 emissions			31.1901 ZC4
Residual CO2 emissions offset from biofuel CHP			0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year			0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000 ZC7
Net CO2 emissions			31.1901 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.5000 (1b)	x 2.3500 (2b)	= 111.6250 (1b) - (3b)
First floor	47.5000 (1c)	x 2.6500 (2c)	= 125.8750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 237.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1263 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3763 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3199 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4078	0.3998	0.3918	0.3519	0.3439	0.3039	0.3039	0.2959	0.3199	0.3439	0.3599	0.3758 (22b)
Effective ac	0.5832	0.5799	0.5768	0.5619	0.5591	0.5462	0.5462	0.5438	0.5512	0.5591	0.5647	0.5706 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			1.9500	1.0000	1.9500		(26)					
TER Opening Type (Uw = 1.40)			18.2700	1.3258	24.2216		(27)					
Heat Loss Floor 1			47.5000	0.1300	6.1750		(28a)					
External Wall 1	98.5000	20.2200	78.2800	0.1800	14.0904		(29a)					
External Roof 1	47.5000		47.5000	0.1300	6.1750		(30)					
Total net area of external elements Aum(A, m2)			193.5000				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)... (30) + (32) =		52.6120		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.9719 (36)					
Total fabric heat loss						(33) + (36) =	62.5839 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	45.7054	45.4523	45.2043	44.0390	43.8210	42.8061	42.8061	42.6181	43.1970	43.8210	44.2620	44.7231 (38)
Heat transfer coeff	106.2893	106.0362	107.7881	106.6229	106.4049	105.3900	105.3900	105.2020	105.7809	106.4049	106.8459	107.3070 (39)
Average = Sum(39)m / 12 =												106.6218 (39)
HLP	Jan 1.1399	Feb 1.1372	Mar 1.1346	Apr 1.1223	May 1.1201	Jun 1.1094	Jul 1.1094	Aug 1.1074	Sep 1.1135	Oct 1.1201	Nov 1.1247	Dec 1.1295 (40)
HLP (average)												1.1223 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6882 (42)
Average daily hot water use (litres/day)												98.0440 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.8484	103.9267	100.0049	96.0831	92.1614	88.2396	88.2396	92.1614	96.0831	100.0049	103.9267	107.8484 (44)
Energy conte	159.9361	139.8811	144.3448	125.8433	120.7496	104.1977	96.5545	110.7977	112.1210	130.6662	142.6324	154.8896 (45)
Energy content (annual)											Total = Sum(45)m =	1542.6141 (45)
Distribution loss	(46)m = 0.15 x (45)m											
	23.9904	20.9822	21.6517	18.8765	18.1124	15.6297	14.4832	16.6197	16.8182	19.5999	21.3949	23.2334 (46)
Water storage loss:												
Total storage loss												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

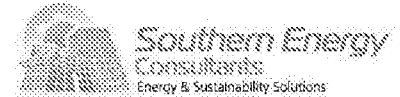
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Energy & Sustainability Solutions

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	50.9589	46.0274	50.9589	47.3835	46.9644	43.5154	44.9659	46.9644	47.3835	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	210.8950	185.9085	195.3037	173.2267	167.7141	147.7132	141.5205	157.7622	159.5045	181.6251	191.9475	205.8485 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
								Solar input (sum of months) = Sum(63)m =				0.0000 (63)
Output from w/h												
	210.8950	185.9085	195.3037	173.2267	167.7141	147.7132	141.5205	157.7622	159.5045	181.6251	191.9475	205.8485 (64)
								Total per year (kWh/year) = Sum(64)m =				2118.9694 (64)
Heat gains from water heating, kWh/month												
	65.9185	58.0173	60.7344	53.6888	51.8904	45.5246	43.3459	48.5814	49.1261	56.1862	59.7540	64.2405 (65)

elmhurst
energy

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

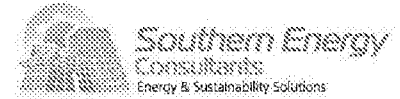
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4053.3368 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	745.0902	583.0769	489.9390	279.3001	116.6969	0.0000	0.0000	0.0000	0.0000	278.3417	530.4341	762.9376	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	797.7411	624.2793	524.5600	299.0366	124.9432	0.0000	0.0000	0.0000	0.0000	298.0104	567.9165	816.8497	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	210.8950	185.9085	195.3037	173.2267	167.7141	147.7132	141.5205	157.7622	159.5045	181.6251	191.9475	205.8485	(64)
Efficiency of water heater	87.9594	87.7322	87.2714	86.2474	84.1580	80.3000	80.3000	80.3000	80.3000	86.1227	87.4764	88.0469	(217)
Fuel for water heating, kWh/month	239.7641	211.9044	223.7888	200.8487	199.2848	183.9516	176.2397	196.4660	198.6357	210.8912	219.4276	233.7941	(219)
Water heating fuel used												2494.9967	(219)
Annual totals kWh/year													
Space heating fuel - main system												4053.3368	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												394.9758	(232)
Total delivered energy for all uses												7018.3094	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4053.3368	0.2160	875.5208 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2494.9967	0.2160	538.9193 (264)
Space and water heating			1414.4401 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	394.9758	0.5190	204.9924 (268)
Total CO2, kg/m2/year			1658.3575 (272)
Emissions per m2 for space and water heating			14.8888 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.1578 (272b)
Emissions per m2 for pumps and fans			0.4097 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.8888 * 1.00) + 2.1578 + 0.4097, rounded to 2 d.p.			17.4600 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.5000 (1b)	x 2.3500 (2b)	= 111.6250 (1b) - (3b)
First floor	47.5000 (1c)	x 2.6500 (2c)	= 125.8750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 237.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1263 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3763 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3199 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4078	0.3998	0.3918	0.3519	0.3439	0.3039	0.3039	0.2959	0.3199	0.3439	0.3599	0.3758 (22b)
Effective ac	0.5832	0.5799	0.5768	0.5619	0.5591	0.5462	0.5462	0.5438	0.5512	0.5591	0.5647	0.5706 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
Opening Type 1			1.9500	1.2000	2.3400			(26)					
Opening Type 2 (Uw = 1.40)			18.2700	1.3258	24.2216			(27)					
Heat Loss Floor 1			47.5000	0.1500	7.1250			(28a)					
External Wall 1	98.5000	20.2200	78.2800	0.2400	18.7872			(29a)					
External Roof 1	47.5000		47.5000	0.1100	5.2250			(30)					
Total net area of external elements Aum(A, m2)			193.5000					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)... (30) + (32) =	57.6988			(33)					
Party Wall 1			42.0000	0.0000	0.0000			(32)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								100.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								9.7797 (36)					
Total fabric heat loss						(33) + (36) =		67.4785 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 45.7054	Feb 45.4523	Mar 45.2043	Apr 44.0390	May 43.8210	Jun 42.8061	Jul 42.8061	Aug 42.6181	Sep 43.1970	Oct 43.8210	Nov 44.2620	Dec 44.7231	(38)
Heat transfer coeff	113.1840	112.9309	112.6828	111.5175	111.2995	110.2846	110.2846	110.0967	110.6755	111.2995	111.7406	112.2016	(39)
Average = Sum(39)m / 12 =												111.5165	(39)
HLP	Jan 1.1914	Feb 1.1887	Mar 1.1861	Apr 1.1739	May 1.1716	Jun 1.1609	Jul 1.1609	Aug 1.1589	Sep 1.1650	Oct 1.1716	Nov 1.1762	Dec 1.1811	(40)
HLP (average)												1.1739	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6882 (42)
Average daily hot water use (litres/day)												98.0440 (43)
Daily hot water use	107.8484	103.9267	100.0049	96.0831	92.1614	88.2396	88.2396	92.1614	96.0831	100.0049	103.9267	107.8484 (44)
Energy conte	159.9361	139.8811	144.3448	125.8433	120.7496	104.1977	96.5545	110.7977	112.1210	130.6662	142.6324	154.8896 (45)
Energy content (annual)										Total = Sum(45)m =		1542.6141 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

Regs Region: England

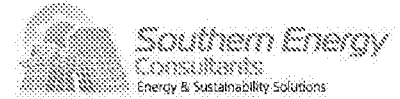
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	33.9864	29.7247	30.6733	26.7417	25.6593	22.1420	20.5178	23.5445	23.8257	27.7666	30.3094	32.9140 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.3652	19.8645	16.1549	12.2303	9.1423	7.7183	8.3399	10.8405	14.5502	18.4748	21.5628	22.9868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	247.9820	250.5553	244.0707	230.2658	212.8396	196.4615	185.5198	182.9466	189.4311	203.2360	220.6622	237.0404	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	(71)
Water heating gains (Table 5)	45.6807	44.2332	41.2275	37.1412	34.4083	30.7528	27.5777	31.6459	33.0913	37.3207	42.0964	44.2393	(72)
Total internal gains	379.3504	377.9756	364.7757	342.9599	319.7928	298.2551	284.7600	288.7555	300.3951	322.3540	347.6439	367.5890	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W		
North				11.8500	10.6334		0.7200	0.7000	0.7700		44.0103 (74)		
South				6.4200	46.7521		0.7200	0.7000	0.7700		104.8334 (78)		
Solar gains	148.8436	255.7959	361.6191	476.7419	566.8173	578.9336	551.2749	480.4209	400.2926	285.3009	178.5556	127.2748	(83)
Total gains	528.1940	633.7716	726.3948	819.7019	886.6101	877.1887	836.0349	769.1764	700.6877	607.6549	526.1995	494.8638	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil/m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	23.3150	23.3673	23.4187	23.6634	23.7098	23.9280	23.9280	23.9688	23.8435	23.7098	23.6162	23.5192	
alpha	2.5543	2.5578	2.5612	2.5776	2.5807	2.5952	2.5952	2.5979	2.5896	2.5807	2.5744	2.5679	
util living area	0.9719	0.9550	0.9262	0.8694	0.7740	0.6397	0.5113	0.5608	0.7517	0.9000	0.9584	0.9760	(86)
MIT	18.4474	18.7491	19.2149	19.8125	20.3488	20.7290	20.8917	20.8592	20.5567	19.8602	19.0452	18.3915	(87)
Th 2	19.9269	19.9290	19.9311	19.9410	19.9428	19.9514	19.9514	19.9530	19.9481	19.9428	19.9391	19.9352	(88)
util rest of house	0.9675	0.9480	0.9144	0.8472	0.7329	0.5692	0.4108	0.4613	0.6922	0.8783	0.9508	0.9722	(89)
MIT 2	17.5952	17.8944	18.3538	18.9398	19.4433	19.7811	19.9024	19.8848	19.6446	18.9980	18.1977	17.5455	(90)
Living area fraction									fLA = Living area / (4) =			0.2411	(91)
MIT	17.8006	18.1004	18.5613	19.1501	19.6616	20.0096	20.1408	20.1197	19.8645	19.2059	18.4020	17.7494	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8006	18.1004	18.5613	19.1501	19.6616	20.0096	20.1408	20.1197	19.8645	19.2059	18.4020	17.7494	(93)

8. Space heating requirement

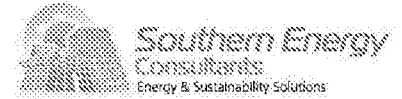
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	504.7391	590.8608	650.2557	678.2429	638.8209	503.0121	359.6415	367.9878	481.2518	522.2655	492.4969	475.8202	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1528.0528	1490.7362	1359.1056	1143.0710	886.1167	596.5928	390.5005	409.5245	637.9881	957.8281	1262.8936	1520.2667	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	761.3454	604.7163	527.3844	334.6762	183.9880	0.0000	0.0000	0.0000	0.0000	324.0586	554.6856	777.0682	(98)
Space heating												4067.9227	(98)
Space heating per m ²												42.8202	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1036.6753	816.1061	836.7346	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7515	0.8132	0.7832	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	779.0111	663.6707	655.3698	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1127.5309	1077.2506	1000.9132	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	250.9343	307.7035	257.0843	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												815.7220	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

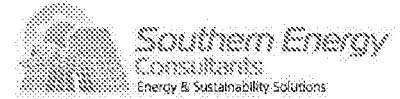


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction	FC = cooled area / (4) =										1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	62.7336	76.9259	64.2711	0.0000	0.0000	0.0000 (107)
Space cooling											203.9305 (107)
Space cooling per m2											2.1466 (108)
Energy for space heating											42.8202 (99)
Energy for space cooling											2.1466 (108)
Total											44.9669 (109)
Dwelling Fabric Energy Efficiency (DFEE)											45.0 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.5000 (1b)	x 2.3500 (2b)	= 111.6250 (1b) - (3b)
First floor	47.5000 (1c)	x 2.6500 (2c)	= 125.8750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 237.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1263 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3763 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3199 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4078	0.3998	0.3918	0.3519	0.3439	0.3039	0.3039	0.2959	0.3199	0.3439	0.3599	0.3758 (22b)
Effective ac	0.5832	0.5799	0.5768	0.5619	0.5591	0.5462	0.5462	0.5438	0.5512	0.5591	0.5647	0.5706 (25)

3. Heat losses and heat loss parameter

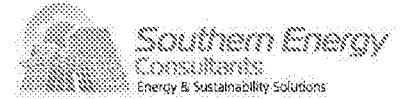
Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			1.9500	1.0000	1.9500		(26)					
TER Opening Type (Uw = 1.40)			18.2700	1.3258	24.2216		(27)					
Heat Loss Floor 1			47.5000	0.1300	6.1750		(28a)					
External Wall 1	98.5000	20.2200	78.2800	0.1800	14.0904		(29a)					
External Roof 1	47.5000		47.5000	0.1300	6.1750		(30)					
Total net area of external elements Aum(A, m2)			193.5000				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)... (30) + (32) =		52.6120		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.9719 (36)					
Total fabric heat loss						(33) + (36) =	62.5839 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 45.7054	Feb 45.4523	Mar 45.2043	Apr 44.0390	May 43.8210	Jun 42.8061	Jul 42.8061	Aug 42.6181	Sep 43.1970	Oct 43.8210	Nov 44.2620	Dec 44.7231 (38)
Heat transfer coeff	106.2893	106.0362	107.7881	106.6229	106.4049	105.3900	105.3900	105.2020	105.7809	106.4049	106.8459	107.3070 (39)
Average = Sum(39)m / 12 =												106.6218 (39)
HLP	Jan 1.1399	Feb 1.1372	Mar 1.1346	Apr 1.1223	May 1.1201	Jun 1.1094	Jul 1.1094	Aug 1.1074	Sep 1.1135	Oct 1.1201	Nov 1.1247	Dec 1.1295 (40)
HLP (average)												1.1223 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6882 (42)
Average daily hot water use (litres/day)												98.0440 (43)
Daily hot water use	Jan 107.8484	Feb 103.9267	Mar 100.0049	Apr 96.0831	May 92.1614	Jun 88.2396	Jul 88.2396	Aug 92.1614	Sep 96.0831	Oct 100.0049	Nov 103.9267	Dec 107.8484 (44)
Energy conte	159.9361	139.8811	144.3448	125.8433	120.7496	104.1977	96.5545	110.7977	112.1210	130.6662	142.6324	154.8896 (45)
Energy content (annual)										Total = Sum(45)m =		1542.6141 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Heat gains from water heating, kWh/month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
	33.9864	29.7247	30.6733	26.7417	25.6593	22.1420	20.5178	23.5445	23.8257	27.7666	30.3094	32.9140 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	134.4085	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.3652	19.8645	16.1549	12.2303	9.1423	7.7183	8.3399	10.8405	14.5502	18.4748	21.5628	22.9868	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	247.9820	250.5553	244.0707	230.2658	212.8396	196.4615	185.5198	182.9466	189.4311	203.2360	220.6622	237.0404	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	36.4408	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	(71)
Water heating gains (Table 5)	45.6807	44.2332	41.2275	37.1412	34.4883	30.7528	27.5777	31.6459	33.0913	37.3207	42.0964	44.2393	(72)
Total internal gains	379.3504	377.9756	364.7757	342.9599	319.7928	298.2551	284.7600	288.7555	300.3951	322.3540	347.6439	367.5890	(73)

6. Solar gains

[Jan]												
			Area m2			Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d	Gains W
North			11.8500			10.6334	0.6300		0.7000		0.7700	38.5090 (74)
South			6.4200			46.7521	0.6300		0.7000		0.7700	91.7292 (78)
Solar gains	130.2382	223.8214	316.4167	417.1492	495.9652	506.5669	482.3655	420.3683	350.2560	249.6383	156.2362	111.3655 (83)
Total gains	509.5886	601.7971	681.1924	760.1091	815.7579	804.8220	767.1255	709.1238	650.6511	571.9923	503.8801	478.9545 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
tau	60.9222	61.0649	61.2055	61.8744	62.0011	62.5982	62.5982	62.7100	62.3669	62.0011	61.7452	61.4799		
alpha	5.0615	5.0710	5.0804	5.1250	5.1334	5.1732	5.1732	5.1807	5.1578	5.1334	5.1163	5.0987		
util living area	0.9988	0.9970	0.9916	0.9716	0.9061	0.7561	0.5860	0.6494	0.8817	0.9834	0.9974	0.9991	(86)	
MIT	19.7130	19.8710	20.1202	20.4519	20.7511	20.9343	20.9859	20.9766	20.8445	20.4591	20.0241	19.6860	(87)	
Th 2	19.9684	19.9705	19.9727	19.9826	19.9845	19.9932	19.9932	19.9948	19.9898	19.9845	19.9807	19.9768	(88)	
util rest of house	0.9984	0.9959	0.9885	0.9601	0.8676	0.6674	0.4613	0.5235	0.8189	0.9747	0.9963	0.9989	(89)	
MIT 2	18.7918	18.9511	19.2006	19.5337	19.8118	19.9620	19.9895	19.9879	19.9001	19.5461	19.1124	18.7716	(90)	
Living area fraction	19.0139	19.1728	19.4223	19.7550	20.0382	20.1964	20.2297	20.2262	20.1277	19.7662	19.3322	18.9920	(92)	
Temperature adjustment												0.0000		
adjusted MIT	19.0139	19.1728	19.4223	19.7550	20.0382	20.1964	20.2297	20.2262	20.1277	19.7662	19.3322	18.9920	(93)	

8. Space heating requirement

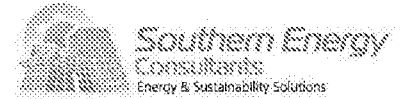
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9948	0.9863	0.9569	0.8700	0.6869	0.4917	0.5542	0.8290	0.9722	0.9953	0.9984	(94)
Useful gains	508.5062	598.6792	671.8787	727.3719	709.6904	552.8156	377.2165	392.9798	539.3981	556.1083	501.5127	478.2107	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1593.3573	1541.9840	1392.8671	1157.3933	887.2249	589.8055	382.5304	402.5273	637.6182	975.3277	1306.9612	1587.2866	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	807.1292	633.9009	536.4154	309.6154	132.0857	0.0000	0.0000	0.0000	0.0000	311.8993	579.9229	825.1525	(98)
Space heating												4136.1212	(98)
Space heating per m2												(98) / (4) =	43.5381 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	990.6657	779.8857	799.5354	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8588	0.9216	0.8947	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	850.7489	718.7483	715.3061	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1042.9464	996.7072	930.7219	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	138.3822	206.8014	160.2694	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												505.4530	(104)
Cooled fraction												1.0000	(105)
												fc = cooled area / (4) =	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

