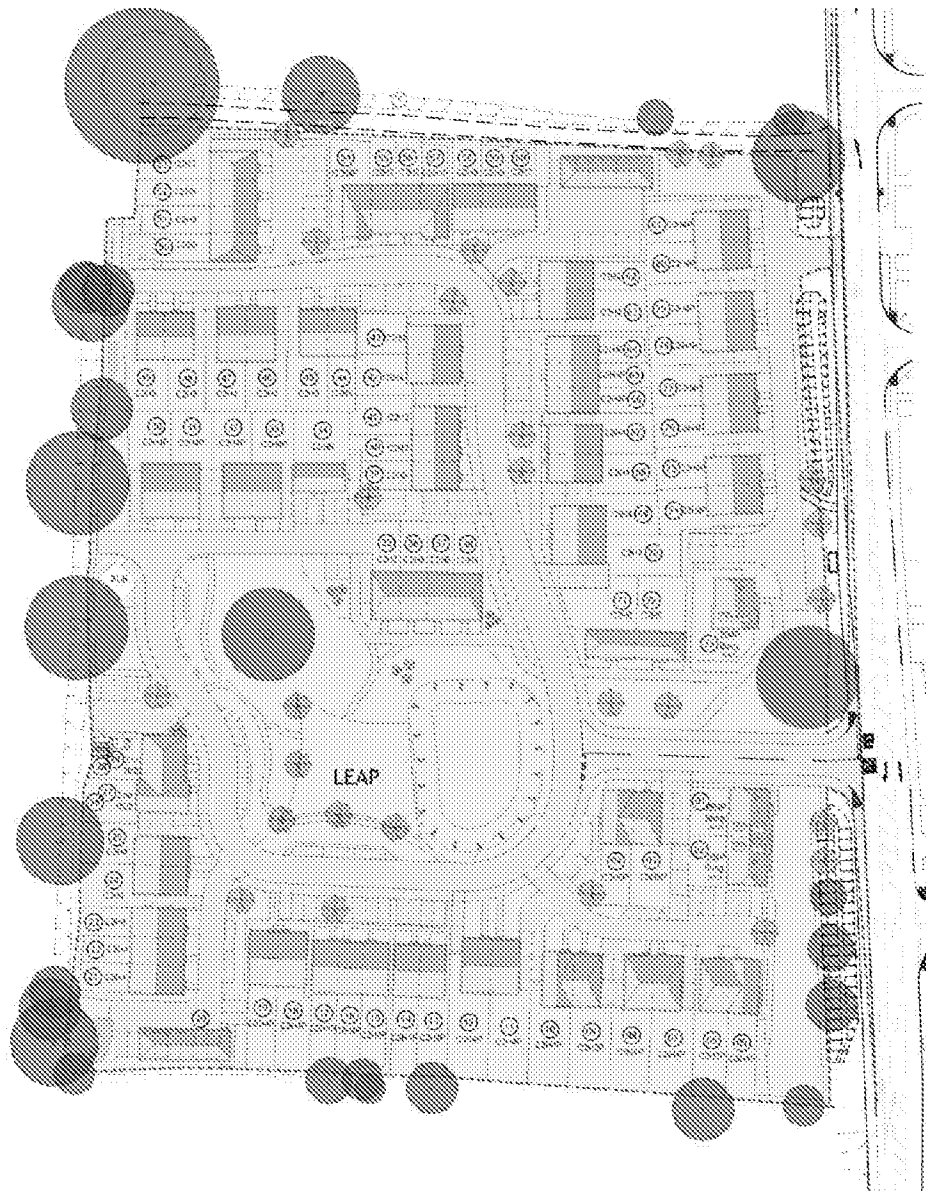




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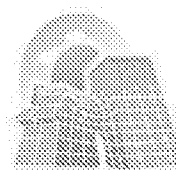
LIDSEY ROAD – WOODGATE, WEST SUSSEX



ENERGY STATEMENT

12th June 2020

ARUN DISTRICT COUNCIL AL/46/20/PL



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

12th June 2020

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 81 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 endeavour to utilise best practice energy efficiency techniques to reduce carbon dioxide emissions across the lifetime of 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. In Section 3, a conclusion is provided concerning projected emissions performance against the policy requirement for a 10% reduction 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 81 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;

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)
Bungalows	1,511	3	4,533
C2H4	1,422	10	14,220
C2H3	1,411	20	28,220
C2H6	1,418	3	4,254
C3H3	1,645	3	4,935
C3H4	1,676	35	58,660
C3H5	1,643	1	1,643
FOG	1,367	2	6,734
12B Apartments	1,198	4	4,792
TOTAL		81	127,991
Average per dwelling			1,580

Policy target

- 2.3 Based on the calculation in Table 1, site-wide carbon dioxide emissions are projected to be **127,991 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 **12,799 kgCO₂/year**. This can be achieved by best practice energy efficiency measures, renewable energy technologies or a combination of both.