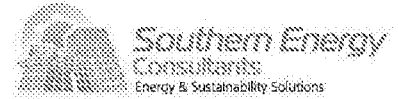


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	34.5956	51.7004	40.0673	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												126.3633	(107)
Space cooling per m2												1.3301	(108)
Energy for space heating												43.5381	(99)
Energy for space cooling												1.3301	(108)
Total												44.8683	(109)
Target Fabric Energy Efficiency (TFEE)												51.6	(109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.5000 (1b)	x 2.3500 (2b)	= 111.6250 (1b) - (3b)
First floor	47.5000 (1c)	x 2.6500 (2c)	= 125.8750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 237.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour							
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)							
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)							
Number of intermittent fans					0 * 10 = 0.0000 (7a)							
Number of passive vents					0 * 10 = 0.0000 (7b)							
Number of flueless gas fires					0 * 40 = 0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.2500 (18)							
Number of sides sheltered					2 (19)							
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.8500 (20)							
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.2125 (21)							
Wind speed	Jan 5.0000	Feb 4.6000	Mar 4.4000	Apr 4.2000	May 4.4000	Jun 3.9000	Jul 4.1000	Aug 3.9000	Sep 4.0000	Oct 4.3000	Nov 4.3000	Dec 4.5000 (22)
Wind factor	1.2500	1.1500	1.1000	1.0500	1.1000	0.9750	1.0250	0.9750	1.0000	1.0750	1.0750	1.1250 (22a)
Adj infilt rate	0.2656	0.2444	0.2338	0.2231	0.2338	0.2072	0.2178	0.2072	0.2125	0.2284	0.2284	0.2391 (22b)
Mechanical extract ventilation - centralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5156	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			1.9500	1.2000	2.3400		(26)
Opening Type 2 (Uw = 1.40)			18.2700	1.3258	24.2216		(27)
Heat Loss Floor 1			47.5000	0.1500	7.1250		(28a)
External Wall 1	98.5000	20.2200	78.2800	0.2400	18.7872		(29a)
External Roof 1	47.5000		47.5000	0.1100	5.2250		(30)
Total net area of external elements Aum(A, m ²)			193.5000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	57.6988			(33)
Party Wall 1			42.0000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.7797 (36)
Total fabric heat loss						(33) + (36) =	67.4785 (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	40.4121	39.1875	39.1875	39.1875	39.1875	39.1875	39.1875	39.1875	39.1875	39.1875	39.1875	39.1875 (38)
Heat transfer coeff	107.8906	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660 (39)
Average = Sum(39)m / 12 =												106.7681 (39)
HLP	Jan 1.1357	Feb 1.1228	Mar 1.1228	Apr 1.1228	May 1.1228	Jun 1.1228	Jul 1.1228	Aug 1.1228	Sep 1.1228	Oct 1.1228	Nov 1.1228	Dec 1.1228 (40)
HLP (average)												1.1239 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6882 (42)
Average daily hot water use (litres/day)												98.0440 (43)
Daily hot water use	Jan 107.8484	Feb 103.9267	Mar 100.0049	Apr 96.0831	May 92.1614	Jun 88.2396	Jul 88.2396	Aug 92.1614	Sep 96.0831	Oct 100.0049	Nov 103.9267	Dec 107.8484 (44)
Energy conte	159.9361	139.8811	144.3448	125.8433	120.7496	104.1977	96.5545	110.7977	112.1210	130.6662	142.6324	154.8896 (45)
Energy content (annual)										Total = Sum(45)m =		1542.6141 (45)
Distribution loss (46)m = 0.15 x (45)m	23.9904	20.9822	21.6517	18.8765	18.1124	15.6297	14.4832	16.6197	16.8182	19.5999	21.3949	23.2334 (46)

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Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)	
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)	
CombI loss	4.2507	3.8394	4.2507	4.1136	4.2507	4.1136	4.2507	4.2507	4.1136	4.2507	4.1136	4.2507 (61)	
Total heat required for water heating calculated for each month	164.1868	143.7205	148.5955	129.9569	125.0003	108.3113	100.8053	115.0485	116.2346	134.9170	146.7460	159.1403 (62)	
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)	
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	Solar input (sum of months) = Sum(63)m =				0.0000 (63)	
Output from w/h	164.1868	143.7205	148.5955	129.9569	125.0003	108.3113	100.8053	115.0485	116.2346	134.9170	146.7460	159.1403 (64)	
RHI water heating demand												Total per year (kWh/year) = Sum(64)m =	1592.6629 (64)
Heat gains from water heating, kWh/month	54.2414	47.4703	49.0573	42.8713	41.2119	35.6742	33.1671	37.9029	38.3086	44.5092	48.4537	52.5635 (65)	

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.9129	49.6614	40.3873	30.5758	22.8558	19.2958	20.8498	27.1014	36.3754	46.1869	53.9069	57.4669 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	370.1224	373.9631	364.2847	343.6804	317.6711	293.2261	276.8953	273.0546	282.7330	303.3374	329.3466	353.7917 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268 (71)
Water heating gains (Table 5)	72.9051	70.6403	65.9373	59.5435	55.3924	49.5474	44.5794	50.9448	53.2064	59.8242	67.2968	70.6498 (72)
Total internal gains	609.5211	604.8454	581.1898	544.3802	506.4998	472.6499	452.9050	461.6813	482.8954	519.9290	561.1309	592.4889 (73)

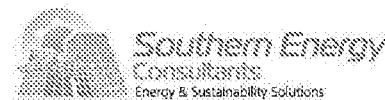
[Jan]				Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				11.8500	14.6401	0.7200	0.7000	0.7700	60.5934 (74)			
South				6.4200	61.3950	0.7200	0.7000	0.7700	137.6676 (78)			
Solar gains	198.2610	285.2397	406.1191	559.7953	649.5939	711.9947	672.6126	584.4020	481.9569	339.0423	228.1504	164.3887 (83)
Total gains	807.7820	890.0851	987.3089	1104.1755	1156.0937	1184.6446	1125.5177	1046.0833	964.8523	858.9713	789.2813	756.8776 (84)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	24.4589	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397
alpha	2.6306	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493
util living area	0.9179	0.8963	0.8453	0.7508	0.6140	0.4395	0.3112	0.3148	0.5390	0.7573	0.8771	0.9255 (86)
MIT	19.2408	19.4365	19.8506	20.3261	20.7073	20.9153	20.9764	20.9772	20.8532	20.4530	19.8235	19.2315 (87)
Th 2	19.9718	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823 (88)
util rest of house	0.9062	0.8820	0.8238	0.7163	0.5604	0.3660	0.2224	0.2193	0.4616	0.7135	0.8567	0.9145 (89)
MIT 2	18.4043	18.6007	18.9986	19.4422	19.7780	19.9382	19.9750	19.9758	19.8998	19.5698	18.9812	18.4041 (90)
Living area fraction	18.6059	18.8021	19.2040	19.6552	20.0020	20.1737	20.2164	20.2172	20.1296	19.7827	19.1843	18.6035 (91)
MIT												18.6035 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.4559	18.6521	19.0540	19.5052	19.8520	20.0237	20.0664	20.0672	19.9796	19.6327	19.0343	18.4535 (93)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8845	0.8592	0.8008	0.6983	0.5530	0.3691	0.2299	0.2275	0.4614	0.6963	0.8336	0.8936 (94)
Useful gains	714.4569	764.7517	790.6236	771.0292	639.3346	437.2975	258.7712	237.9748	445.1393	598.0892	657.9710	676.3720 (95)
Ext temp.	5.5000	5.8000	7.5000	9.9000	12.9000	15.7000	17.6000	17.8000	15.4000	12.2000	8.7000	5.7000 (96)
Heat loss rate W	1397.8222	1370.8873	1232.4216	1024.5534	741.5462	461.1972	263.0784	241.8324	488.4916	792.8143	1102.3154	1360.3674 (97)
Month fractl	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	508.4238	407.3231	328.6977	182.5375	76.0454	0.0000	0.0000	0.0000	0.0000	144.8754	319.9279	508.8925 (98)
Space heating RHI space heating demand												2476.7233 (98) 2477 (98)

FULL SAP CALCULATION PRINTOUT

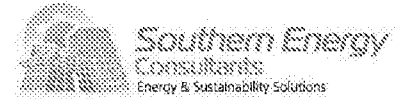
Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.5000 (1b)	x 2.3500 (2b)	= 111.6250 (1b) - (3b)
First floor	47.5000 (1c)	x 2.6500 (2c)	= 125.8750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	237.5000 (5)

2. Ventilation rate

					main heating	secondary heating	other		total	m3 per hour		
Number of chimneys					0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues					0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans											0 * 10 =	0.0000 (7a)
Number of passive vents											0 * 10 =	0.0000 (7b)
Number of flueless gas fires											0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =											0.0000 / (5) =	0.0000 (8)
Pressure test											Yes	
Measured/design AP50											5.0000	
Infiltration rate											0.2500 (18)	
Number of sides sheltered											2 (19)	
Shelter factor											(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =	0.2125 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497 (22b)
Mechanical extract ventilation - centralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			1.9500	1.2000	2.3400		(26)
Opening Type 2 (Uw = 1.40)			18.2700	1.3258	24.2216		(27)
Heat Loss Floor 1			47.5000	0.1500	7.1250		(28a)
External Wall 1	98.5000	20.2200	78.2800	0.2400	18.7872		(29a)
External Roof 1	47.5000		47.5000	0.1100	5.2250		(30)
Total net area of external elements Aum(A, m ²)			193.5000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	57.6988			(33)
Party Wall 1			42.0000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.7797 (36)
Total fabric heat loss						(33) + (36) =	67.4785 (37)

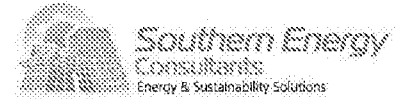
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 40.8285	Feb 40.4121	Mar 39.9957	Apr 39.1875	May 39.1875	Jun 39.1875	Jul 39.1875	Aug 39.1875	Sep 39.1875	Oct 39.1875	Nov 39.1875	Dec 39.1875 (38)
Heat transfer coeff	108.3070	107.8906	107.4743	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660 (39)
Average = Sum(39)m / 12 =												106.9722 (39)
HLP	Jan 1.1401	Feb 1.1357	Mar 1.1313	Apr 1.1228	May 1.1228	Jun 1.1228	Jul 1.1228	Aug 1.1228	Sep 1.1228	Oct 1.1228	Nov 1.1228	Dec 1.1228 (40)
HLP (average)												1.1260 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6882 (42)
Average daily hot water use (litres/day)												98.0440 (43)
Daily hot water use	Jan 107.8484	Feb 103.9267	Mar 100.0049	Apr 96.0831	May 92.1614	Jun 88.2396	Jul 88.2396	Aug 92.1614	Sep 96.0831	Oct 100.0049	Nov 103.9267	Dec 107.8484 (44)
Energy conte	159.9361	139.8811	144.3448	125.8433	120.7496	104.1977	96.5545	110.7977	112.1210	130.6662	142.6324	154.8896 (45)
Energy content (annual)										Total = Sum(45)m =		1542.6141 (45)
Distribution loss (46)m = 0.15 x (45)m	23.9904	20.9822	21.6517	18.8765	18.1124	15.6297	14.4832	16.6197	16.8182	19.5999	21.3949	23.2334 (46)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Calculation of Energy Ratings 09 Jan 2014

Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	4.2507	3.8394	4.2507	4.1136	4.2507	4.1136	4.2507	4.2507	4.1136	4.2507	4.1136	4.2507 (61)
Total heat required for water heating calculated for each month												
	164.1868	143.7205	148.5955	129.9569	125.0003	108.3113	100.8053	115.0485	116.2346	134.9170	146.7460	159.1403 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	Solar input (sum of months) = Sum(63)m =				0.0000 (63)
Output from w/h	164.1868	143.7205	148.5955	129.9569	125.0003	108.3113	100.8053	115.0485	116.2346	134.9170	146.7460	159.1403 (64)
Total per year (kWh/year) = Sum(64)m =												1592.6629 (64)
Heat gains from water heating, kWh/month												
	54.2414	47.4703	49.0573	42.8713	41.2119	35.6742	33.1671	37.9029	38.3086	44.5092	48.4537	52.5635 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.9129	49.6614	40.3873	30.5758	22.8558	19.2958	20.8498	27.1014	36.3754	46.1869	53.9069	57.4669	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	370.1224	373.9631	364.2847	343.6804	317.6711	293.2261	276.8953	273.0546	282.7330	303.3374	329.3466	353.7917	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	(71)
Water heating gains (Table 5)	72.9051	70.6403	65.9373	59.5435	55.3924	49.5474	44.5794	50.9448	53.2064	59.8242	67.2968	70.6498	(72)
Total internal gains	609.5211	604.8454	581.1898	544.3802	506.4998	472.6499	452.9050	461.6813	482.8954	519.9290	561.1309	592.4889	(73)

6. Solar gains

[Jan]	Area m2				Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W				
North	11.8500				10.6334	0.7200	0.7000	0.7700	44.0103 (74)				
South	6.4200				46.7521	0.7200	0.7000	0.7700	104.8334 (78)				
Solar gains	148.8436	255.7959	361.6191	476.7419	566.8173	578.9336	551.2749	480.4209	400.2926	285.3009	178.5556	127.2748	(83)
Total gains	758.3647	860.6413	942.8089	1021.1221	1073.3171	1051.5835	1004.1799	942.1021	883.1881	805.2299	739.6865	719.7637	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	24.3649	24.4589	24.5537	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	
alpha	2.6243	2.6306	2.6369	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	
util living area	0.9380	0.9137	0.8749	0.8046	0.6968	0.5578	0.4320	0.4720	0.6570	0.8298	0.9138	0.9446	(86)
MIT	18.9292	19.2033	19.6116	20.1095	20.5366	20.8176	20.9325	20.9127	20.7043	20.1625	19.4684	18.8887	(87)
Th 2	19.9682	19.9718	19.9753	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	(88)
util rest of house	0.9294	0.9020	0.8576	0.7767	0.6522	0.4899	0.3436	0.3827	0.5938	0.7994	0.9001	0.9369	(89)
MIT 2	18.0959	18.3657	18.7644	19.2438	19.6340	19.8704	19.9524	19.9413	19.7867	19.3044	18.6375	18.0665	(90)
Living area fraction									fLA = Living area / (4) =			0.2411	(91)
MIT	18.2968	18.5676	18.9686	19.4525	19.8515	20.0987	20.1887	20.1754	20.0079	19.5113	18.8378	18.2647	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1468	18.4176	18.8186	19.3025	19.7015	19.9487	20.0387	20.0254	19.8579	19.3613	18.6878	18.1147	(93)

8. Space heating requirement

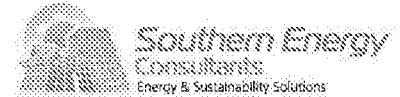
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9098	0.8800	0.8342	0.7554	0.6386	0.4875	0.3488	0.3867	0.5852	0.7776	0.8783	0.9185	(94)
Ext temp.	689.9600	757.3299	786.4473	771.3602	685.4128	512.6658	350.2175	364.2932	516.8650	626.1247	649.6417	661.0883	(95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Month fracti	1499.7027	1458.4197	1323.9379	1109.5946	853.4912	570.5261	366.7890	386.7083	614.1681	934.5304	1236.0250	1484.2253	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating	602.4485	471.1323	399.8931	243.5287	125.0503	0.0000	0.0000	0.0000	0.0000	229.4539	422.1960	612.4139	(98)
Space heating per m2												3106.1167	(98)
												(98) / (4) =	32.6960 (99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



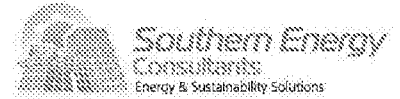
CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												90.6000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3428.3849 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	602.4485	471.1323	399.8931	243.5287	125.0503	0.0000	0.0000	0.0000	0.0000	229.4539	422.1960	612.4139 (98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000 (210)
Space heating fuel (main heating system)	664.9542	520.0136	441.3831	268.7955	138.0246	0.0000	0.0000	0.0000	0.0000	253.2603	466.0000	675.9535 (211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	164.1868	143.7205	148.5955	129.9569	125.0003	108.3113	100.8053	115.0485	116.2346	134.9170	146.7460	159.1403 (64)
Efficiency of water heater (217)m	89.8270	89.7569	89.6243	89.3507	88.8159	87.1000	87.1000	87.1000	87.1000	89.2717	89.6706	87.1000 (216)
Fuel for water heating, kWh/month	182.7812	160.1219	165.7982	145.4459	140.7410	124.3529	115.7351	132.0878	133.4496	151.1307	163.6501	177.1074 (219)
Water heating fuel used												1792.4016 (219)
Annual totals kWh/year												
Space heating fuel - main system												3428.3849 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEVCentralised, Database: in-use factor = 1.3000, SFP = 0.2210)												
mechanical ventilation fans (SFP = 0.2210)												64.0348 (230a)
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												139.0348 (231)
Electricity for lighting (calculated in Appendix L)												394.9758 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.50 * 1080 * 1.00) =												-431.8098 (233)
Total delivered energy for all uses												5322.9872 (238)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

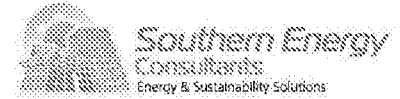


CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9060 = 3.841$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9060 = 0.2384$, stars = 4
Water heating energy efficiency	$3.48 / 0.8871 = 3.923$, stars = 4
Water heating environmental impact	$0.216 / 0.8871 = 0.2435$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.5000 (1b)	x 2.3500 (2b)	= 111.6250 (1b) - (3b)
First floor	47.5000 (1c)	x 2.6500 (2c)	= 125.8750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	237.5000 (5)

2. Ventilation rate

					main heating	secondary heating	other		total	m3 per hour			
Number of chimneys					0	+	0	+	0	=	0 * 40 =	0.0000 (6a)	
Number of open flues					0	+	0	+	0	=	0 * 20 =	0.0000 (6b)	
Number of intermittent fans											0 * 10 =	0.0000 (7a)	
Number of passive vents											0 * 10 =	0.0000 (7b)	
Number of flueless gas fires											0 * 40 =	0.0000 (7c)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =											Air changes per hour		
Pressure test											0.0000 / (5) =		0.0000 (8)
Measured/design AP50											Yes		
Infiltration rate											5.0000		
Number of sides sheltered											0.2500 (18)		
											2 (19)		
Shelter factor											(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =		0.2125 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	5.0000	4.6000	4.4000	4.2000	4.4000	3.9000	4.1000	3.9000	4.0000	4.3000	4.3000	4.5000 (22)	
Adj infilt rate	1.2500	1.1500	1.1000	1.0500	1.1000	0.9750	1.0250	0.9750	1.0000	1.0750	1.0750	1.1250 (22a)	
	0.2656	0.2444	0.2338	0.2231	0.2338	0.2072	0.2178	0.2072	0.2125	0.2284	0.2284	0.2391 (22b)	
Mechanical extract ventilation - centralised													
If mechanical ventilation:													0.5000 (23a)
Effective ac	0.5156	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)	

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			1.9500	1.2000	2.3400		(26)
Opening Type 2 (Uw = 1.40)			18.2700	1.3258	24.2216		(27)
Heat Loss Floor 1			47.5000	0.1500	7.1250		(28a)
External Wall 1	98.5000	20.2200	78.2800	0.2400	18.7872		(29a)
External Roof 1	47.5000		47.5000	0.1100	5.2250		(30)
Total net area of external elements Aum(A, m ²)			193.5000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.6988		(33)
Party Wall 1			42.0000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.7797 (36)
Total fabric heat loss						(33) + (36) =	67.4785 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

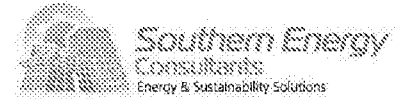
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	40.4121	39.1875	39.1875	39.1875	39.1875	39.1875	39.1875	39.1875	39.1875	39.1875	39.1875	39.1875 (38)
Heat transfer coeff	107.8906	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660 (39)
Average = Sum(39)m / 12 =												106.7681 (39)
HLP	1.1357	1.1228	1.1228	1.1228	1.1228	1.1228	1.1228	1.1228	1.1228	1.1228	1.1228	1.1228 (40)
HLP (average)												1.1239 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6882 (42)
Average daily hot water use (litres/day)												98.0440 (43)
Daily hot water use	107.8484	103.9267	100.0049	96.0831	92.1614	88.2396	88.2396	92.1614	96.0831	100.0049	103.9267	107.8484 (44)
Energy conte	159.9361	139.8811	144.3448	125.8433	120.7496	104.1977	96.5545	110.7977	112.1210	130.6662	142.6324	154.8896 (45)
Energy content (annual)										Total = Sum(45)m =		1542.6141 (45)
Distribution loss (46)m = 0.15 x (45)m	23.9904	20.9822	21.6517	18.8765	18.1124	15.6297	14.4832	16.6197	16.8182	19.5999	21.3949	23.2334 (46)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Calculation of EPC Costs, Emissions and Primary Energy 09 Jan 2014

Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	4.2507	3.8394	4.2507	4.1136	4.2507	4.1136	4.2507	4.2507	4.1136	4.2507	4.1136	4.2507	(61)
Total heat required for water heating calculated for each month	164.1868	143.7205	148.5955	129.9569	125.0003	108.3113	100.8053	115.0485	116.2346	134.9170	146.7460	159.1403	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Output from w/h	164.1868	143.7205	148.5955	129.9569	125.0003	108.3113	100.8053	115.0485	116.2346	134.9170	146.7460	159.1403	(64)
Heat gains from water heating, kWh/month	54.2414	47.4703	49.0573	42.8713	41.2119	35.6742	33.1671	37.9029	38.3086	44.5092	48.4537	52.5635	(65)
Total per year (kWh/year) = Sum(63)m =													1592.6629 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.9129	49.6614	40.3873	30.5758	22.8558	19.2958	20.8498	27.1014	36.3754	46.1869	53.9069	57.4669	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	370.1224	373.9631	364.2847	343.6804	317.6711	293.2261	276.8953	273.0546	282.7330	303.3374	329.3466	353.7917	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	(71)
Water heating gains (Table 5)	72.9051	70.6403	65.9373	59.5435	55.3924	49.5474	44.5794	50.9448	53.2064	59.8242	67.2968	70.6498	(72)
Total internal gains	609.5211	604.8454	581.1898	544.3802	506.4998	472.6499	452.9050	461.6813	482.8954	519.9290	561.1309	592.4889	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d			Gains W	
North				11.8500	14.6401	0.7200	0.7000	0.7700			60.5934 (74)	
South				6.4200	61.3950	0.7200	0.7000	0.7700			137.6676 (78)	
Solar gains	198.2610	285.2397	406.1191	559.7953	649.5939	711.9947	672.6126	584.4020	481.9569	339.0423	228.1504	164.3887 (83)
Total gains	807.7820	890.0851	987.3089	1104.1755	1156.0937	1184.6446	1125.5177	1046.0833	964.8523	858.9713	789.2813	756.8776 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	24.4589	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	
alpha	2.6306	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	
util living area	0.9179	0.8963	0.8453	0.7508	0.6140	0.4395	0.3112	0.3148	0.5390	0.7573	0.8771	0.9255	(86)
MIT	19.2408	19.4365	19.8506	20.3261	20.7073	20.9153	20.9764	20.9772	20.8532	20.4530	19.8235	19.2315	(87)
Th 2	19.9718	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	(88)
util rest of house	0.9062	0.8820	0.8238	0.7163	0.5604	0.3660	0.2224	0.2193	0.4616	0.7135	0.8567	0.9145	(89)
MIT 2	18.4043	18.6007	18.9986	19.4422	19.7780	19.9382	19.9750	19.9758	19.8998	19.5698	18.9812	18.4041	(90)
Living area fraction									fLA = Living area / (4) =			0.2411	(91)
MIT	18.6059	18.8021	19.2040	19.6552	20.0020	20.1737	20.2164	20.2172	20.1296	19.7827	19.1843	18.6035	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.4559	18.6521	19.0540	19.5052	19.8520	20.0237	20.0664	20.0672	19.9796	19.6327	19.0343	18.4535	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.8845	0.8592	0.8008	0.6983	0.5530	0.3691	0.2299	0.2275	0.4614	0.6963	0.8336	0.8936	(94)
Useful gains	714.4569	764.7517	790.6236	771.0292	639.3346	437.2975	258.7712	237.9748	445.1393	598.0892	657.9710	676.3720	(95)
Ext temp.	5.5000	5.8000	7.5000	9.9000	12.9000	15.7000	17.6000	17.8000	15.4000	12.2000	8.7000	5.7000	(96)
Heat loss rate W	1397.8222	1370.8873	1232.4216	1024.5534	741.5462	461.1972	263.0784	241.8324	488.4916	792.8143	1102.3154	1360.3674	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	508.4238	407.3231	328.6977	182.5375	76.0454	0.0000	0.0000	0.0000	0.0000	144.8754	319.9279	508.8925	(98)
Space heating												2476.7233	(98)
Space heating per m2										(98) / (4) =		26.0708	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.6000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2733.6902 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	508.4238	407.3231	328.6977	182.5375	76.0454	0.0000	0.0000	0.0000	0.0000	144.8754	319.9279	508.8925	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	561.1741	449.5840	362.8010	201.4762	83.9353	0.0000	0.0000	0.0000	0.0000	159.9067	353.1213	561.6915	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	164.1868	143.7205	148.5955	129.9569	125.0003	108.3113	100.8053	115.0485	116.2346	134.9170	146.7460	159.1403	(64)
Efficiency of water heater (217)m	89.7199	89.6603	89.4806	89.1109	88.3916	87.1000	87.1000	87.1000	87.1000	88.8778	89.4695	87.1000	(216)
Fuel for water heating, kWh/month	182.9992	160.2944	166.0646	145.8373	141.4165	124.3529	115.7351	132.0878	133.4496	151.8004	164.0179	177.3330	(219)
Water heating fuel used												1795.3888	(219)
Annual totals kWh/year													
Space heating fuel - main system												2733.6902	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEV)Centralised, Database: in-use factor = 1.3000, SFP = 0.2210)													
mechanical ventilation fans (SFP = 0.2210)													64.0348 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													139.0348 (231)
Electricity for lighting (calculated in Appendix L)													394.9758 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.50 * 1299 * 1.00) =													-519.6476 (233)
Total delivered energy for all uses													4543.4420 (238)

10a. Fuel costs - using BEDF prices (470)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2733.6902	3.8700	105.7938 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1795.3888	3.8700	69.4815 (247)
Mechanical ventilation fans	64.0348	18.9000	12.1026 (249)
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)
Energy for lighting	394.9758	18.9000	74.6504 (250)
Additional standing charges			93.0000 (251)
Energy saving/generation technologies			
PV Unit	-519.6476	18.9000	-98.2134 (252)
Total energy cost			270.9900 (255)

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

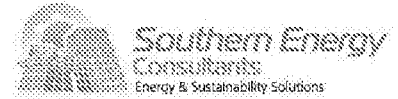
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2733.6902	0.2160	590.4771 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1795.3888	0.2160	387.8040 (264)
Space and water heating			978.2811 (265)
Pumps and fans	139.0348	0.5190	72.1590 (267)
Energy for lighting	394.9758	0.5190	204.9924 (268)
Energy saving/generation technologies			
PV Unit	-519.6476	0.5190	-269.6971 (269)
Total kg/year			985.7354 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2733.6902	1.2200	3335.1021 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1795.3888	1.2200	2190.3743 (264)
Space and water heating			5525.4764 (265)
Pumps and fans	139.0348	3.0700	426.8367 (267)
Energy for lighting	394.9758	3.0700	1212.5757 (268)
Energy saving/generation technologies			
PV Unit	-519.6476	3.0700	-1595.3182 (269)
Primary energy kWh/year			5569.5706 (272)
Primary energy kWh/m2/year			58.6271 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

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

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Recommended
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 29	-190 kg (19.3%)
V2 Wind turbine	+ 19.7	-£ 676	-1856 kg (233.3%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£29	2.00 kg/m²	B 88 B 90
Wind turbine	£676	19.53 kg/m²	A 108 A 108
Total Savings	£705	21.54 kg/m²	

Potential energy efficiency rating: A 108
Potential environmental impact rating: A 108

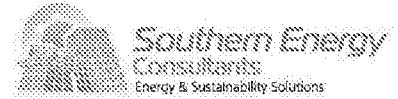
Fuel prices for cost data on this page from database revision number 470 TEST (21 Dec 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£101	£110	-£9
Mains gas	£268	£230	£39
Space heating	£225	£225	£0
Water heating	£69	£40	£29
Lighting	£75	£75	£0
Generated (PV)	-£98	-£98	£0
Generated (wind)	-£0	-£676	£676
Total cost of fuels	£271	-£434	£706
Total cost of uses	£271	-£434	£705
Delivered energy	48 kWh/m²	0 kWh/m²	48 kWh/m²
Carbon dioxide emissions	1.0 tonnes	-1.1 tonnes	2.0 tonnes
CO2 emissions per m²	10 kg/m²	-11 kg/m²	22 kg/m²
Primary energy	59 kWh/m²	-68 kWh/m²	127 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.5000 (1b)	x 2.3500 (2b)	= 111.6250 (1b) - (3b)
First floor	47.5000 (1c)	x 2.6500 (2c)	= 125.8750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	237.5000 (5)

2. Ventilation rate

					main heating	secondary heating	other		total	m3 per hour			
Number of chimneys					0	+	0	+	0	=	0 * 40 =	0.0000 (6a)	
Number of open flues					0	+	0	+	0	=	0 * 20 =	0.0000 (6b)	
Number of intermittent fans											0 * 10 =	0.0000 (7a)	
Number of passive vents											0 * 10 =	0.0000 (7b)	
Number of flueless gas fires											0 * 40 =	0.0000 (7c)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =											Air changes per hour		
Pressure test											0.0000 / (5) =		0.0000 (8)
Measured/design AP50											Yes		
Infiltration rate											5.0000		
Number of sides sheltered											0.2500 (18)		
											2 (19)		
Shelter factor											(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =		0.2125 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)	
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)	
	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497 (22b)	
Mechanical extract ventilation - centralised													
If mechanical ventilation:													0.5000 (23a)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)	

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Opening Type 1			1.9500	1.2000	2.3400			(26)				
Opening Type 2 (Uw = 1.40)			18.2700	1.3258	24.2216			(27)				
Heat Loss Floor 1			47.5000	0.1500	7.1250			(28a)				
External Wall 1	98.5000	20.2200	78.2800	0.2400	18.7872			(29a)				
External Roof 1	47.5000		47.5000	0.1100	5.2250			(30)				
Total net area of external elements Aum(A, m2)			193.5000					(31)				
Fabric heat loss, W/K = Sum (A x U)			(26)... (30) + (32) =		57.6988			(33)				
Party Wall 1			42.0000	0.0000	0.0000			(32)				
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								100.0000 (35)				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								9.7797 (36)				
Total fabric heat loss						(33) + (36) =		67.4785 (37)				
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 40.8285	Feb 40.4121	Mar 39.9957	Apr 39.1875	May 39.1875	Jun 39.1875	Jul 39.1875	Aug 39.1875	Sep 39.1875	Oct 39.1875	Nov 39.1875	Dec 39.1875 (38)
Heat transfer coeff	108.3070	107.8906	107.4743	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660 (39)
Average = Sum(39)m / 12 =												106.9722 (39)
HLP	Jan 1.1401	Feb 1.1357	Mar 1.1313	Apr 1.1228	May 1.1228	Jun 1.1228	Jul 1.1228	Aug 1.1228	Sep 1.1228	Oct 1.1228	Nov 1.1228	Dec 1.1228 (40)
HLP (average)												1.1260 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6882 (42)
Average daily hot water use (litres/day)												98.0440 (43)
Daily hot water use	Jan 107.8484	Feb 103.9267	Mar 100.0049	Apr 96.0831	May 92.1614	Jun 88.2396	Jul 88.2396	Aug 92.1614	Sep 96.0831	Oct 100.0049	Nov 103.9267	Dec 107.8484 (44)
Energy conte	159.9361	139.8811	144.3448	125.8433	120.7496	104.1977	96.5545	110.7977	112.1210	130.6662	142.6324	154.8896 (45)
Energy content (annual)										Total = Sum(45)m =		1542.6141 (45)
Distribution loss (46)m = 0.15 x (45)m	23.9904	20.9822	21.6517	18.8765	18.1124	15.6297	14.4832	16.6197	16.8182	19.5999	21.3949	23.2334 (46)

**Southern Energy
Consultants**
Energy & Sustainability Solutions

Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	4.2507	3.8394	4.2507	4.1136	4.2507	4.1136	4.2507	4.2507	4.1136	4.2507	4.1136	4.2507 (63)
Total heat required for water heating calculated for each month	164.1868	143.7205	148.5955	129.9569	125.0003	108.3113	100.8053	115.0485	116.2346	134.9170	146.7460	159.1403 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m2												1079.5246 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1813.6014 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.1757 (H8)
Utilisation factor												0.5728 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												98.0440 (H14)
Volume ratio Veff/V												0.7650 (H15)
Solar storage volume factor												0.9464 (H16)
Solar input								-99.9934	-78.3149	-53.4799	-29.7366	-864.5400 (H17)
Solar input	-25.0699	-41.8345	-71.2490	-95.4877	-117.9670	-115.9803	-114.4476	0.0000	0.0000	0.0000	0.0000	-20.9793 (63)
								Solar input (sum of months) = Sum(63)m =				-864.5400 (63)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Output from w/h	139.1169	101.8860	77.3465	34.4692	7.0334	0.0000	0.0000	15.0550	37.9197	81.4371	117.0095	138.1610 (64)
								Total per year (kWh/year) = Sum(64)m =				749.4342 (64)
Heat gains from water heating, kWh/month												
	54.2414	47.4703	49.0573	42.8713	41.2119	35.6742	33.1671	37.9029	38.3086	44.5092	48.4537	52.5635 (65)

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
((66)m	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901 ((66)
Lighting gains	(calculated in Appendix L, equation L9 or L9a), also see Table 5											
	55.9129	49.6614	40.3873	30.5758	22.8558	19.2958	20.8498	27.1014	36.3754	46.1869	53.9069	57.4669 ((67)
Appliances gains	(calculated in Appendix L, equation L13 or L13a), also see Table 5											
	370.1224	373.9631	364.2847	343.6804	317.6711	293.2261	276.8953	273.0546	282.7330	303.3374	329.3466	353.7917 ((68)
Cooking gains	(calculated in Appendix L, equation L15 or L15a), also see Table 5											
	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172 ((69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 ((70)
Losses e.g. evaporation	(negative values) (Table 5)											
	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268 ((71)
Water heating gains	(Table 5)											
	72.9051	70.6403	65.9373	59.5435	55.3924	49.5474	44.5794	50.9448	53.2064	59.8242	67.2968	70.6498 ((72)
Total internal gains	609.5211	604.8454	581.1898	544.3802	506.4998	472.6499	452.9050	461.6813	482.8954	519.9290	561.1309	592.4889 ((73)

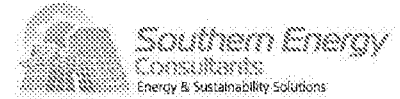
[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W		
North					11.8500	10.6334	0.7200	0.7000	0.7700	44.0103		
South					6.4200	46.7521	0.7200	0.7000	0.7700	104.8334 (74)		
Solar gains	148.8436	255.7959	361.6191	476.7419	566.8173	578.9336	551.2749	480.4209	400.2926	285.3009	178.5556	129.2748 (83)
Total gains	758.3647	860.6413	942.8089	1021.1221	1073.3171	1051.5835	1004.1799	942.1021	883.1881	805.2299	739.6865	719.7637 (84)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, n _{l,m} (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	24.3649	24.4589	24.5537	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397
alpha	2.6243	2.6306	2.6369	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493
util living area												
	0.9380	0.9137	0.8749	0.8046	0.6968	0.5578	0.4320	0.4720	0.6570	0.8298	0.9138	0.9446 (86)
MIT	18.9292	19.2033	19.6116	20.1095	20.5366	20.8176	20.9325	20.9127	20.7043	20.1625	19.4684	18.8887 (87)
Th 2	19.9682	19.9718	19.9753	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823 (88)
util rest of house												
	0.9294	0.9020	0.8576	0.7767	0.6522	0.4899	0.3436	0.3827	0.5938	0.7994	0.9001	0.9369 (89)
MIT 2	18.0959	18.3657	18.7644	19.2438	19.6340	19.8704	19.9524	19.9413	19.7867	19.3044	18.6375	18.0665 (90)
Living area fraction												
	18.2968	18.5676	18.9686	19.4525	19.8515	20.0987	20.1887	20.1754	20.0079	19.5113	18.8378	18.2647 (91)
MIT												
Temperature adjustment												
adjusted MIT	18.1468	18.4176	18.8186	19.3025	19.7015	19.9487	20.0387	20.0254	19.8579	19.3613	18.6878	18.1147 (93)

Regs Region: England
Elmhurst Energy Systems
SAP2012 Calculator (Design
System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9098	0.8800	0.8342	0.7554	0.6386	0.4875	0.3488	0.3867	0.5852	0.7776	0.8783	0.9185	(94)
Useful gains	689.9600	757.3299	786.4473	771.3602	685.4128	512.6658	350.2175	364.2932	516.8650	626.1247	649.6417	661.0883	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
Month fracti	1499.7027	1458.4197	1323.9379	1109.5946	853.4912	570.5261	366.7890	386.7083	614.1681	934.5304	1236.0250	1484.2253	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating	602.4485	471.1323	399.8931	243.5287	125.0503	0.0000	0.0000	0.0000	0.0000	229.4539	422.1960	612.4139	(98)
Space heating per m2												3106.1167	(98)
											(98) / (4) =	32.6960	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.6000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3428.3849 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	602.4485	471.1323	399.8931	243.5287	125.0503	0.0000	0.0000	0.0000	0.0000	229.4539	422.1960	612.4139	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	664.9542	520.0136	441.3831	268.7955	138.0246	0.0000	0.0000	0.0000	0.0000	253.2603	466.0000	675.9535	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	139.1169	101.8860	77.3465	34.4692	7.0334	0.0000	0.0000	15.0550	37.9197	81.4371	117.0095	138.1610	(64)
Efficiency of water heater	89.9221	89.9573	90.0138	90.1508	90.4066	87.1000	87.1000	87.1000	87.1000	89.6563	89.8168	89.9348	(216)
Fuel for water heating, kWh/month	154.7082	113.2604	85.9274	38.2350	7.7797	0.0000	0.0000	17.2847	43.5358	90.8325	130.2757	153.6236	(219)
Water heating fuel used												835.4631	(219)
Annual totals kWh/year													
Space heating fuel - main system												3428.3849	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEV)Centralised, Database: in-use factor = 1.3000, SFP = 0.2210)													
mechanical ventilation fans (SFP = 0.2210)													64.0348 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													189.0348 (231)
Electricity for lighting (calculated in Appendix L)													394.9758 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.50 * 1080 * 1.00) =										-431.8098		-431.8098	(233)
Wind generation												-3575.5408	(234)
Total delivered energy for all uses												840.5080	(238)

10a. Fuel costs - using Table 12 prices

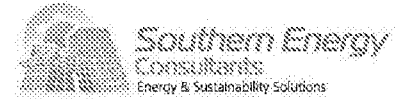
	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3428.3849	3.4800	119.3078	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	835.4631	3.4800	29.0741	(247)
Mechanical ventilation fans	64.0348	13.1900	8.4462	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	394.9758	13.1900	52.0973	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-431.8098	13.1900	-56.9557	(252)
Wind Turbine	-3575.5408	13.1900	-471.6138	(252)
Total energy cost			-183.1566	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	-0.5495 (257)
SAP value		107.6651
SAP rating (Section 12)		108 (258)
SAP band		A

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



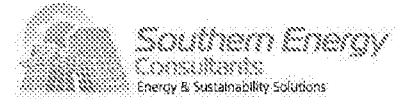
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3428.3849	0.2160	740.5311 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	835.4631	0.2160	180.4600 (264)
Space and water heating			920.9912 (265)
Pumps and fans	189.0348	0.5190	98.1090 (267)
Energy for lighting	394.9758	0.5190	204.9924 (268)
Energy saving/generation technologies			
PV Unit	-431.8098	0.5190	-224.1093 (269)
Wind Turbine	-3575.5408	0.5190	-1855.7056 (269)
Total kg/year			-855.7223 (272)
CO2 emissions per m2			-9.0100 (273)
EI value			108.1905
EI rating			108 (274)
EI band			A