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 fully filling external walls with 110mm of Recticel Eurothane GP insulation, fully filling and sealing all party walls, 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	0.17	43.33
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 Newick 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 **127,991 kgCO₂/year** to **113,297 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)
Bungalows	1,335	3	4,005
C2H4	1,256	10	12,560
C2H3	1,249	20	24,980
C2H6	1,255	3	3,765
C3H3	1,470	3	4,410
C3H4	1,490	35	52,150
C3H5	1,472	1	1,472
FOG	1,219	2	2,438
12B Apartments	1,079	4	4,316
TOTAL		81	113,297
Average per dwelling			1,399

- 2.11 The reduction against the baseline is **14,694 kgCO₂/year**, or **11.48%** in percentage terms. Examples of SAP calculations for common dwelling types are provided in the Appendix to this Statement. All others are available upon request.

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. Overall, the Applicant's strategy of best practice energy efficiency measures and strategically located renewable energy installations will reduce carbon dioxide emissions by **11.48%** across the Lidsey Road development.

Appendix

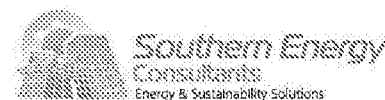
SAP example calculations:

Type C2H4 (Plot 13) with energy efficiency measures

Type C3H3 (Plot 33) with energy efficiency measures

FULL SAP CALCULATION PRINTOUT

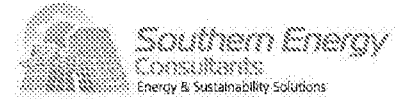
Calculation Type: New Build (As Designed)



Property Reference	SECLID013				Issued on Date	06/06/2020	
Assessment Reference	001			Prop Type Ref	Type C2H4		
Property	Plot 13, Lidsey Road, Woodgate, West Sussex, PO20						
SAP Rating	84 B	DER	15.90	TER	18.00		
Environmental	87 B	% DER<TER	11.68				
CO ₂ Emissions (t/year)	1.04	DFEE	42.30	TFEE	50.29		
General Requirements Compliance	Pass	% DFEE<TFEE	15.88				
Assessor Details	Mr. Stephen Smith, Southern Energy Consultants Limited, Tel: [REDACTED]				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) 15.90 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)50.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)42.3 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (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

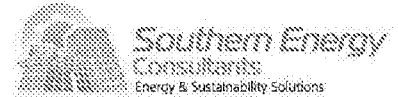
Overheating risk (South East England): Slight OK
Based on:
Overshading: Average
Windows facing North: 6.42 m², No overhang
Windows facing South: 11.85 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K

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	0.1700	11.9476		(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) =		48.7792		(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) =	58.5589 (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	92.5110	92.1648	91.8185	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464 (39)
Average = Sum(39)m / 12 =												91.4010 (39)
HLP	Jan 1.1710	Feb 1.1666	Mar 1.1623	Apr 1.1538	May 1.1538	Jun 1.1538	Jul 1.1538	Aug 1.1538	Sep 1.1538	Oct 1.1538	Nov 1.1538	Dec 1.1538 (40)
HLP (average)												1.1570 (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)
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)
								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 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)