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	47.5000 (1b)	x 2.3500 (2b)	= 111.6250 (1b) - (3b)
First floor	47.5000 (1c)	x 2.6500 (2c)	= 125.8750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	237.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour							
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)							
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)							
Number of intermittent fans					0 * 10 = 0.0000 (7a)							
Number of passive vents					0 * 10 = 0.0000 (7b)							
Number of flueless gas fires					0 * 40 = 0.0000 (7c)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)							
Pressure test					Yes							
Measured/design AP50					5.0000							
Infiltration rate					0.2500 (18)							
Number of sides sheltered					2 (19)							
Shelter factor	(20) = 1 - [0.075 x (19)] =				0.8500 (20)							
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =				0.2125 (21)							
Wind speed	Jan 5.0000	Feb 4.6000	Mar 4.4000	Apr 4.2000	May 4.4000	Jun 3.9000	Jul 4.1000	Aug 3.9000	Sep 4.0000	Oct 4.3000	Nov 4.3000	Dec 4.5000 (22)
Wind factor	1.2500	1.1500	1.1000	1.0500	1.1000	0.9750	1.0250	0.9750	1.0000	1.0750	1.0750	1.1250 (22a)
Adj infilt rate	0.2656	0.2444	0.2338	0.2231	0.2338	0.2072	0.2178	0.2072	0.2125	0.2284	0.2284	0.2391 (22b)
Mechanical extract ventilation - centralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5156	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Opening Type 1			1.9500	1.2000	2.3400		(26)					
Opening Type 2 (Uw = 1.40)			18.2700	1.3258	24.2216		(27)					
Heat Loss Floor 1			47.5000	0.1500	7.1250		(28a)					
External Wall 1	98.5000	20.2200	78.2800	0.2400	18.7872		(29a)					
External Roof 1	47.5000		47.5000	0.1100	5.2250		(30)					
Total net area of external elements Aum(A, m2)			193.5000				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)... (30) + (32) =		57.6988		(33)					
Party Wall 1			42.0000	0.0000	0.0000		(32)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.7797 (36)					
Total fabric heat loss						(33) + (36) =	67.4785 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 40.4121	Feb 39.1875	Mar 39.1875	Apr 39.1875	May 39.1875	Jun 39.1875	Jul 39.1875	Aug 39.1875	Sep 39.1875	Oct 39.1875	Nov 39.1875	Dec 39.1875 (38)
Heat transfer coeff	107.8906	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660	106.6660 (39)
Average = Sum(39)m / 12 =												106.7681 (39)
HLP	Jan 1.1357	Feb 1.1228	Mar 1.1228	Apr 1.1228	May 1.1228	Jun 1.1228	Jul 1.1228	Aug 1.1228	Sep 1.1228	Oct 1.1228	Nov 1.1228	Dec 1.1228 (40)
HLP (average)												1.1239 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6882 (42)
Average daily hot water use (litres/day)												98.0440 (43)
Daily hot water use	Jan 107.8484	Feb 103.9267	Mar 100.0049	Apr 96.0831	May 92.1614	Jun 88.2396	Jul 88.2396	Aug 92.1614	Sep 96.0831	Oct 100.0049	Nov 103.9267	Dec 107.8484 (44)
Energy conte	159.9361	139.8811	144.3448	125.8433	120.7496	104.1977	96.5545	110.7977	112.1210	130.6662	142.6324	154.8896 (45)
Energy content (annual)										Total = Sum(45)m =		1542.6141 (45)
Distribution loss (46)m = 0.15 x (45)m	23.9904	20.9822	21.6517	18.8765	18.1124	15.6297	14.4832	16.6197	16.8182	19.5999	21.3949	23.2334 (46)

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Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	4.2507	3.8394	4.2507	4.1136	4.2507	4.1136	4.2507	4.2507	4.1136	4.2507	4.1136	4.2507 (61)
Total heat required for water heating calculated for each month	164.1868	143.7205	148.5955	129.9569	125.0003	108.3113	100.8053	115.0485	116.2346	134.9170	146.7460	159.1403 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m ²												1299.1191 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2182.5200 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.4148 (H8)
Utilisation factor												0.5068 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												98.0440 (H14)
Volume ratio Veff/V												0.7650 (H15)
Solar storage volume factor												0.9464 (H16)
Solar input												-920.4381 (H17)
Solar input	-30.2972	-42.2372	-71.9109	-99.6376	-119.2610	-125.5415	-123.0108	-107.7098	-84.3656	-57.4172	-34.4618	-24.5876 (63)
								Solar input (sum of months) = Sum(63)m =				-920.4381 (63)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Output from w/h	133.8897	101.4832	76.6847	30.3192	5.7394	0.0000	0.0000	7.3386	31.8690	77.4998	112.2842	134.5527 (64)
								Total per year (kWh/year) = Sum(64)m =				711.6605 (64)
Heat gains from water heating, kWh/month	54.2414	47.4703	49.0573	42.8713	41.2119	35.6742	33.1671	37.9029	38.3086	44.5092	48.4537	52.5635 (65)

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
((66)m	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	161.2901	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.9129	49.6614	40.3873	30.5758	22.8558	19.2958	20.8498	27.1014	36.3754	46.1869	53.9069	57.4669	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	370.1224	373.9631	364.2847	343.6804	317.6711	293.2261	276.8953	273.0546	282.7330	303.3374	329.3466	353.7917	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	53.8172	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	-107.5268	(71)
Water heating gains (Table 5)													
	72.9051	70.6403	65.9373	59.5435	55.3924	49.5474	44.5794	50.9448	53.2064	59.8242	67.2968	70.6498	(72)
Total internal gains	609.5211	604.8454	581.1898	544.3802	506.4998	472.6499	452.9050	461.6813	482.8954	519.9290	561.1309	592.4889	(73)

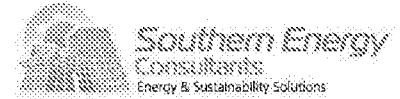
[Jan]				Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				11.8500	14.6401	0.7200	0.7000	0.7700	60.5934 (74)			
South				6.4200	61.3950	0.7200	0.7000	0.7700	137.6676 (78)			
Solar gains	198.2610	285.2397	406.1191	559.7953	649.5939	711.9947	672.6126	584.4020	481.9569	339.0423	228.1504	164.3887 (84)
Total gains	807.7820	890.0851	987.3089	1104.1755	1156.0937	1184.6446	1125.5177	1046.0633	964.8523	858.9713	789.2813	756.8776 (83)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nll,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	24.4589	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397	24.7397
alpha	2.6306	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493	2.6493
util living area												
	0.9179	0.8963	0.8453	0.7508	0.6140	0.4395	0.3112	0.3148	0.5390	0.7573	0.8771	0.9255 (86)
MIT	19.2408	19.4365	19.8506	20.3261	20.7073	20.9153	20.9764	20.9772	20.8532	20.4530	19.8235	19.2315 (87)
Th 2	19.9718	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823	19.9823 (88)
util rest of house												
	0.9062	0.8820	0.8238	0.7163	0.5604	0.3660	0.2224	0.2193	0.4616	0.7135	0.8567	0.9145 (89)
MIT 2	18.4043	18.6007	18.9986	19.4422	19.7780	19.9382	19.9750	19.9758	19.8998	19.5698	18.9812	18.4041 (90)
Living area fraction												
									fLa = Living area / (4) =			0.2411 (91)
MIT	18.6059	18.8021	19.2040	19.6552	20.0020	20.1737	20.2164	20.2172	20.1296	19.7827	19.1843	18.6035 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.4559	18.6521	19.0540	19.5052	19.8520	20.0237	20.0664	20.0672	19.9796	19.6327	19.0343	18.4535 (93)

Regs Region: England
Elmhurst Energy Systems
SAP2012 Calculator (Design
System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8845	0.8592	0.8008	0.6983	0.5530	0.3691	0.2299	0.2275	0.4614	0.6963	0.8336	0.8936	(94)
Useful gains	714.4569	764.7517	790.6236	771.0292	639.3346	437.2975	258.7712	237.9748	445.1393	598.0892	657.9710	676.3720	(95)
Ext temp.	5.5000	5.8000	7.5000	9.9000	12.9000	15.7000	17.6000	17.8000	15.4000	12.2000	8.7000	5.7000	(96)
Heat loss rate W													
	1397.8222	1370.8873	1232.4216	1024.5534	741.5462	461.1972	263.0784	241.8324	488.4916	792.8143	1102.3154	1360.3674	(97)
Month fractl	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	508.4238	407.3231	328.6977	182.5375	76.0454	0.0000	0.0000	0.0000	0.0000	144.8754	319.9279	508.8925	(98)
Space heating													
Space heating per m2												2476.7233	(98)
											(98) / (4) =	26.0708	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)
Fraction of space heat from main system(s)													1.0000	(202)
Efficiency of main space heating system 1 (in %)													90.6000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													2733.6902	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	508.4238	407.3231	328.6977	182.5375	76.0454	0.0000	0.0000	0.0000	0.0000	144.8754	319.9279	508.8925	(98)	
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)	
Space heating fuel (main heating system)	561.1741	449.5840	362.8010	201.4762	83.9353	0.0000	0.0000	0.0000	0.0000	159.9067	353.1213	561.6915	(211)	
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating														
Water heating requirement	133.8897	101.4832	76.6847	30.3192	5.7394	0.0000	0.0000	7.3386	31.8690	77.4998	112.2842	134.5527	(64)	
Efficiency of water heater	89.8474	89.8796	89.9165	90.0844	90.3452	87.1000	87.1000	87.1000	87.1000	89.3487	89.6640	89.8450	(216)	
Fuel for water heating, kWh/month	149.0189	112.9102	85.2843	33.6565	6.3527	0.0000	0.0000	8.4255	36.5890	86.7385	125.2278	149.7608	(219)	
Water heating fuel used														
Annual totals kWh/year													793.9643	(219)
Space heating fuel - main system													2733.6902	(211)
Space heating fuel - secondary													0.0000	(215)
Electricity for pumps and fans:														
(MEV)Centralised, Database: in-use factor = 1.3000, SFP = 0.2210)														
mechanical ventilation fans (SFP = 0.2210)													64.0348	(230a)
central heating pump													30.0000	(230c)
main heating flue fan													45.0000	(230e)
pump for solar water heating													50.0000	(230g)
Total electricity for the above, kWh/year													189.0348	(231)
Electricity for lighting (calculated in Appendix L)													394.9758	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV Unit 0 (0.80 * 0.50 * 1299 * 1.00) =										-519.6476			-519.6476	(233)
Wind generation													-3575.5408	(234)
Total delivered energy for all uses													16.4767	(238)

10a. Fuel costs - using BEDF prices (470)

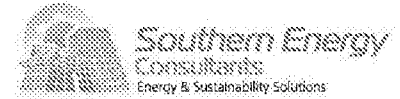
	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2733.6902	3.8700	105.7938	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	793.9643	3.8700	30.7264	(247)
Mechanical ventilation fans	64.0348	18.9000	12.1026	(249)
Pumps and fans for heating	75.0000	18.9000	14.1750	(249)
Pump for solar water heating	50.0000	18.9000	9.4500	(249)
Energy for lighting	394.9758	18.9000	74.6504	(250)
Additional standing charges			93.0000	(251)
Energy saving/generation technologies				
PV Unit	-519.6476	18.9000	-98.2134	(252)
Wind Turbine	-3575.5408	18.9000	-675.7772	(252)
Total energy cost			-434.0924	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2733.6902	0.2160	590.4771	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	793.9643	0.2160	171.4963	(264)
Space and water heating			761.9734	(265)
Pumps and fans	189.0348	0.5190	98.1090	(267)
Energy for lighting	394.9758	0.5190	204.9924	(268)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

Energy saving/generation technologies			
PV Unit	-519.6476	0.5190	-269.6971 (269)
Wind Turbine	-3575.5408	0.5190	-1855.7056 (269)
Total kg/year			-1060.3279 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2733.6902	1.2200	3335.1021 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	793.9643	1.2200	968.6365 (264)
Space and water heating			4303.7385 (265)
Pumps and fans	189.0348	3.0700	580.3367 (267)
Energy for lighting	394.9758	3.0700	1212.5757 (268)
Energy saving/generation technologies			
PV Unit	-519.6476	3.0700	-1595.3182 (269)
Wind Turbine	-3575.5408	3.0700	-10976.9101 (269)
Primary energy kWh/year			-6475.5773 (272)
Primary energy kWh/m2/year			-68.1640 (273)

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

Overheating Calculation Input Data

Dwelling type	EndTerrace House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	South East England
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	627.00 (P1)
Transmission heat loss coefficient	67.48 (37)
Summer heat loss coefficient	694.48 (P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	11.8500	86.6589	0.7200	0.7000	0.9000	419.2247
South	6.4200	118.3991	0.7200	0.7000	0.9000	310.3122
total:						729.5369

	Jun	Jul	Aug	
Solar gains	776	730	639	(P3)
Internal gains	470	450	459	
Total summer gains	1245	1179	1098	(P5)

	1.79	1.70	1.58	(P6)
Summer gain/loss ratio				
Summer external temperature	15.40	17.40	17.50	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	18.49	20.40	20.38	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature: Not significant

FULL SAP CALCULATION PRINTOUT

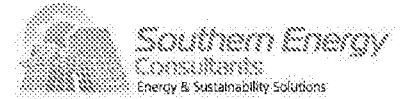
Calculation Type: New Build (As Designed)



Property Reference	SECLID013			Issued on Date	23/01/2021
Assessment Reference	With solar PV	Prop Type Ref	Type C2H4		
Property	Plot 13, Lidsey Road, Woodgate, West Sussex, PO20				
SAP Rating	87 B	DER	13.77	TER	18.00
Environmental	89 B	% DER<TER	23.51		
CO ₂ Emissions (t/year)	0.81	DFEE	45.19	TFEE	50.29
General Requirements Compliance	Pass	% DFEE<TFEE	10.14		
Assessor Details	Mr. Stephen Smith, Southern Energy Consultants Limited, Tel: 01635261582, info@southernenergyconsultants.co.uk			Assessor ID	d168-0001
Client	Thakeham Homes, THA001				

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

DWELLING AS DESIGNED

Semi-Detached House, total floor area 79 m²

This report covers items included within the SAP calculations.
It is not a complete report of regulations compliance.

1a TER and DER

Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.00 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.77 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)50.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.2 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.38 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

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

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoTEC exclusive 835 VUW 356/5-7 (H-GB)
Combi boiler
Efficiency: 89.7% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system:

None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls:

No cylinder

Boiler interlock

Yes

OK

7 Low energy lights

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

8 Mechanical ventilation

Continuous extract system
Specific fan power: 0.17
Maximum 0.7 OK

9 Summertime temperature

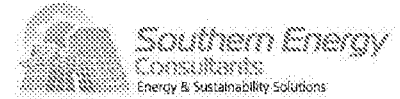
Overheating risk (South East England): Slight OK
Based on:
Overshading: Average
Windows facing North: 6.42 m², No overhang
Windows facing South: 11.85 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Photovoltaic array 0.50 kW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	39.5000 (1b)	x 2.3500 (2b)	= 92.8250 (1b) - (3b)
First floor	39.5000 (1c)	x 2.6500 (2c)	= 104.6750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	197.5000 (5)

2. Ventilation rate

					main heating	secondary heating	other		total	m3 per hour			
Number of chimneys					0	+	0	+	0	=	0 * 40 =	0.0000 (6a)	
Number of open flues					0	+	0	+	0	=	0 * 20 =	0.0000 (6b)	
Number of intermittent fans											0 * 10 =	0.0000 (7a)	
Number of passive vents											0 * 10 =	0.0000 (7b)	
Number of flueless gas fires											0 * 40 =	0.0000 (7c)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =											Air changes per hour		
Pressure test											0.0000 / (5) =		0.0000 (8)
Measured/design AP50											Yes		
Infiltration rate											5.0000		
Number of sides sheltered											0.2500 (18)		
											2 (19)		
Shelter factor											(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =		0.2125 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)	
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)	
	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497 (22b)	
Mechanical extract ventilation - centralised													
If mechanical ventilation:													0.5000 (23a)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)	

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Opening Type 1			1.9500	1.2000	2.3400			(26)				
Opening Type 2 (Uw = 1.40)			18.2700	1.3258	24.2216			(27)				
Heat Loss Floor 1			39.5000	0.1500	5.9250			(28a)				
External Wall 1	90.5000	20.2200	70.2800	0.2400	16.8672			(29a)				
External Roof 1	39.5000		39.5000	0.1100	4.3450			(30)				
Total net area of external elements Aum(A, m2)			169.5000					(31)				
Fabric heat loss, W/K = Sum (A x U)			(26)... (30) + (32) =		53.6988			(33)				
Party Wall 1			42.0000	0.0000	0.0000			(32)				
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								100.0000 (35)				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								9.7797 (36)				
Total fabric heat loss						(33) + (36) =		63.4785 (37)				
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 33.9521	Feb 33.6059	Mar 33.2596	Apr 32.5875	May 32.5875	Jun 32.5875	Jul 32.5875	Aug 32.5875	Sep 32.5875	Oct 32.5875	Nov 32.5875	Dec 32.5875 (38)
Heat transfer coeff	97.4306	97.0844	96.7381	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660 (39)
Average = Sum(39)m / 12 =												96.3206 (39)
HLP	Jan 1.2333	Feb 1.2289	Mar 1.2245	Apr 1.2160	May 1.2160	Jun 1.2160	Jul 1.2160	Aug 1.2160	Sep 1.2160	Oct 1.2160	Nov 1.2160	Dec 1.2160 (40)
HLP (average)												1.2192 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4436 (42)
Average daily hot water use (litres/day)												92.2358 (43)
Daily hot water use	Jan 101.4594	Feb 97.7700	Mar 94.0805	Apr 90.3911	May 86.7017	Jun 83.0122	Jul 83.0122	Aug 86.7017	Sep 90.3911	Oct 94.0805	Nov 97.7700	Dec 101.4594 (44)
Energy conte	150.4613	131.5945	135.7937	118.3882	113.5963	98.0250	90.8346	104.2340	105.4789	122.9255	134.1828	145.7138 (45)
Energy content (annual)										Total = Sum(45)m =		1451.2285 (45)
Distribution loss (46)m = 0.15 x (45)m	22.5692	19.7392	20.3691	17.7582	17.0394	14.7037	13.6252	15.6351	15.8218	18.4388	20.1274	21.8571 (46)

Southern Energy
Consultants
Energy & Sustainability Solutions

Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	4.2507	3.8394	4.2507	4.1136	4.2507	4.1136	4.2507	4.2507	4.1136	4.2507	4.1136	4.2507 (61)
Total heat required for water heating calculated for each month												
	154.7121	135.4338	140.0444	122.5018	117.8470	102.1386	95.0853	108.4847	109.5925	127.1762	138.2964	149.9645 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
	Solar input (sum of months) = Sum(63)m =											0.0000 (63)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Output from w/h	154.7121	135.4338	140.0444	122.5018	117.8470	102.1386	95.0853	108.4847	109.5925	127.1762	138.2964	149.9645 (64)
	Total per year (kWh/year) = Sum(64)m =											1501.2773 (64)
Heat gains from water heating, kWh/month												
	51.0911	44.7150	46.2141	40.3925	38.8335	33.6217	31.2652	35.7205	36.1001	41.9354	45.6442	49.5125 (65)

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.3758	17.2094	13.9957	10.5956	7.9203	6.6867	7.2252	9.3916	12.6054	16.0054	18.6807	19.9143 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	217.3379	219.5931	213.9099	201.8109	186.5382	172.1839	162.5944	160.3391	166.0223	178.1213	193.3941	207.7483 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445 (71)
Water heating gains (Table 5)	68.6708	66.5402	62.1157	56.1007	52.1955	46.6968	42.0231	48.0114	50.1391	56.3648	63.3947	66.5491 (72)
Total internal gains	368.0387	365.9969	352.6754	331.1614	309.3082	288.2216	274.4969	280.3963	291.4210	313.1457	338.1236	356.8659 (73)

[Jan	Area				Solar flux	g	FF	Access		Gains		
	m ²				Table 6a	or Table 6b	or Table 6c	factor		W		
					W/m ²			Table 6d				
North	6.4200				10.6334	0.7200	0.7000	0.7700		23.8435 (74)		
South	11.8500				46.7521	0.7200	0.7000	0.7700		193.5009 (78)		
Solar gains	217.3444	362.4708	481.1083	580.6157	642.9738	636.8966	614.4969	566.9948	514.7853	396.0519	258.7786	187.0797 (83)
Total gains	585.3831	728.4677	833.7838	911.7771	952.2820	925.1182	888.9937	847.3911	806.2063	709.1976	596.9022	543.9457 (84)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	22.5231	22.6035	22.6844	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431
alpha	2.5015	2.5069	2.5123	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229
util living area												
	0.9489	0.9154	0.8692	0.7968	0.6929	0.5604	0.4342	0.4678	0.6432	0.8257	0.9230	0.9564 (86)
MIT	18.6446	19.0272	19.5053	20.0362	20.4837	20.7868	20.9190	20.8994	20.6809	20.0857	19.2658	18.5820 (87)
Th 2	19.8935	19.8969	19.9004	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072 (88)
util rest of house												
	0.9414	0.9034	0.8505	0.7670	0.6458	0.4884	0.3398	0.3733	0.5761	0.7934	0.9099	0.9499 (89)
MIT 2	17.7653	18.1406	18.6060	19.1155	19.5238	19.7789	19.8726	19.8616	19.7007	19.1744	18.3879	17.7134 (90)
Living area fraction									fLA = Living area / (4) =			0.2899 (91)
MIT	18.0201	18.3976	18.8667	19.3824	19.8020	20.0711	20.1759	20.1625	19.9848	19.4386	18.6423	17.9652 (92)
temperature adjustment												-0.1500
adjusted MIT	17.8701	18.2476	18.7167	19.2324	19.6520	19.9211	20.0259	20.0125	19.8348	19.2866	18.4923	17.8152 (93)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9230	0.8809	0.8264	0.7458	0.6337	0.4894	0.3506	0.3830	0.5712	0.7718	0.8883	0.9331 (94)
Useful gains	540.2865	641.6793	689.0640	680.0480	603.4355	452.7368	311.6929	324.5156	460.5271	547.3307	530.2340	507.5577 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1322.1481	1295.8464	1181.8181	992.5900	763.9201	511.1765	329.1151	347.0342	550.9224	834.6775	1094.4176	1307.9588 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	581.7051	439.6003	366.6090	225.0302	119.4005	0.0000	0.0000	0.0000	0.0000	213.7860	406.2122	595.4984 (98)
Space heating												2947.8419 (98)
Space heating per m2										(98) / (4) =		37.3145 (99)

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.6000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3253.6886 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	581.7051	439.6003	366.6090	225.0302	119.4005	0.0000	0.0000	0.0000	0.0000	213.7860	406.2122	595.4984	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	642.0586	485.2100	404.6457	248.3777	131.7887	0.0000	0.0000	0.0000	0.0000	235.9669	448.3579	657.2830	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	154.7121	135.4338	140.0444	122.5018	117.8470	102.1386	95.0853	108.4847	109.5925	127.1762	138.2964	149.9645	(64)
Efficiency of water heater (217)m	89.8415	89.7506	89.6047	89.3346	88.8270	87.1000	87.1000	87.1000	87.1000	89.2621	89.6847	87.1000	(216)
Fuel for water heating, kWh/month	172.2055	150.9002	156.2913	137.1269	132.6703	117.2659	109.1679	124.5519	125.8237	142.4750	154.2029	166.8618	(219)
Water heating fuel used												1689.5433	(219)
Annual totals kWh/year													
Space heating fuel - main system												3253.6886	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEV)Centralised, Database: in-use factor = 1.3000, SFP = 0.2210)													
mechanical ventilation fans (SFP = 0.2210)													53.2500 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													128.2500 (231)
Electricity for lighting (calculated in Appendix L)													342.1832 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.50 * 1080 * 1.00) =													-431.8098 (233)
Total delivered energy for all uses													4981.8552 (238)

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

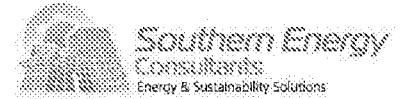
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3253.6886	0.2160	702.7967 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1689.5433	0.2160	364.9414 (264)
Space and water heating			1067.7381 (265)
Pumps and fans	128.2500	0.5190	66.5617 (267)
Energy for lighting	342.1832	0.5190	177.5931 (268)
Energy saving/generation technologies			
PV Unit	-431.8098	0.5190	-224.1093 (269)
Total CO2, kg/year			1087.7836 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.7700 (273)

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

DER			13.7700 ZC1
Total Floor Area		TFA	79.0000
Assumed number of occupants		N	2.4436
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			16.3025 ZC2
CO2 emissions from cooking, equation (L16)			2.2487 ZC3
Total CO2 emissions			32.3212 ZC4
Residual CO2 emissions offset from biofuel CHP			0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year			0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000 ZC7
Net CO2 emissions			32.3212 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	39.5000 (1b)	x 2.3500 (2b)	= 92.8250 (1b) - (3b)
First floor	39.5000 (1c)	x 2.6500 (2c)	= 104.6750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	197.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1519 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4019 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3416 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4356	0.4270	0.4185	0.3758	0.3672	0.3245	0.3245	0.3160	0.3416	0.3672	0.3843	0.4014 (22b)
Effective ac	0.5949	0.5912	0.5876	0.5706	0.5674	0.5527	0.5527	0.5499	0.5584	0.5674	0.5738	0.5806 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			1.9500	1.0000	1.9500		(26)					
TER Opening Type (Uw = 1.40)			17.7900	1.3258	23.5852		(27)					
Heat Loss Floor 1			39.5000	0.1300	5.1350		(28a)					
External Wall 1	90.5000	19.7400	70.7600	0.1800	12.7368		(29a)					
External Roof 1	39.5000		39.5000	0.1300	5.1350		(30)					
Total net area of external elements Aum(A, m2)			169.5000				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)... (30) + (32) =	48.5420		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.9719 (36)					
Total fabric heat loss						(33) + (36) =	58.5139 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 38.7697	Feb 38.5296	Mar 38.2943	Apr 37.1891	May 36.9823	Jun 36.0197	Jul 36.0197	Aug 35.8414	Sep 36.3905	Oct 36.9823	Nov 37.4006	Dec 37.8380 (38)
Heat transfer coeff	97.2836	97.0436	96.8082	95.7030	95.4962	94.5336	94.5336	94.3553	94.9044	95.4962	95.9146	96.3519 (39)
Average = Sum(39)m / 12 =												95.7020 (39)
HLP	Jan 1.2314	Feb 1.2284	Mar 1.2254	Apr 1.2114	May 1.2088	Jun 1.1966	Jul 1.1966	Aug 1.1944	Sep 1.2013	Oct 1.2088	Nov 1.2141	Dec 1.2196 (40)
HLP (average)												1.2114 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4436 (42)
Average daily hot water use (litres/day)												92.2358 (43)
Daily hot water use	Jan 101.4594	Feb 97.7700	Mar 94.0805	Apr 90.3911	May 86.7017	Jun 83.0122	Jul 83.0122	Aug 86.7017	Sep 90.3911	Oct 94.0805	Nov 97.7700	Dec 101.4594 (44)
Energy conte	150.4613	131.5945	135.7937	118.3882	113.5963	98.0250	90.8346	104.2340	105.4789	122.9255	134.1828	145.7138 (45)
Energy content (annual)										Total = Sum(45)m =		1451.2285 (45)
Distribution loss (46)m = 0.15 x (45)m												
	22.5692	19.7392	20.3691	17.7582	17.0394	14.7037	13.6252	15.6351	15.8218	18.4388	20.1274	21.8571 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												

Regs Region: England

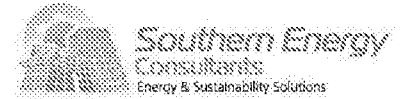
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Total heat required for water heating calculated for each month	50.9589	45.0010	47.9424	44.5764	44.1822	40.9375	42.3021	44.1822	44.5764	47.9424	48.2153	50.9589 (61)
Solar input	201.4203	176.5954	183.7361	162.9647	157.7785	138.9625	133.1367	148.4162	150.0553	170.8679	182.3981	196.6727 (62)
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Heat gains from water heating, kWh/month	201.4203	176.5954	183.7361	162.9647	157.7785	138.9625	133.1367	148.4162	150.0553	170.8679	182.3981	196.6727 (64)
	62.7681	55.0054	57.1370	50.5082	48.8163	42.8277	40.7780	45.7034	46.2158	52.8583	56.6696	61.1896 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.3729	17.2069	13.9936	10.5940	7.9192	6.6857	7.2241	9.3902	12.6035	16.0030	18.6779	19.9114	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	217.3379	219.5931	213.9099	201.8109	186.5382	172.1839	162.5944	160.3391	166.0223	178.1213	193.3941	207.7483	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	(71)
Water heating gains (Table 5)	84.3658	81.8533	76.7970	70.1503	65.6133	59.4829	54.8092	61.4292	64.1887	71.0461	78.7078	82.2440	(72)
Total internal gains	383.7307	381.3075	367.3547	345.2094	322.7249	301.0067	287.2819	293.8127	305.4687	327.8246	353.4339	372.5579	(73)

6. Solar gains

[Jan]				Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				6.2500	10.6334	0.6300		0.7000		0.7700		20.3106
South				11.5400	46.7521	0.6300		0.7000		0.7700		164.8840 (78)

Solar gains	185.1946	308.8521	409.9354	494.7135	547.8374	542.6556	523.5719	483.1046	438.6276	337.4645	220.4995	159.4069 (83)
Total gains	568.9253	690.1596	777.2901	839.9229	870.5623	843.6623	810.8538	776.9173	744.0962	665.2892	573.9335	531.9648 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.3930	56.5325	56.6699	57.3243	57.4485	58.0335	58.0335	58.1431	57.8067	57.4485	57.1979	56.9383	
alpha	4.7595	4.7688	4.7780	4.8216	4.8299	4.8689	4.8689	4.8762	4.8538	4.8299	4.8132	4.7959	
util living area	0.9956	0.9886	0.9726	0.9310	0.8366	0.6703	0.5031	0.5438	0.7722	0.9472	0.9901	0.9968	(86)
MIT	19.7604	19.9684	20.2404	20.5579	20.8121	20.9534	20.9906	20.9863	20.9055	20.5731	20.1011	19.7222	(87)
Th 2	19.8949	19.8973	19.8997	19.9109	19.9130	19.9227	19.9227	19.9245	19.9189	19.9130	19.9087	19.9043	(88)
util rest of house	0.9941	0.9848	0.9634	0.9073	0.7826	0.5760	0.3850	0.4241	0.6876	0.9240	0.9862	0.9957	(89)
MIT 2	18.2623	18.5657	18.9579	19.4085	19.7355	19.8930	19.9194	19.9192	19.8490	19.4399	18.7684	18.2134	(90)
Living area fraction	18.6966	18.9723	19.3297	19.7417	20.0476	20.2004	20.2299	20.2286	20.1552	19.7683	19.1547	18.6507	(92)
Temperature adjustment	18.6966	18.9723	19.3297	19.7417	20.0476	20.2004	20.2299	20.2286	20.1552	19.7683	19.1547	18.6507	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	564.2590	676.7202	744.0941	758.3249	687.7944	507.6072	340.1210	356.5744	526.7796	612.1690	563.8328	528.6957	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1400.5491	1365.6265	1242.0160	1037.5805	797.1602	529.4214	343.1477	361.2445	574.6675	875.5419	1156.2236	1392.3558	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	622.1999	462.9450	370.4538	201.0640	81.3682	0.0000	0.0000	0.0000	0.0000	195.9495	426.5214	642.5631	(98)
Space heating												3003.0650	(98)
Space heating per m ²												38.0135	(99)

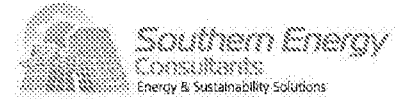
8c. Space cooling requirement

Not applicable

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

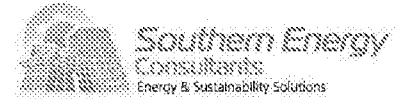
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3215.2730 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	622.1999	462.9450	370.4538	201.0640	81.3682	0.0000	0.0000	0.0000	0.0000	195.9495	426.5214	642.5631	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	666.1669	495.6585	396.6315	215.2720	87.1180	0.0000	0.0000	0.0000	0.0000	209.7960	456.6610	687.9691	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	201.4203	176.5954	183.7361	162.9647	157.7785	138.9625	133.1367	148.4162	150.0553	170.8679	182.3981	196.6727	(64)
Efficiency of water heater (217)m	87.7023	87.3657	86.7812	85.5812	83.4731	80.3000	80.3000	80.3000	80.3000	85.3967	87.1177	87.8117	(217)
Fuel for water heating, kWh/month	229.6636	202.1336	211.7234	190.4212	189.0171	173.0542	165.7991	184.8272	186.8684	200.0872	209.3696	223.9710	(219)
Water heating fuel used												2366.9356	(219)
Annual totals kWh/year													
Space heating fuel - main system												3215.2730	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												342.1318	(232)
Total delivered energy for all uses												5999.3404	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3215.2730	0.2160	694.4990 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2366.9356	0.2160	511.2581 (264)
Space and water heating			1205.7570 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	342.1318	0.5190	177.5664 (268)
Total CO2, kg/m2/year			1422.2485 (272)
Emissions per m2 for space and water heating			15.2627 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.2477 (272b)
Emissions per m2 for pumps and fans			0.4927 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.2627 * 1.00) + 2.2477 + 0.4927, rounded to 2 d.p.			18.0000 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	39.5000 (1b)	x 2.3500 (2b)	= 92.8250 (1b) - (3b)
First floor	39.5000 (1c)	x 2.6500 (2c)	= 104.6750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 197.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1519 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4019 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3416 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4356	0.4270	0.4185	0.3758	0.3672	0.3245	0.3245	0.3160	0.3416	0.3672	0.3843	0.4014 (22b)
Effective ac	0.5949	0.5912	0.5876	0.5706	0.5674	0.5527	0.5527	0.5499	0.5584	0.5674	0.5738	0.5806 (25)

3. Heat losses and heat loss parameter

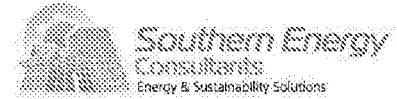
Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			1.9500	1.2000	2.3400		(26)
Opening Type 2 (Uw = 1.40)			18.2700	1.3258	24.2216		(27)
Heat Loss Floor 1			39.5000	0.1500	5.9250		(28a)
External Wall 1	90.5000	20.2200	70.2800	0.2400	16.8672		(29a)
External Roof 1	39.5000		39.5000	0.1100	4.3450		(30)
Total net area of external elements Aum(A, m ²)			169.5000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.6988		(33)
Party Wall 1			42.0000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.7797 (36)
Total fabric heat loss						(33) + (36) =	63.4785 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	38.7697	38.5296	38.2943	37.1891	36.9823	36.0197	36.0197
Heat transfer coeff	102.2482	102.0082	101.7729	100.6676	100.4608	99.4982	99.4982
Average = Sum(39)m / 12 =							
HLP	1.2943	1.2912	1.2883	1.2743	1.2717	1.2595	1.2595
HLP (average)							
Days in month	31	28	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4436 (42)
Average daily hot water use (litres/day)												92.2358 (43)
Daily hot water use	101.4594	97.7700	94.0805	90.3911	86.7017	83.0122	83.0122	86.7017	90.3911	94.0805	97.7700	101.4594 (44)
Energy conte	150.4613	131.5945	135.7937	118.3882	113.5963	98.0250	90.8346	104.2340	105.4789	122.9255	134.1828	145.7138 (45)
Energy content (annual)												Total = Sum(45)m = 1451.2285 (45)
Distribution loss (46)m = 0.15 x (45)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	31.9730	27.9638	28.8562	25.1575	24.1392	20.8303	19.3023	22.1497	22.4143	26.1217	28.5138	30.9642 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.3758	17.2094	13.9957	10.5956	7.9203	6.6867	7.2252	9.3916	12.6054	16.0054	18.6807	19.9143	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	217.3379	219.5931	213.9099	201.8109	186.5382	172.1839	162.5944	160.3391	166.0223	178.1213	193.3941	207.7483	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	(71)
Water heating gains (Table 5)	42.9745	41.6128	38.7852	34.9410	32.4452	28.9310	25.9440	29.7711	31.1309	35.1098	39.6025	41.6185	(72)
Total internal gains	339.3424	338.0696	326.3449	307.0017	286.5579	267.4558	255.4178	259.1560	269.4128	288.8907	311.3315	328.9354	(73)

6. Solar gains

[Jan]				Area	Solar flux	g		FF			Access			Gains	
				m2	Table 6a	or Table 6b		Specific data	Specific data			factor			W
					W/m2			or Table 6c	or Table 6c			Table 6d			
North				6.4200	10.6334			0.7200	0.7000			0.7700			23.8435 (74)
South				11.8500	46.7521			0.7200	0.7000			0.7700			193.5009 (78)
Solar gains	217.3444	362.4708	481.1083	580.6157	642.9738	636.8966	614.4969	566.9948	514.7853	396.0519	258.7786	187.0797			(83)
Total gains	556.6868	700.5404	807.4532	887.6174	929.5317	904.3524	869.9147	826.1508	784.1982	684.9426	570.1101	516.0151			(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil/m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.4619	21.5124	21.5622	21.7989	21.8438	22.0551	22.0551	22.0947	21.9732	21.8438	21.7532	21.6593	
alpha	2.4308	2.4342	2.4375	2.4533	2.4563	2.4703	2.4703	2.4730	2.4649	2.4563	2.4502	2.4440	
util living area	0.9548	0.9238	0.8809	0.8123	0.7125	0.5797	0.4528	0.4875	0.6641	0.8410	0.9315	0.9617	(86)
MIT	18.4671	18.8545	19.3503	19.9222	20.4097	20.7549	20.9043	20.8820	20.6339	19.9827	19.1129	18.3926	(87)
Th 2	19.8453	19.8477	19.8500	19.8610	19.8631	19.8727	19.8727	19.8745	19.8690	19.8631	19.8589	19.8546	(88)
util rest of house	0.9479	0.9125	0.8630	0.7830	0.6649	0.5054	0.3529	0.3882	0.5958	0.8097	0.9194	0.9557	(89)
MIT 2	17.5583	17.9386	18.4217	18.9755	19.4248	19.7254	19.8322	19.8214	19.6321	19.0472	18.2062	17.4914	(90)
Living area fraction									fLA = Living area / (4) =			0.2899	(91)
MIT	17.8218	18.2041	18.6909	19.2499	19.7103	20.0238	20.1430	20.1288	19.9225	19.3184	18.4690	17.7527	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8218	18.2041	18.6909	19.2499	19.7103	20.0238	20.1430	20.1288	19.9225	19.3184	18.4690	17.7527	(93)

8. Space heating requirement

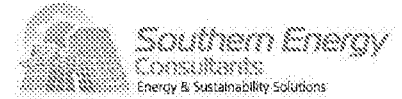
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9315	0.8921	0.8412	0.7649	0.6579	0.5161	0.3782	0.4120	0.5994	0.7919	0.9003	0.9409	(94)
Useful gains	518.5730	624.9687	679.1913	678.9000	611.5121	466.7148	328.9820	340.4061	470.0224	542.3764	513.2972	485.5087	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1382.5774	1357.1230	1240.6981	1041.9009	804.7214	539.6622	352.5188	370.3452	581.4844	875.8538	1146.8999	1373.1092	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	642.8193	492.0077	417.7611	261.3607	143.7477	0.0000	0.0000	0.0000	0.0000	248.1072	456.1939	660.3747	(98)
Space heating												3322.3723	(98)
Space heating per m2										(98) / (4) =		42.0553	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	935.2831	736.2867	754.8316	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7806	0.8382	0.8195	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	730.0411	617.1728	618.5641	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1148.0408	1105.9058	1056.2609	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	300.9597	363.6174	325.6464	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												990.2235	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