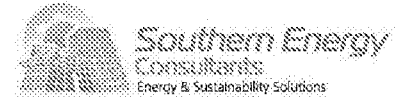
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	23.7209	23.8100	23.8998	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760
alpha	2.5814	2.5873	2.5933	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051
util living area												
	0.9477	0.9124	0.8636	0.7874	0.6794	0.5441	0.4181	0.4514	0.6282	0.8177	0.9203	0.9554 (86)
MIT	18.7769	19.1580	19.6233	20.1305	20.5467	20.8193	20.9337	20.9169	20.7235	20.1688	19.3792	18.7154 (87)
Th 2	19.9432	19.9468	19.9503	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572 (88)
util rest of house												
	0.9401	0.9004	0.8449	0.7578	0.6333	0.4754	0.3299	0.3627	0.5634	0.7855	0.9072	0.9489 (89)
MIT 2	17.9297	18.3033	18.7556	19.2414	19.6196	19.8477	19.9284	19.9190	19.7773	19.2891	18.5335	17.8792 (90)
Living area fraction									fLA = Living area / (4) =	0.2899		0.2899 (91)
MIT	18.1753	18.5511	19.0071	19.4991	19.8883	20.1293	20.2198	20.2082	20.0516	19.5441	18.7786	18.1216 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.0253	18.4011	18.8571	19.3491	19.7383	19.9793	20.0698	20.0582	19.9016	19.3941	18.6286	17.9716 (93)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9221	0.8784	0.8219	0.7382	0.6228	0.4770	0.3398	0.3717	0.5596	0.7653	0.8862	0.9325 (94)
Useful gains	539.7829	639.9172	685.2472	673.0488	593.0654	441.2501	302.1232	314.9891	451.1751	542.7196	528.9714	507.2474 (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	1269.7384	1244.3240	1134.6153	952.4014	732.6636	490.3077	316.2616	333.4363	528.7923	801.5532	1050.7925	1255.2314 (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	543.0869	406.1614	334.3298	201.1339	103.8610	0.0000	0.0000	0.0000	0.0000	192.5722	375.7112	556.5001 (98)
Space heating												2713.3566 (98)
Space heating per m2												34.3463 (99)
										(98) / (4) =		

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												2994.8748 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	543.0869	406.1614	334.3298	201.1339	103.8610	0.0000	0.0000	0.0000	0.0000	192.5722	375.7112	556.5001 (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)	599.4337	448.3017	369.0175	222.0021	114.6369	0.0000	0.0000	0.0000	0.0000	212.5521	414.6923	614.2385 (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	154.7121	135.4338	140.0444	122.5016	117.8470	102.1386	95.0853	108.4847	109.5925	127.1762	138.2964	149.9645 (64)
Efficiency of water heater (217)m	89.7999	89.6987	89.5378	89.2426	88.7053	87.1000	87.1000	87.1000	87.1000	89.1748	89.6309	87.1000 (216)
Fuel for water heating, kWh/month	172.2853	150.9876	156.4081	137.2683	132.8523	117.2659	109.1679	124.5519	125.8237	142.6146	154.2953	166.9356 (219)
Water heating fuel used												1690.4566 (219)
Annual totals kWh/year												
Space heating fuel - main system												2994.8748 (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)
Total delivered energy for all uses												5155.7645 (238)

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

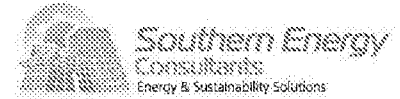
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2994.8748	0.2160	646.8930 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1690.4566	0.2160	365.1386 (264)
Space and water heating			1012.0316 (265)
Pumps and fans	128.2500	0.5190	66.5617 (267)
Energy for lighting	342.1832	0.5190	177.5931 (268)
Total CO2, kg/year			1256.1864 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.9000 (273)

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

DER		15.9000 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		34.4512 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		34.4512 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)
Air changes per hour					
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

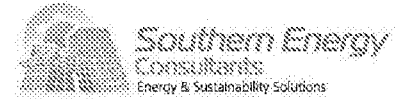
Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			1.9500	1.0000	1.9500		(26)					
TER Opening Type (Uw = 1.40)			17.7900	1.3258	23.5852		(27)					
Heat Loss Floor 1			39.5000	0.1300	5.1350		(28a)					
External Wall 1	90.5000	19.7400	70.7600	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												

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 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	
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 m2												38.0135	(99)

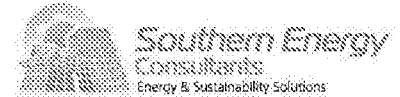
8c. Space cooling requirement

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

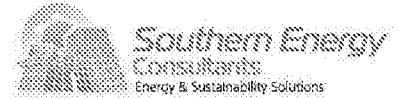
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													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