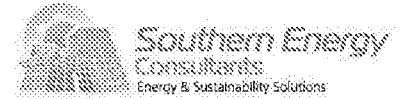


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction	FC = cooled area / (4) =										1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	75.2399	90.9043	81.4116	0.0000	0.0000	0.0000 (107)
Space cooling											247.5559 (107)
Space cooling per m2											3.1336 (108)
Energy for space heating											42.0553 (99)
Energy for space cooling											3.1336 (108)
Total											45.1890 (109)
Dwelling Fabric Energy Efficiency (DFEE)											45.2 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	39.5000 (1b)	x 2.3500 (2b)	= 92.8250 (1b) - (3b)
First floor	39.5000 (1c)	x 2.6500 (2c)	= 104.6750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	197.5000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1519 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4019 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3416 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4356	0.4270	0.4185	0.3758	0.3672	0.3245	0.3245	0.3160	0.3416	0.3672	0.3843	0.4014 (22b)
Effective ac	0.5949	0.5912	0.5876	0.5706	0.5674	0.5527	0.5527	0.5499	0.5584	0.5674	0.5738	0.5806 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			1.9500	1.0000	1.9500		(26)					
TER Opening Type (Uw = 1.40)			17.7900	1.3258	23.5852		(27)					
Heat Loss Floor 1			39.5000	0.1300	5.1350		(28a)					
External Wall 1	90.5000	19.7400	70.7600	0.1800	12.7368		(29a)					
External Roof 1	39.5000		39.5000	0.1300	5.1350		(30)					
Total net area of external elements Aum(A, m2)			169.5000				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)... (30) + (32) =	48.5420		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.9719 (36)					
Total fabric heat loss						(33) + (36) =	58.5139 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 38.7697	Feb 38.5296	Mar 38.2943	Apr 37.1891	May 36.9823	Jun 36.0197	Jul 36.0197	Aug 35.8414	Sep 36.3905	Oct 36.9823	Nov 37.4006	Dec 37.8380 (38)
Heat transfer coeff	97.2836	97.0436	96.8082	95.7030	95.4962	94.5336	94.5336	94.3553	94.9044	95.4962	95.9146	96.3519 (39)
Average = Sum(39)m / 12 =												95.7020 (39)
HLP	Jan 1.2314	Feb 1.2284	Mar 1.2254	Apr 1.2114	May 1.2088	Jun 1.1966	Jul 1.1966	Aug 1.1944	Sep 1.2013	Oct 1.2088	Nov 1.2141	Dec 1.2196 (40)
HLP (average)												1.2114 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4436 (42)
Average daily hot water use (litres/day)												92.2358 (43)
Daily hot water use	Jan 101.4594	Feb 97.7700	Mar 94.0805	Apr 90.3911	May 86.7017	Jun 83.0122	Jul 83.0122	Aug 86.7017	Sep 90.3911	Oct 94.0805	Nov 97.7700	Dec 101.4594 (44)
Energy conte	150.4613	131.5945	135.7937	118.3882	113.5963	98.0250	90.8346	104.2340	105.4789	122.9255	134.1828	145.7138 (45)
Energy content (annual)										Total = Sum(45)m =		1451.2285 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												

Regs Region: England

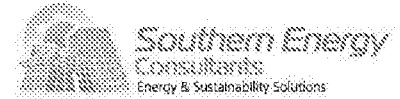
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Heat gains from water heating, kWh/month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
	31.9730	27.9638	28.8562	25.1575	24.1392	20.8303	19.3023	22.1497	22.4143	26.1217	28.5138	30.9642 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	122.1807	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.3729	17.2069	13.9936	10.5940	7.9192	6.6857	7.2241	9.3902	12.6035	16.0030	18.6779	19.9114	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	217.3379	219.5931	213.9099	201.8109	186.5382	172.1839	162.5944	160.3391	166.0223	178.1213	193.3941	207.7483	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	35.2181	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	(71)
Water heating gains (Table 5)	42.9745	41.6128	38.7852	34.9410	32.4452	28.9310	25.9440	29.7711	31.1309	35.1098	39.6025	41.6185	(72)
Total internal gains	339.3395	338.0670	326.3428	307.0001	286.5567	267.4548	255.4167	259.1546	269.4109	288.8883	311.3287	328.9324	(73)

6. Solar gains

[Jan]													
				Area m2	Solar flux Table 6a W/m2			g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d			Gains W
North				6.2500	10.6334			0.6300	0.7000	0.7700			20.3106 (74)
South				11.5400	46.7521			0.6300	0.7000	0.7700			164.8840 (78)
Solar gains	185.1946	308.8521	409.9354	494.7135	547.8374	542.6556	523.5719	483.1046	438.6276	337.4645	220.4995	159.4069	(83)
Total gains	524.5341	646.9192	736.2782	801.7136	834.3941	810.1104	778.9887	742.2592	708.0385	626.3528	531.8282	488.3393	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
tau	56.3930	56.5325	56.6699	57.3243	57.4485	58.0335	58.0335	58.1431	57.8067	57.4485	57.1979	56.9383		
alpha	4.7595	4.7688	4.7780	4.8216	4.8299	4.8689	4.8689	4.8762	4.8538	4.8299	4.8132	4.7959		
util living area	0.9969	0.9912	0.9777	0.9408	0.8533	0.6912	0.5219	0.5662	0.7953	0.9572	0.9928	0.9978	(86)	
MIT	19.7094	19.9203	20.1980	20.5253	20.7928	20.9468	20.9890	20.9838	20.8919	20.5371	20.0538	19.6718	(87)	
Th 2	19.8949	19.8973	19.8997	19.9109	19.9130	19.9227	19.9227	19.9245	19.9189	19.9130	19.9087	19.9043	(88)	
util rest of house	0.9958	0.9883	0.9700	0.9196	0.8019	0.5965	0.4003	0.4431	0.7129	0.9375	0.9898	0.9970	(89)	
MIT 2	18.7296	18.9409	19.2160	19.5388	19.7774	19.8991	19.9200	19.9202	19.8631	19.5576	19.0837	18.6996	(90)	
Living area fraction									fLA = Living area / (4) =			0.2899	(91)	
MIT	19.0136	19.2248	19.5007	19.8247	20.0717	20.2028	20.2299	20.2285	20.1613	19.8415	19.3649	18.9814	(92)	
Temperature adjustment												0.0000		
adjusted MIT	19.0136	19.2248	19.5007	19.8247	20.0717	20.2028	20.2299	20.2285	20.1613	19.8415	19.3649	18.9814	(93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9947	0.9859	0.9665	0.9176	0.8103	0.6226	0.4359	0.4791	0.7334	0.9359	0.9879	0.9961	(94)
Useful gains	521.7299	637.7996	711.5805	735.6698	676.1004	504.4108	339.5713	355.6202	519.2872	586.2076	525.3817	486.4432	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1431.3935	1390.1272	1258.5710	1045.5303	799.4695	529.6568	343.1460	361.2364	575.2433	882.5288	1176.3809	1424.2139	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	676.7898	505.5641	406.9609	223.0996	91.7866	0.0000	0.0000	0.0000	0.0000	220.4629	468.7194	697.7014	(98)
Space heating												3291.0847	(98)
Space heating per m2										(98) / (4) =		41.6593	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	888.6159	699.5487	717.1006	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8871	0.9398	0.9251	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	788.2700	657.4295	663.4197	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1037.8865	999.6272	958.2040	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	179.7239	254.5951	219.3195	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													653.6386 (104)
Cooled fraction									fC = cooled area / (4) =				1.0000 (105)

Regs Region: England

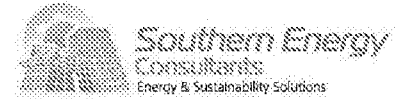
Elmhurst Energy Systems

SAP2012 Calculator (Design

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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

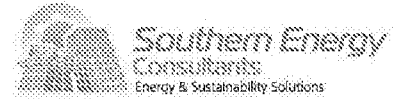


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	44.9310	63.6488	54.8299	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												163.4096	(107)
Space cooling per m2												2.0685	(108)
Energy for space heating												41.6593	(99)
Energy for space cooling												2.0685	(108)
Total												43.7278	(109)
Target Fabric Energy Efficiency (TFEE)												50.3	(109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Calculation of Heat Demand 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	39.5000 (1b)	x 2.3500 (2b)	= 92.8250 (1b) - (3b)
First floor	39.5000 (1c)	x 2.6500 (2c)	= 104.6750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	197.5000 (5)

2. Ventilation rate

					main heating	secondary heating	other		total	m3 per hour			
Number of chimneys					0	+	0	+	0	=	0 * 40 =	0.0000 (6a)	
Number of open flues					0	+	0	+	0	=	0 * 20 =	0.0000 (6b)	
Number of intermittent fans											0 * 10 =	0.0000 (7a)	
Number of passive vents											0 * 10 =	0.0000 (7b)	
Number of flueless gas fires											0 * 40 =	0.0000 (7c)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =											Air changes per hour		
Pressure test											0.0000 / (5) =		0.0000 (8)
Measured/design AP50											Yes		
Infiltration rate											5.0000		
Number of sides sheltered											0.2500 (18)		
											2 (19)		
Shelter factor											(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =		0.2125 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	5.0000	4.6000	4.4000	4.2000	4.4000	3.9000	4.1000	3.9000	4.0000	4.3000	4.3000	4.5000 (22)	
Adj infilt rate	1.2500	1.1500	1.1000	1.0500	1.1000	0.9750	1.0250	0.9750	1.0000	1.0750	1.0750	1.1250 (22a)	
	0.2656	0.2444	0.2338	0.2231	0.2338	0.2072	0.2178	0.2072	0.2125	0.2284	0.2284	0.2391 (22b)	
Mechanical extract ventilation - centralised													
If mechanical ventilation:													0.5000 (23a)
Effective ac	0.5156	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)	

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			1.9500	1.2000	2.3400		(26)
Opening Type 2 (Uw = 1.40)			18.2700	1.3258	24.2216		(27)
Heat Loss Floor 1			39.5000	0.1500	5.9250		(28a)
External Wall 1	90.5000	20.2200	70.2800	0.2400	16.8672		(29a)
External Roof 1	39.5000		39.5000	0.1100	4.3450		(30)
Total net area of external elements Aum(A, m ²)			169.5000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	53.6988			(33)
Party Wall 1			42.0000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.7797 (36)
Total fabric heat loss						(33) + (36) =	63.4785 (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	33.6059	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875 (38)
Heat transfer coeff	97.0844	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660 (39)
Average = Sum(39)m / 12 =												96.1509 (39)
HLP	1.2289	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160 (40)
HLP (average)												1.2171 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4436 (42)
Average daily hot water use (litres/day)												92.2358 (43)
Daily hot water use	101.4594	97.7700	94.0805	90.3911	86.7017	83.0122	83.0122	86.7017	90.3911	94.0805	97.7700	101.4594 (44)
Energy conte	150.4613	131.5945	135.7937	118.3882	113.5963	98.0250	90.8346	104.2340	105.4789	122.9255	134.1828	145.7138 (45)
Energy content (annual)										Total = Sum(45)m =		1451.2285 (45)
Distribution loss (46)m = 0.15 x (45)m	22.5692	19.7392	20.3691	17.7582	17.0394	14.7037	13.6252	15.6351	15.8218	18.4388	20.1274	21.8571 (46)

Regs Region: England

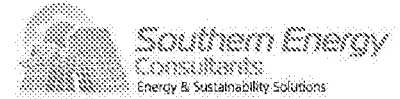
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	4.2507	3.8394	4.2507	4.1136	4.2507	4.1136	4.2507	4.2507	4.1136	4.2507	4.1136	4.2507	(61)
Total heat required for water heating calculated for each month	154.7121	135.4338	140.0444	122.5018	117.8470	102.1386	95.0853	108.4847	109.5925	127.1762	138.2964	149.9645	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64)
Output from w/h	154.7121	135.4338	140.0444	122.5018	117.8470	102.1386	95.0853	108.4847	109.5925	127.1762	138.2964	149.9645	(64)
RHI water heating demand													(64)
Heat gains from water heating, kWh/month	51.0911	44.7150	46.2141	40.3925	38.8335	33.6217	31.2652	35.7205	36.1001	41.9354	45.6442	49.5125	(65)
												1501	(64)
													(64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.4396	43.0236	34.9891	26.4890	19.8009	16.7167	18.0630	23.4790	31.5134	40.0135	46.7017	49.7859	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	324.3849	327.7510	319.2685	301.2103	278.4152	256.9909	242.6782	239.3121	247.7945	265.8527	288.6479	310.0721	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	(71)
Water heating gains (Table 5)	68.6708	66.5402	62.1157	56.1007	52.1955	46.6968	42.0231	48.0114	50.1391	56.3648	63.3947	66.5491	(72)
Total internal gains	545.4728	541.2923	520.3509	487.7776	454.3891	424.3820	406.7418	414.7800	433.4246	466.2086	502.7218	530.3846	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					6.4200	14.6401	0.7200	0.7000	0.7700		32.8278	
South					11.8500	61.3950	0.7200	0.7000	0.7700		254.1060 (74)	
Solar gains	286.9338	398.9165	530.1005	667.0634	722.5578	769.7183	736.0206	675.1727	607.0133	463.4255	327.3405	239.7463 (83)
Total gains	832.4066	940.2087	1050.4514	1154.8410	1176.9469	1194.1003	1142.7625	1089.9527	1040.4379	929.6341	830.0624	770.1309 (84)

7. Mean internal temperature (heating season)

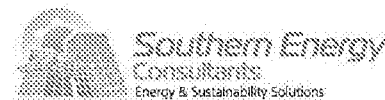
Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)														
tau	22.6035	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	
alpha	2.5069	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	
util living area	0.8842	0.8512	0.7869	0.6871	0.5583	0.3964	0.2771	0.2736	0.4646	0.6814	0.8285	0.8961	0.8961	(86)
MIT	19.3077	19.5409	19.9603	20.3966	20.7325	20.9209	20.9778	20.9797	20.8794	20.5314	19.9080	19.2762	19.2762	(87)
Th 2	19.8969	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	(88)
util rest of house	0.8683	0.8319	0.7598	0.6479	0.5024	0.3236	0.1915	0.1836	0.3883	0.6309	0.8020	0.8813	0.8813	(89)
MIT 2	18.4112	18.6402	19.0366	19.4360	19.7263	19.8679	19.9009	19.9020	19.8431	19.5669	18.9986	18.3903	18.3903	(90)
Living area fraction	18.6711	18.9013	19.3043	19.7145	20.0180	20.1731	20.2131	20.2144	20.1435	19.8465	19.2622	18.6471	18.6471	(92)
Temperature adjustment	18.5211	18.7513	19.1543	19.5645	19.8680	20.0231	20.0631	20.0644	19.9935	19.6965	19.1122	-0.1500	-0.1500	(93)
adjusted MIT												18.4971	18.4971	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.8442	0.8079	0.7386	0.6345	0.5003	0.3316	0.2040	0.1968	0.3946	0.6201	0.7793	0.8578	(94)
Ext temp.	702.7078	759.5746	775.8374	732.7609	588.8349	395.9768	233.0720	214.5345	410.5910	576.5125	646.8823	660.6494	(95)
Heat loss rate W	5.5000	5.8000	7.5000	9.9000	12.9000	15.7000	17.6000	17.8000	15.4000	12.2000	8.7000	5.7000	(96)
Month fracti	1264.1418	1244.1784	1119.5850	928.4290	669.3867	415.3066	236.6166	217.5309	441.2777	720.1593	1000.2621	1229.3686	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
RHI space heating demand	417.7069	325.6538	255.7482	140.8810	59.9305	0.0000	0.0000	0.0000	0.0000	106.8732	254.4334	423.1270	(98)
												1984.3541	(98)
												1984	(98)

FULL SAP CALCULATION PRINTOUT

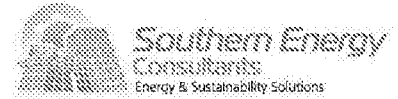
Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	39.5000 (1b)	x 2.3500 (2b)	= 92.8250 (1b) - (3b)
First floor	39.5000 (1c)	x 2.6500 (2c)	= 104.6750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	197.5000 (5)

2. Ventilation rate

					main heating	secondary heating	other		total	m3 per hour		
Number of chimneys					0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues					0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans											0 * 10 =	0.0000 (7a)
Number of passive vents											0 * 10 =	0.0000 (7b)
Number of flueless gas fires											0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =											0.0000 / (5) =	0.0000 (8)
Pressure test											Yes	
Measured/design AP50											5.0000	
Infiltration rate											0.2500 (18)	
Number of sides sheltered											2 (19)	
Shelter factor											(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =	0.2125 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497 (22b)
Mechanical extract ventilation - centralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			1.9500	1.2000	2.3400		(26)
Opening Type 2 (Uw = 1.40)			18.2700	1.3258	24.2216		(27)
Heat Loss Floor 1			39.5000	0.1500	5.9250		(28a)
External Wall 1	90.5000	20.2200	70.2800	0.2400	16.8672		(29a)
External Roof 1	39.5000		39.5000	0.1100	4.3450		(30)
Total net area of external elements Aum(A, m ²)			169.5000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	53.6988			(33)
Party Wall 1			42.0000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.7797 (36)
Total fabric heat loss						(33) + (36) =	63.4785 (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	33.9521	33.6059	33.2596	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875 (38)
Heat transfer coeff	97.4306	97.0844	96.7381	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660 (39)
Average = Sum(39)m / 12 =												96.3206 (39)
HLP	1.2333	1.2289	1.2245	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160 (40)
HLP (average)												1.2192 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4436 (42)
Average daily hot water use (litres/day)												92.2358 (43)
Daily hot water use	101.4594	97.7700	94.0805	90.3911	86.7017	83.0122	83.0122	86.7017	90.3911	94.0805	97.7700	101.4594 (44)
Energy conte	150.4613	131.5945	135.7937	118.3882	113.5963	98.0250	90.8346	104.2340	105.4789	122.9255	134.1828	145.7138 (45)
Energy content (annual)										Total = Sum(45)m =		1451.2285 (45)
Distribution loss (46)m = 0.15 x (45)m	22.5692	19.7392	20.3691	17.7582	17.0394	14.7037	13.6252	15.6351	15.8218	18.4388	20.1274	21.8571 (46)

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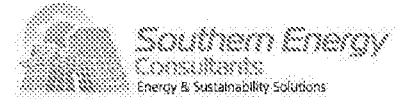
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	4.2507	3.8394	4.2507	4.1136	4.2507	4.1136	4.2507	4.2507	4.1136	4.2507	4.1136	4.2507 (61)
Total heat required for water heating calculated for each month												
	154.7121	135.4338	140.0444	122.5018	117.8470	102.1386	95.0853	108.4847	109.5925	127.1762	138.2964	149.9645 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	Solar input (sum of months) = Sum(63)m =			0.0000 (63)	
Output from w/h	154.7121	135.4338	140.0444	122.5018	117.8470	102.1386	95.0853	108.4847	109.5925	127.1762	138.2964	149.9645 (64)
Total per year (kWh/year) = Sum(64)m =												1501.2773 (64)
Heat gains from water heating, kWh/month												
	51.0911	44.7150	46.2141	40.3925	38.8335	33.6217	31.2652	35.7205	36.1001	41.9354	45.6442	49.5125 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.4396	43.0236	34.9891	26.4890	19.8009	16.7167	18.0630	23.4790	31.5134	40.0135	46.7017	49.7859	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	324.3849	327.7510	319.2685	301.2103	278.4152	256.9909	242.6782	239.3121	247.7945	265.8527	288.6479	310.0721	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	(71)
Water heating gains (Table 5)	68.6708	66.5402	62.1157	56.1007	52.1955	46.6968	42.0231	48.0114	50.1391	56.3648	63.3947	66.5491	(72)
Total internal gains	545.4728	541.2923	520.3509	487.7776	454.3891	424.3820	406.7418	414.7800	433.4246	466.2086	502.7218	530.3846	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W
North				6.4200	10.6334	0.7200	0.7000			0.7700			23.8435 (74)
South				11.8500	46.7521	0.7200	0.7000			0.7700			193.5009 (78)
Solar gains	217.3444	362.4708	481.1083	580.6157	642.9738	636.8966	614.4969	566.9948	514.7853	396.0519	258.7786	187.0797	(83)
Total gains	762.8172	903.7631	1001.4592	1068.3933	1097.3629	1061.2786	1021.2387	981.7748	948.2099	862.2605	761.5004	717.4643	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	22.5231	22.6035	22.6844	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	
alpha	2.5015	2.5069	2.5123	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	
util living area	0.9141	0.8749	0.8232	0.7456	0.6394	0.5073	0.3865	0.4150	0.5801	0.7667	0.8791	0.9238	(86)
MIT	18.9563	19.2997	19.7250	20.1914	20.5760	20.8310	20.9381	20.9237	20.7506	20.2527	19.5278	18.8971	(87)
Th 2	19.8935	19.8969	19.9004	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	(88)
util rest of house	0.9024	0.8587	0.8004	0.7124	0.5908	0.4379	0.2997	0.3276	0.5132	0.7290	0.8607	0.9133	(89)
MIT 2	18.0671	18.4003	18.8098	19.2522	19.5974	19.8075	19.8813	19.8735	19.7497	19.3202	18.6361	18.0198	(90)
Living area fraction									FLA = Living area / (4) =			0.2899	(91)
MIT	18.3248	18.6610	19.0751	19.5244	19.8811	20.1042	20.1877	20.1779	20.0398	19.5905	18.8946	18.2741	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1748	18.5110	18.9251	19.3744	19.7311	19.9542	20.0377	20.0279	19.8898	19.4405	18.7446	18.1241	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.8796	0.8343	0.7771	0.6944	0.5823	0.4411	0.3105	0.3378	0.5121	0.7107	0.8369	0.8916	(94)
Useful gains	671.0064	754.0414	778.2730	741.8590	639.0329	468.1206	317.0463	331.5957	485.5563	612.7953	637.3258	639.7068	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1351.8335	1321.4156	1201.9804	1006.2374	771.5156	514.3593	330.2424	348.5195	556.2078	849.2705	1118.6506	1337.6347	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	506.5354	381.2754	315.2383	190.3525	98.5671	0.0000	0.0000	0.0000	0.0000	175.9375	346.5539	519.2583	(98)
Space heating												2533.7184	(98)
Space heating per m2										(98) / (4) =		32.0724	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												90.6000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												2796.5987 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	506.5354	381.2754	315.2383	190.3525	98.5671	0.0000	0.0000	0.0000	0.0000	175.9375	346.5539	519.2583 (98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000 (210)
Space heating fuel (main heating system)	559.0898	420.8338	347.9451	210.1021	108.7937	0.0000	0.0000	0.0000	0.0000	194.1916	382.5098	573.1328 (211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	154.7121	135.4338	140.0444	122.5018	117.8470	102.1386	95.0853	108.4847	109.5925	127.1762	138.2964	149.9645 (64)
Efficiency of water heater (217)m	89.7561	89.6557	89.4938	89.1965	88.6600	87.1000	87.1000	87.1000	87.1000	89.0978	89.5733	87.1000 (216)
Fuel for water heating, kWh/month	172.3694	151.0599	156.4850	137.3392	132.9203	117.2659	109.1679	124.5519	125.8237	142.7377	154.3946	167.0142 (219)
Water heating fuel used												1691.1297 (219)
Annual totals kWh/year												
Space heating fuel - main system												2796.5987 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEV)Centralised, Database: in-use factor = 1.3000, SFP = 0.2210)												
mechanical ventilation fans (SFP = 0.2210)												53.2500 (230a)
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												128.2500 (231)
Electricity for lighting (calculated in Appendix L)												342.1832 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 0.50 * 1080 * 1.00) =												-431.8098 (233)
Total delivered energy for all uses												4526.3517 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2796.5987	3.4800	97.3216 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1691.1297	3.4800	58.8513 (247)
Mechanical ventilation fans	53.2500	13.1900	7.0237 (249)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	342.1832	13.1900	45.1340 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-431.8098	13.1900	-56.9557 (252)
Total energy cost			281.2674 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.9527 (257)
SAP value		86.7101
SAP rating (Section 12)		87 (258)
SAP band		B

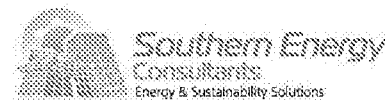
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2796.5987	0.2160	604.0653 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1691.1297	0.2160	365.2840 (264)
Space and water heating			969.3493 (265)
Pumps and fans	128.2500	0.5190	66.5617 (267)
Energy for lighting	342.1832	0.5190	177.5931 (268)
Energy saving/generation technologies			
PV Unit	-431.8098	0.5190	-224.1093 (269)
Total kg/year			989.3948 (272)
CO2 emissions per m2			12.5200 (273)
EI value			89.3082
EI rating			89 (274)
EI band			B

Calculation of stars for heating and DHW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

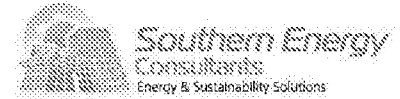


CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9060 = 3.841$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9060 = 0.2384$, stars = 4
Water heating energy efficiency	$3.48 / 0.8864 = 3.926$, stars = 4
Water heating environmental impact	$0.216 / 0.8864 = 0.2437$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	39.5000 (1b)	x 2.3500 (2b)	= 92.8250 (1b) - (3b)
First floor	39.5000 (1c)	x 2.6500 (2c)	= 104.6750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	197.5000 (5)

2. Ventilation rate

					main heating	secondary heating	other		total	m3 per hour		
Number of chimneys					0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues					0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans											0 * 10 =	0.0000 (7a)
Number of passive vents											0 * 10 =	0.0000 (7b)
Number of flueless gas fires											0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =											0.0000 / (5) =	0.0000 (8)
Pressure test											Yes	
Measured/design AP50											5.0000	
Infiltration rate											0.2500 (18)	
Number of sides sheltered											2 (19)	
Shelter factor											(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =	0.2125 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	5.0000	4.6000	4.4000	4.2000	4.4000	3.9000	4.1000	3.9000	4.0000	4.3000	4.3000	4.5000 (22)
Adj infilt rate	1.2500	1.1500	1.1000	1.0500	1.1000	0.9750	1.0250	0.9750	1.0000	1.0750	1.0750	1.1250 (22a)
	0.2656	0.2444	0.2338	0.2231	0.2338	0.2072	0.2178	0.2072	0.2125	0.2284	0.2284	0.2391 (22b)
Mechanical extract ventilation - centralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5156	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			1.9500	1.2000	2.3400		(26)
Opening Type 2 (Uw = 1.40)			18.2700	1.3258	24.2216		(27)
Heat Loss Floor 1			39.5000	0.1500	5.9250		(28a)
External Wall 1	90.5000	20.2200	70.2800	0.2400	16.8672		(29a)
External Roof 1	39.5000		39.5000	0.1100	4.3450		(30)
Total net area of external elements Aum(A, m ²)			169.5000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	53.6988			(33)
Party Wall 1			42.0000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.7797 (36)
Total fabric heat loss						(33) + (36) =	63.4785 (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	33.6059	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875 (38)
Heat transfer coeff	97.0844	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660 (39)
Average = Sum(39)m / 12 =												96.1509 (39)
HLP	1.2289	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160 (40)
HLP (average)												1.2171 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4436 (42)
Average daily hot water use (litres/day)												92.2358 (43)
Daily hot water use	101.4594	97.7700	94.0805	90.3911	86.7017	83.0122	83.0122	86.7017	90.3911	94.0805	97.7700	101.4594 (44)
Energy conte	150.4613	131.5945	135.7937	118.3882	113.5963	98.0250	90.8346	104.2340	105.4789	122.9255	134.1828	145.7138 (45)
Energy content (annual)										Total = Sum(45)m =		1451.2285 (45)
Distribution loss (46)m = 0.15 x (45)m	22.5692	19.7392	20.3691	17.7582	17.0394	14.7037	13.6252	15.6351	15.8218	18.4388	20.1274	21.8571 (46)

Regs Region: England

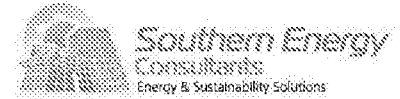
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Calculation of EPC Costs, Emissions and Primary Energy 09 Jan 2014

Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	4.2507	3.8394	4.2507	4.1136	4.2507	4.1136	4.2507	4.2507	4.1136	4.2507	4.1136	4.2507	(61)
Total heat required for water heating calculated for each month	154.7121	135.4338	140.0444	122.5018	117.8470	102.1386	95.0853	108.4847	109.5925	127.1762	138.2964	149.9645	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Output from w/h	154.7121	135.4338	140.0444	122.5018	117.8470	102.1386	95.0853	108.4847	109.5925	127.1762	138.2964	149.9645	(64)
Heat gains from water heating, kWh/month	51.0911	44.7150	46.2141	40.3925	38.8335	33.6217	31.2652	35.7205	36.1001	41.9354	45.6442	49.5125	(65)
													(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.4396	43.0236	34.9891	26.4890	19.8009	16.7167	18.0630	23.4790	31.5134	40.0135	46.7017	49.7859	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	324.3849	327.7510	319.2685	301.2103	278.4152	256.9909	242.6782	239.3121	247.7945	265.8527	288.6479	310.0721	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	(71)
Water heating gains (Table 5)	68.6708	66.5402	62.1157	56.1007	52.1955	46.6968	42.0231	48.0114	50.1391	56.3648	63.3947	66.5491	(72)
Total internal gains	545.4728	541.2923	520.3509	487.7776	454.3891	424.3820	406.7418	414.7800	433.4246	466.2086	502.7218	530.3846	(73)

6. Solar gains

[Jan]						Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North						6.4200	14.6401	0.7200	0.7000	0.7700	32.8278
South						11.8500	61.3950	0.7200	0.7000	0.7700	254.1060 (74)
Solar gains	286.9338	398.9165	530.1005	667.0634	722.5578	769.7183	736.0206	675.1727	607.0133	463.4255	327.3405
Total gains	832.4066	940.2087	1050.4514	1154.8410	1176.9469	1194.1003	1142.7625	1089.9527	1040.4379	929.6341	830.0624
											239.7463 (83)
											770.1309 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
tau	22.6035	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431		
alpha	2.5069	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229		
util living area	0.8842	0.8512	0.7869	0.6871	0.5583	0.3964	0.2771	0.2736	0.4646	0.6814	0.8285	0.8961	(86)	
MIT	19.3077	19.5409	19.9603	20.3966	20.7325	20.9209	20.9778	20.9797	20.8794	20.5314	19.9080	19.2762	(87)	
Th 2	19.8969	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	(88)	
util rest of house	0.8683	0.8319	0.7598	0.6479	0.5024	0.3236	0.1915	0.1836	0.3883	0.6309	0.8020	0.8813	(89)	
MIT 2	18.4112	18.6402	19.0366	19.4360	19.7263	19.8679	19.9009	19.9020	19.8431	19.5669	18.9986	18.3903	(90)	
Living area fraction									fLA = Living area / (4) =			0.2899	(91)	
MIT	18.6711	18.9013	19.3043	19.7145	20.0180	20.1731	20.2131	20.2144	20.1435	19.8465	19.2622	18.6471	(92)	
Temperature adjustment												-0.1500		
adjusted MIT	18.5211	18.7513	19.1543	19.5645	19.8680	20.0231	20.0631	20.0644	19.9935	19.6965	19.1122	18.4971	(93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.8442	0.8079	0.7386	0.6345	0.5003	0.3316	0.2040	0.1968	0.3946	0.6201	0.7793	0.8578	(94)
Useful gains	702.7078	759.5746	775.8374	732.7609	588.8349	395.9768	233.0720	214.5345	410.5910	576.5125	646.8823	660.6494	(95)
Ext temp.	5.5000	5.8000	7.5000	9.9000	12.9000	15.7000	17.6000	17.8000	15.4000	12.2000	8.7000	5.7000	(96)
Heat loss rate W	1264.1418	1244.1784	1119.5850	928.4290	669.3867	415.3066	236.6166	217.5309	441.2777	720.1593	1000.2621	1229.3686	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	417.7069	325.6538	255.7482	140.8810	59.9305	0.0000	0.0000	0.0000	0.0000	106.8732	254.4334	423.1270	(98)
Space heating												1984.3541	(98)
Space heating per m2										(98) / (4) =		25.1184	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.6000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2190.2363 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	417.7069	325.6538	255.7482	140.8810	59.9305	0.0000	0.0000	0.0000	0.0000	106.8732	254.4334	423.1270	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	461.0451	359.4413	282.2828	155.4978	66.1485	0.0000	0.0000	0.0000	0.0000	117.9616	280.8316	467.0276	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	154.7121	135.4338	140.0444	122.5018	117.8470	102.1386	95.0853	108.4847	109.5925	127.1762	138.2964	149.9645	(64)
Efficiency of water heater (217)m	89.6266	89.5431	89.3299	88.9378	88.2493	87.1000	87.1000	87.1000	87.1000	88.6640	89.3359	87.1000	(216)
Fuel for water heating, kWh/month	172.6185	151.2498	156.7722	137.7388	133.5388	117.2659	109.1679	124.5519	125.8237	143.4360	154.8050	167.2642	(219)
Water heating fuel used												1694.2329	(219)
Annual totals kWh/year													
Space heating fuel - main system												2190.2363	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEV)Centralised, Database: in-use factor = 1.3000, SFP = 0.2210)													
mechanical ventilation fans (SFP = 0.2210)													53.2500 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
Total electricity for the above, kWh/year													128.2500 (231)
Electricity for lighting (calculated in Appendix L)													342.1832 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.50 * 1299 * 1.00) =													-519.6476 (233)
Total delivered energy for all uses													3835.2547 (238)

10a. Fuel costs - using BEDF prices (470)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2190.2363	3.8700	84.7621 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1694.2329	3.8700	65.5668 (247)
Mechanical ventilation fans	53.2500	18.9000	10.0642 (249)
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)
Energy for lighting	342.1832	18.9000	64.6726 (250)
Additional standing charges			93.0000 (251)
Energy saving/generation technologies			
PV Unit	-519.6476	18.9000	-98.2134 (252)
Total energy cost			234.0274 (255)

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

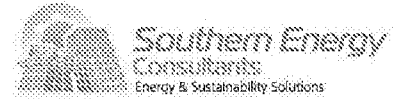
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2190.2363	0.2160	473.0910 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1694.2329	0.2160	365.9543 (264)
Space and water heating			839.0453 (265)
Pumps and fans	128.2500	0.5190	66.5617 (267)
Energy for lighting	342.1832	0.5190	177.5931 (268)
Energy saving/generation technologies			
PV Unit	-519.6476	0.5190	-269.6971 (269)
Total kg/year			813.5030 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2190.2363	1.2200	2672.0883 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1694.2329	1.2200	2066.9641 (264)
Space and water heating			4739.0524 (265)
Pumps and fans	128.2500	3.0700	393.7273 (267)
Energy for lighting	342.1832	3.0700	1050.5024 (268)
Energy saving/generation technologies			
PV Unit	-519.6476	3.0700	-1595.3182 (269)
Primary energy kWh/year			4587.9639 (272)
Primary energy kWh/m2/year			58.0755 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 EPC IMPROVEMENTS

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

(For testing purposes):			
A			Not considered
B			Not considered
C			Not considered
D			Not considered
E	Low energy lighting		Already installed
F			Not considered
G			Not considered
H			Not considered
I			Not considered
J			Not considered
K			Not considered
M			Not considered
N	Solar water heating		Recommended
O			Not considered
P			Not considered
R			Not considered
S			Not considered
T			Not considered
U	Solar photovoltaic panels		Already installed
A2			Not considered
A3			Not considered
T2			Not considered
W			Not considered
X			Not considered
Y			Not considered
J2			Not considered
Q2			Not considered
Z1			Not considered
Z2			Not considered
Z3			Not considered
Z4			Not considered
Z5			Not considered
V2	Wind turbine		Recommended
L2			Not considered
Q3			Not considered
O3			Not considered
Recommended measures:			
N	Solar water heating	SAP change + 1.2	Cost change -£ 28
V2	Wind turbine	SAP change + 22.3	Cost change -£ 676
		CO2 change	-183 kg (22.5%)
			-1856 kg (294.2%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£28	2.31 kg/m²	B 88 B 91
Wind turbine	£676	23.49 kg/m²	A 110 A 111
Total Savings	£704	25.80 kg/m²	

Potential energy efficiency rating: A 110
Potential environmental impact rating: A 111

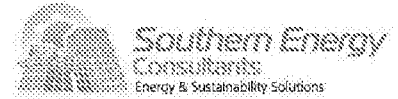
Fuel prices for cost data on this page from database revision number 470 TEST (21 Dec 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£89	£98	-£9
Mains gas	£243	£206	£37
Space heating	£202	£202	£0
Water heating	£66	£38	£28
Lighting	£65	£65	£0
Generated (PV)	-£98	-£98	£0
Generated (wind)	-£0	-£676	£676
Total cost of fuels	£234	-£470	£704
Total cost of uses	£235	-£469	£704
Delivered energy	49 kWh/m²	-8 kWh/m²	57 kWh/m²
Carbon dioxide emissions	0.8 tonnes	-1.2 tonnes	2.0 tonnes
CO2 emissions per m²	10 kg/m²	-16 kg/m²	26 kg/m²
Primary energy	58 kWh/m²	-94 kWh/m²	152 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	39.5000 (1b)	x 2.3500 (2b)	= 92.8250 (1b) - (3b)
First floor	39.5000 (1c)	x 2.6500 (2c)	= 104.6750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	197.5000 (5)

2. Ventilation rate

					main heating	secondary heating	other		total	m3 per hour		
Number of chimneys					0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues					0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans											0 * 10 =	0.0000 (7a)
Number of passive vents											0 * 10 =	0.0000 (7b)
Number of flueless gas fires											0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =											0.0000 / (5) =	0.0000 (8)
Pressure test											Yes	
Measured/design AP50											5.0000	
Infiltration rate											0.2500 (18)	
Number of sides sheltered											2 (19)	
Shelter factor											(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =	0.2125 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497 (22b)
Mechanical extract ventilation - centralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			1.9500	1.2000	2.3400		(26)
Opening Type 2 (Uw = 1.40)			18.2700	1.3258	24.2216		(27)
Heat Loss Floor 1			39.5000	0.1500	5.9250		(28a)
External Wall 1	90.5000	20.2200	70.2800	0.2400	16.8672		(29a)
External Roof 1	39.5000		39.5000	0.1100	4.3450		(30)
Total net area of external elements Aum(A, m ²)			169.5000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	53.6988			(33)
Party Wall 1			42.0000	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.7797 (36)
Total fabric heat loss						(33) + (36) =	63.4785 (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	33.9521	33.6059	33.2596	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875	32.5875 (38)
Heat transfer coeff	97.4306	97.0844	96.7381	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660 (39)
Average = Sum(39)m / 12 =												96.3206 (39)
HLP	1.2333	1.2289	1.2245	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160	1.2160 (40)
HLP (average)												1.2192 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4436 (42)
Average daily hot water use (litres/day)												92.2358 (43)
Daily hot water use	101.4594	97.7700	94.0805	90.3911	86.7017	83.0122	83.0122	86.7017	90.3911	94.0805	97.7700	101.4594 (44)
Energy conte	150.4613	131.5945	135.7937	118.3882	113.5963	98.0250	90.8346	104.2340	105.4789	122.9255	134.1828	145.7138 (45)
Energy content (annual)										Total = Sum(45)m =		1451.2285 (45)
Distribution loss (46)m = 0.15 x (45)m	22.5692	19.7392	20.3691	17.7582	17.0394	14.7037	13.6252	15.6351	15.8218	18.4388	20.1274	21.8571 (46)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

**Southern Energy
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Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (S6)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (S7)
Combi loss	4.2507	3.8394	4.2507	4.1136	4.2507	4.1136	4.2507	4.2507	4.1136	4.2507	4.1136	4.2507 (G1)
Total heat required for water heating calculated for each month	154.7121	135.4338	140.0444	122.5018	117.8470	102.1386	95.0853	108.4847	109.5925	127.1762	138.2964	149.9645 (H1)
Aperture area of solar collector												3.0000 (G2)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m ²												1079.5246 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1813.6014 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.2497 (H8)
Utilisation factor												0.5508 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												92.2358 (H14)
Volume ratio Veff/V												0.8131 (H15)
Solar storage volume factor												0.9586 (H16)
Solar input												-841.9491 (H17)
Solar input	-24.4148	-40.7414	-69.3872	-92.9925	-114.8844	-112.9497	-111.4570	-97.3806	-76.2685	-52.0824	-28.9595	-20.4311 (G3)
								Solar input (sum of months) = Sum(63)m =				-841.9491 (G3)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Output from w/h	130.2972	94.6925	70.6572	29.5093	2.9626	0.0000	0.0000	11.1042	33.3240	75.0938	109.3368	129.5334 (G4)
								Total per year (kWh/year) = Sum(64)m =				686.5110 (G4)
Heat gains from water heating, kWh/month	51.0911	44.7150	46.2141	40.3925	38.8335	33.6217	31.2652	35.7205	36.1001	41.9354	45.6442	49.5125 (G5)

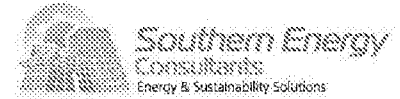
Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
((66)m	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.4396	43.0236	34.9891	26.4890	19.8009	16.7167	18.0630	23.4790	31.5134	40.0135	46.7017	49.7859 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	324.3849	327.7510	319.2685	301.2103	278.4152	256.9909	242.6782	239.3121	247.7945	265.8527	288.6479	310.0721 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445 (71)
Water heating gains (Table 5)	68.6708	66.5402	62.1157	56.1007	52.1955	46.6968	42.0231	48.0114	50.1391	56.3648	63.3947	66.5491 (72)
Total internal gains	545.4728	541.2923	520.3509	487.7776	454.3891	424.3820	406.7418	414.7800	433.4246	466.2086	502.7218	530.3846 (73)

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				6.4200	10.6334	0.7200	0.7000	0.7700	23.8435 (74)			
South				11.8500	46.7521	0.7200	0.7000	0.7700	193.5009 (78)			
Solar gains	217.3444	362.4708	481.1083	580.6157	642.9738	636.8966	614.4969	514.7853	396.0519	258.7786	187.0797 (84)	
Total gains	762.8172	903.7631	1001.4592	1068.3933	1097.3629	1061.2786	1021.2387	981.7748	948.2099	862.2605	761.5004	717.4643 (83)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nll,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	22.5231	22.6035	22.6844	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431
alpha	2.5015	2.5069	2.5123	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229
util living area	0.9141	0.8749	0.8232	0.7456	0.6394	0.5073	0.3865	0.4150	0.5801	0.7667	0.8791	0.9238 (86)
MIT	18.9563	19.2997	19.7250	20.1914	20.5760	20.8310	20.9381	20.9237	20.7506	20.2527	19.5278	18.8971 (87)
Th 2	19.8935	19.8969	19.9004	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072 (88)
util rest of house	0.9024	0.8587	0.8004	0.7124	0.5908	0.4379	0.2997	0.3276	0.5132	0.7290	0.8607	0.9133 (89)
MIT 2	18.0671	18.4003	18.8098	19.2522	19.5974	19.8075	19.8813	19.8735	19.7497	19.3202	18.6361	18.0198 (90)
Living area fraction									fLA = Living area / (4) =			0.2899 (91)
MIT	18.3248	18.6610	19.0751	19.5244	19.8811	20.1042	20.1877	20.1779	20.0398	19.5905	18.8946	18.2741 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1748	18.5110	18.9251	19.3744	19.7311	19.9542	20.0377	20.0279	19.8898	19.4405	18.7446	18.1241 (93)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8796	0.8343	0.7771	0.6944	0.5823	0.4411	0.3105	0.3378	0.5121	0.7107	0.8369	0.8916	(94)
Useful gains	671.0064	754.0414	778.2730	741.8590	639.0329	468.1206	317.0463	331.5957	485.5563	612.7953	637.3258	639.7068	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1351.8335	1321.4156	1201.9804	1006.2374	771.5156	514.3593	330.2424	348.5195	556.2078	849.2705	1118.6506	1337.6347	(97)
Month fractl	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	506.5354	381.2754	315.2383	190.3525	98.5671	0.0000	0.0000	0.0000	0.0000	175.9375	346.5539	519.2583	(98)
Space heating													
Space heating per m2												2533.7184	(98)
										(98) / (4) =		32.0724	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)
Fraction of space heat from main system(s)													1.0000	(202)
Efficiency of main space heating system 1 (in %)													90.6000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													2796.5987	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	506.5354	381.2754	315.2383	190.3525	98.5671	0.0000	0.0000	0.0000	0.0000	175.9375	346.5539	519.2583	(98)	
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)	
Space heating fuel (main heating system)	559.0898	420.8338	347.9451	210.1021	108.7937	0.0000	0.0000	0.0000	0.0000	194.1916	382.5098	573.1328	(211)	
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating														
Water heating requirement	130.2972	94.6925	70.6572	29.5093	2.9626	0.0000	0.0000	11.1042	33.3240	75.0938	109.3368	129.5334	(64)	
Efficiency of water heater	89.8612	89.8814	89.9383	90.1140	90.4939	87.1000	87.1000	87.1000	87.1000	89.5239	89.7352	89.8789	(216)	
(217)m	89.8612	89.8814	89.9383	90.1140	90.4939	87.1000	87.1000	87.1000	87.1000	89.5239	89.7352	89.8789	(217)	
Fuel for water heating, kWh/month	144.9983	105.3526	78.5619	32.7466	3.2738	0.0000	0.0000	12.7487	38.2594	83.8813	121.8439	144.1199	(219)	
Water heating fuel used													765.7866	(219)
Annual totals kWh/year														
Space heating fuel - main system													2796.5987	(211)
Space heating fuel - secondary													0.0000	(215)
Electricity for pumps and fans:														
(MEV)Centralised, Database: in-use factor = 1.3000, SFP = 0.2210)														
mechanical ventilation fans (SFP = 0.2210)													53.2500	(230a)
central heating pump													30.0000	(230c)
main heating flue fan													45.0000	(230e)
pump for solar water heating													50.0000	(230g)
Total electricity for the above, kWh/year													178.2500	(231)
Electricity for lighting (calculated in Appendix L)													342.1832	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV Unit 0 (0.80 * 0.50 * 1080 * 1.00) =										-431.8098			-431.8098	(233)
Wind generation													-3575.5408	(234)
Total delivered energy for all uses													75.4678	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2796.5987	3.4800	97.3216	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	765.7866	3.4800	26.6494	(247)
Mechanical ventilation fans	53.2500	13.1900	7.0237	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	342.1832	13.1900	45.1340	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-431.8098	13.1900	-56.9557	(252)
Wind Turbine	-3575.5408	13.1900	-471.6138	(252)
Total energy cost			-215.9534	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	-0.7315	(257)
SAP value		110.2038	
SAP rating (Section 12)		110	(258)
SAP band		A	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



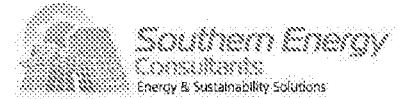
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2796.5987	0.2160	604.0653 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	765.7866	0.2160	165.4099 (264)
Space and water heating			769.4752 (265)
Pumps and fans	178.2500	0.5190	92.5117 (267)
Energy for lighting	342.1832	0.5190	177.5931 (268)
Energy saving/generation technologies			
PV Unit	-431.8098	0.5190	-224.1093 (269)
Wind Turbine	-3575.5408	0.5190	-1855.7056 (269)
Total kg/year			-1040.2349 (272)
CO2 emissions per m2			-13.1700 (273)
EI value			111.2412
EI rating			111 (274)
EI band			A

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	39.5000 (1b)	x 2.3500 (2b)	= 92.8250 (1b) - (3b)
First floor	39.5000 (1c)	x 2.6500 (2c)	= 104.6750 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	79.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 197.5000 (5)

2. Ventilation rate

					main heating	secondary heating	other		total	m3 per hour			
Number of chimneys					0	+	0	+	0	=	0 * 40 =	0.0000 (6a)	
Number of open flues					0	+	0	+	0	=	0 * 20 =	0.0000 (6b)	
Number of intermittent fans											0 * 10 =	0.0000 (7a)	
Number of passive vents											0 * 10 =	0.0000 (7b)	
Number of flueless gas fires											0 * 40 =	0.0000 (7c)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =											Air changes per hour		
Pressure test											0.0000 / (5) =		0.0000 (8)
Measured/design AP50											Yes		
Infiltration rate											5.0000		
Number of sides sheltered											0.2500 (18)		
											2 (19)		
Shelter factor											(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor											(21) = (18) x (20) =		0.2125 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	5.0000	4.6000	4.4000	4.2000	4.4000	3.9000	4.1000	3.9000	4.0000	4.3000	4.3000	4.5000 (22)	
Adj infilt rate	1.2500	1.1500	1.1000	1.0500	1.1000	0.9750	1.0250	0.9750	1.0000	1.0750	1.0750	1.1250 (22a)	
	0.2656	0.2444	0.2338	0.2231	0.2338	0.2072	0.2178	0.2072	0.2125	0.2284	0.2284	0.2391 (22b)	
Mechanical extract ventilation - centralised													
If mechanical ventilation:													0.5000 (23a)
Effective ac	0.5156	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)	

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Opening Type 1			1.9500	1.2000	2.3400			(26)				
Opening Type 2 (Uw = 1.40)			18.2700	1.3258	24.2216			(27)				
Heat Loss Floor 1			39.5000	0.1500	5.9250			(28a)				
External Wall 1	90.5000	20.2200	70.2800	0.2400	16.8672			(29a)				
External Roof 1	39.5000		39.5000	0.1100	4.3450			(30)				
Total net area of external elements Aum(A, m2)			169.5000					(31)				
Fabric heat loss, W/K = Sum (A x U)			(26)... (30) + (32) =		53.6988			(33)				
Party Wall 1			42.0000	0.0000	0.0000			(32)				
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								100.0000 (35)				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								9.7797 (36)				
Total fabric heat loss						(33) + (36) =		63.4785 (37)				
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 33.6059	Feb 32.5875	Mar 32.5875	Apr 32.5875	May 32.5875	Jun 32.5875	Jul 32.5875	Aug 32.5875	Sep 32.5875	Oct 32.5875	Nov 32.5875	Dec 32.5875 (38)
Heat transfer coeff	97.0844	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660	96.0660 (39)
Average = Sum(39)m / 12 =												96.1509 (39)
HLP	Jan 1.2289	Feb 1.2160	Mar 1.2160	Apr 1.2160	May 1.2160	Jun 1.2160	Jul 1.2160	Aug 1.2160	Sep 1.2160	Oct 1.2160	Nov 1.2160	Dec 1.2160 (40)
HLP (average)												1.2171 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.4436 (42)
Average daily hot water use (litres/day)												92.2358 (43)
Daily hot water use	Jan 101.4594	Feb 97.7700	Mar 94.0805	Apr 90.3911	May 86.7017	Jun 83.0122	Jul 83.0122	Aug 86.7017	Sep 90.3911	Oct 94.0805	Nov 97.7700	Dec 101.4594 (44)
Energy conte	150.4613	131.5945	135.7937	118.3882	113.5963	98.0250	90.8346	104.2340	105.4789	122.9255	134.1828	145.7138 (45)
Energy content (annual)										Total = Sum(45)m =		1451.2285 (45)
Distribution loss (46)m = 0.15 x (45)m	22.5692	19.7392	20.3691	17.7582	17.0394	14.7037	13.6252	15.6351	15.8218	18.4388	20.1274	21.8571 (46)

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Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	4.2507	3.8394	4.2507	4.1136	4.2507	4.1136	4.2507	4.2507	4.1136	4.2507	4.1136	4.2507	(61)
Total heat required for water heating calculated for each month	154.7121	135.4338	140.0444	122.5018	117.8470	102.1386	95.0853	108.4847	109.5925	127.1762	138.2964	149.9645	(62)
Aperture area of solar collector													3.0000 (H1)
Zero-loss collector efficiency													0.7000 (H2)
Collector heat loss coefficient													1.8000 (H3)
Collector 2nd order heat loss coefficient													0.0050 (H3a)
Collector effective heat loss coefficient													1.8063 (H3b)
Collector performance ratio													2.5804 (H4)
Annual solar radiation per m2													1299.1191 (H5)
Overshading factor													0.8000 (H6)
Solar energy available													2182.5200 (H7)
Adjustment factor for showers													1.0000 (H7a)
Solar-to-load ratio													1.5039 (H8)
Utilisation factor													0.4857 (H9)
Collector performance factor													0.8793 (H10)
Dedicated solar storage volume													75.0000 (H11)
Effective solar volume													75.0000 (H13)
Daily hot water demand													92.2358 (H14)
Volume ratio Veff/V													0.8131 (H15)
Solar storage volume factor													0.9586 (H16)
Solar input													-893.5171 (H17)
Solar input	-29.4110	-41.0019	-69.8076	-96.7234	-115.7728	-121.8697	-119.4129	-104.5595	-81.8980	-55.7378	-33.4538	-23.8685	(63)
								Solar input (sum of months) = Sum(63)m =					-893.5171 (63)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
Output from w/h	125.3010	94.4319	70.2368	25.7784	2.0742	0.0000	0.0000	3.9252	27.6944	71.4383	104.8425	126.0960	(64)
								Total per year (kWh/year) = Sum(64)m =				651.8189	(64)
Heat gains from water heating, kWh/month	51.0911	44.7150	46.2141	40.3925	38.8335	33.6217	31.2652	35.7205	36.1001	41.9354	45.6442	49.5125	(65)

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
((66)m	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168	146.6168 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.4396	43.0236	34.9891	26.4890	19.8009	16.7167	18.0630	23.4790	31.5134	40.0135	46.7017	49.7859 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	324.3849	327.7510	319.2685	301.2103	278.4152	256.9909	242.6782	239.3121	247.7945	265.8527	288.6479	310.0721 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053	52.1053 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445	-97.7445 (71)
Water heating gains (Table 5)	68.6708	66.5402	62.1157	56.1007	52.1955	46.6968	42.0231	48.0114	50.1391	56.3648	63.3947	66.5491 (72)
Total internal gains	545.4728	541.2923	520.3509	487.7776	454.3891	424.3820	406.7418	414.7800	433.4246	466.2086	502.7218	530.3846 (73)

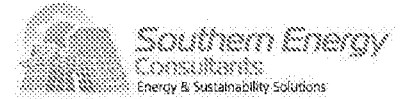
[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				6.4200	14.6401	0.7200	0.7000	0.7700	32.8278 (74)			
South				11.8500	61.3950	0.7200	0.7000	0.7700	254.1060 (78)			
Solar gains	286.9338	398.9165	530.1005	667.0634	722.5578	769.7183	736.0206	675.1727	607.0133	463.4255	327.3405	239.7463 (84)
Total gains	832.4066	940.2087	1050.4514	1154.8410	1176.9469	1194.1003	1142.7625	1089.9527	1040.4379	929.6341	830.0624	770.1309 (83)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nll,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	22.6035	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431	22.8431
alpha	2.5069	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229	2.5229
util living area	0.8842	0.8512	0.7869	0.6871	0.5583	0.3964	0.2771	0.2736	0.4646	0.6814	0.8285	0.8961 (86)
MIT	19.3077	19.5409	19.9603	20.3966	20.7325	20.9209	20.9778	20.9797	20.8794	20.5314	19.9080	19.2762 (87)
Th 2	19.8969	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072	19.9072 (88)
util rest of house	0.8683	0.8319	0.7598	0.6479	0.5024	0.3236	0.1915	0.1836	0.3883	0.6309	0.8020	0.8813 (89)
MIT 2	18.4112	18.6402	19.0366	19.4360	19.7263	19.8679	19.9009	19.9020	19.8431	19.5669	18.9986	18.3903 (90)
Living area fraction									fLa = Living area / (4) =			0.2899 (91)
MIT	18.6711	18.9013	19.3043	19.7145	20.0180	20.1731	20.2131	20.2144	20.1435	19.8465	19.2622	18.6471 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.5211	18.7513	19.1543	19.5645	19.8680	20.0231	20.0631	20.0644	19.9935	19.6965	19.1122	18.4971 (93)

Regs Region: England
Elmhurst Energy Systems
SAP2012 Calculator (Design
System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8442	0.8079	0.7386	0.6345	0.5003	0.3316	0.2040	0.1968	0.3946	0.6201	0.7793	0.8578	(94)
Useful gains	702.7078	759.5746	775.8374	732.7609	588.8349	395.9768	233.0720	214.5345	410.5910	576.5125	646.8823	660.6494	(95)
Ext temp.	5.5000	5.8000	7.5000	9.9000	12.9000	15.7000	17.6000	17.8000	15.4000	12.2000	8.7000	5.7000	(96)
Heat loss rate W	1264.1418	1244.1784	1119.5850	928.4290	669.3867	415.3066	236.6166	217.5309	441.2777	720.1593	1000.2621	1229.3686	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	417.7069	325.6538	255.7482	140.8810	59.9305	0.0000	0.0000	0.0000	0.0000	106.8732	254.4334	423.1270	(98)
Space heating												1984.3541	(98)
Space heating per m2											(98) / (4) =	25.1184	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.6000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2190.2363 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	417.7069	325.6538	255.7482	140.8810	59.9305	0.0000	0.0000	0.0000	0.0000	106.8732	254.4334	423.1270	(98)
Space heating efficiency (main heating system 1)	90.6000	90.6000	90.6000	90.6000	90.6000	0.0000	0.0000	0.0000	0.0000	90.6000	90.6000	90.6000	(210)
Space heating fuel (main heating system)	461.0451	359.4413	282.2828	155.4978	66.1485	0.0000	0.0000	0.0000	0.0000	117.9616	280.8316	467.0276	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	125.3010	94.4319	70.2368	25.7784	2.0742	0.0000	0.0000	3.9252	27.6944	71.4383	104.8425	126.0960	(64)
Efficiency of water heater	89.7676	89.7889	89.8223	90.0404	90.4784	87.1000	87.1000	87.1000	87.1000	89.1645	89.5499	89.7718	(216)
Fuel for water heating, kWh/month	139.5938	105.1710	78.1953	28.6298	2.2925	0.0000	0.0000	4.5065	31.7961	80.1197	117.0772	140.4629	(219)
Water heating fuel used												727.8348	(219)
Annual totals kWh/year													
Space heating fuel - main system												2190.2363	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEV)Centralised, Database: in-use factor = 1.3000, SFP = 0.2210)													
mechanical ventilation fans (SFP = 0.2210)													53.2500 (230a)
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													178.2500 (231)
Electricity for lighting (calculated in Appendix L)													342.1832 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.50 * 1299 * 1.00) =										-519.6476		-519.6476	(233)
Wind generation												-3575.5408	(234)
Total delivered energy for all uses												-656.6841	(238)

10a. Fuel costs - using BEDF prices (470)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2190.2363	3.8700	84.7621	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	727.8348	3.8700	28.1672	(247)
Mechanical ventilation fans	53.2500	18.9000	10.0642	(249)
Pumps and fans for heating	75.0000	18.9000	14.1750	(249)
Pump for solar water heating	50.0000	18.9000	9.4500	(249)
Energy for lighting	342.1832	18.9000	64.6726	(250)
Additional standing charges			93.0000	(251)
Energy saving/generation technologies				
PV Unit	-519.6476	18.9000	-98.2134	(252)
Wind Turbine	-3575.5408	18.9000	-675.7772	(252)
Total energy cost			-469.6994	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2190.2363	0.2160	473.0910	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	727.8348	0.2160	157.2123	(264)
Space and water heating			630.3034	(265)
Pumps and fans	178.2500	0.5190	92.5117	(267)
Energy for lighting	342.1832	0.5190	177.5931	(268)

Regs Region: England

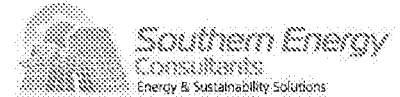
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Energy saving/generation technologies			
PV Unit	-519.6476	0.5190	-269.6971 (269)
Wind Turbine	-3575.5408	0.5190	-1855.7056 (269)
Total kg/year			-1224.9946 (272)

13a. Primary energy - Individual heating systems including micro-CHP

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2190.2363	1.2200	2672.0883 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	727.8348	1.2200	887.9585 (264)
Space and water heating			3560.0468 (265)
Pumps and fans	178.2500	3.0700	547.2273 (267)
Energy for lighting	342.1832	3.0700	1050.5024 (268)
Energy saving/generation technologies			
PV Unit	-519.6476	3.0700	-1595.3182 (269)
Wind Turbine	-3575.5408	3.0700	-10976.9101 (269)
Primary energy kWh/year			-7414.4519 (272)
Primary energy kWh/m2/year			-93.8538 (273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	South East England
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	521.40 (P1)
Transmission heat loss coefficient	63.48 (37)
Summer heat loss coefficient	584.88 (P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	6.4200	86.6589	0.7200	0.7000	0.9000	227.1243
South	11.8500	118.3991	0.7200	0.7000	0.9000	572.7725
total:						799.8968

	Jun	Jul	Aug	
Solar gains	840	800	740	(P3)
Internal gains	421	404	412	
Total summer gains	1262	1204	1152	(P5)
Summer gain/loss ratio	2.16	2.06	1.97	(P6)
Summer external temperature	15.40	17.40	17.50	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	18.86	20.76	20.77	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

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