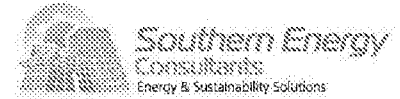
Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			1.9500	1.2000	2.3400		(26)
Opening Type 2 (Uw = 1.40)			18.2700	1.3258	24.2216		(27)
Heat Loss Floor 1			39.5000	0.1500	5.9250		(28a)
External Wall 1	90.5000	20.2200	70.2800	0.1700	11.9476		(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) =	48.7792		(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) =	58.5589 (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	97.3286	97.0886	96.8533	95.7480	95.5412	94.5786	94.5786
Average = Sum(39)m / 12 =						94.4003	94.4003
HLP	1.2320	1.2290	1.2260	1.2120	1.2094	1.1972	1.1972
HLP (average)						1.1949	1.2019
Days in month	31	28	31	30	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	22.5468	22.6025	22.6574	22.9190	22.9686	23.2023	23.2023	23.2461	23.1117	22.9686	22.8684	22.7647	
alpha	2.5031	2.5068	2.5105	2.5279	2.5312	2.5468	2.5468	2.5497	2.5408	2.5312	2.5246	2.5176	
util living area	0.9539	0.9215	0.8764	0.8043	0.7005	0.5645	0.4372	0.4718	0.6506	0.8343	0.9295	0.9610	(86)
MIT	18.5935	18.9802	19.4647	20.0155	20.4739	20.7890	20.9203	20.9009	20.6779	20.0645	19.2218	18.5194	(87)
Th 2	19.8945	19.8969	19.8993	19.9104	19.9125	19.9222	19.9222	19.9240	19.9185	19.9125	19.9083	19.9039	(88)
util rest of house	0.9470	0.9102	0.8584	0.7751	0.6538	0.4932	0.3435	0.3780	0.5842	0.8031	0.9174	0.9551	(89)
MIT 2	17.7161	18.0954	18.5670	19.0996	19.5206	19.7946	19.8879	19.8787	19.7089	19.1599	18.3465	17.6498	(90)
Living area fraction									fLA = Living area / (4) =			0.2899	(91)
MIT	17.9705	18.3519	18.8272	19.3651	19.7969	20.0828	20.1872	20.1750	19.9898	19.4221	18.6002	17.9019	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9705	18.3519	18.8272	19.3651	19.7969	20.0828	20.1872	20.1750	19.9898	19.4221	18.6002	17.9019	(93)

8. Space heating requirement

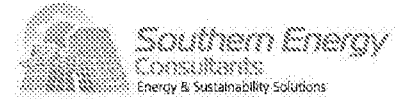
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9311	0.8904	0.8376	0.7585	0.6484	0.5045	0.3676	0.4011	0.5890	0.7866	0.8989	0.9407	(94)
Ext temp.	518.3119	623.7518	676.3239	673.2689	602.7167	456.2287	319.7695	331.3506	461.8699	538.7954	512.4767	485.3904	(95)
Ext temp.	4.3000	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	1330.5272	1306.0228	1193.9342	1002.0161	773.5895	518.5592	339.2714	356.3650	559.2331	842.8766	1103.5583	1320.8210	(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	604.2882	458.4861	385.1020	236.6980	127.1294	0.0000	0.0000	0.0000	0.0000	226.2363	425.5788	621.5604	(98)
Space heating												3085.0791	(98)
Space heating per m2												39.0516	(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	889.0389	699.8817	717.4426	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8027	0.8573	0.8398	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	713.6150	600.0421	602.4838	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	312.7865	376.3627	337.6102	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1026.7594	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

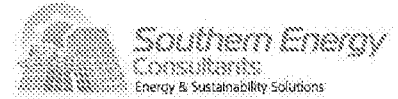


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	78.1966	94.0907	84.4026	0.0000	0.0000	0.0000 (107)
Space cooling											256.6898 (107)
Space cooling per m2											3.2492 (108)
Energy for space heating											39.0516 (99)
Energy for space cooling											3.2492 (108)
Total											42.3009 (109)
Dwelling Fabric Energy Efficiency (DFEE)											42.3 (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

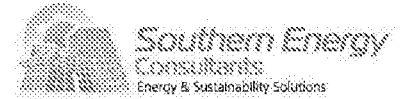
Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			1.9500	1.0000	1.9500		(26)					
TER Opening Type (Uw = 1.40)			17.7900	1.3258	23.5852		(27)					
Heat Loss Floor 1			39.5000	0.1300	5.1350		(28a)					
External Wall 1	90.5000	19.7400	70.7600	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												

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			20.3106 (74)		
South				11.5400	46.7521			0.6300			0.7000			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														
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														
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

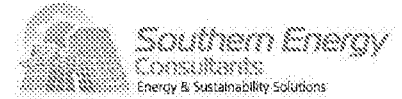
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation	0.9947	0.9859	0.9665	0.9176	0.8103	0.6226	0.4359	0.4791	0.7334	0.9359	0.9879	0.9961	(94)	
Useful gains	521.7299	637.7996	711.5805	735.6698	676.1004	504.4108	339.5713	355.6202	519.2872	586.2076	525.3817	486.4432	(95)	
Ext temp.	4.3000	4.9000	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													(98)	
Space heating per m2													(98) / (4) =	41.6593 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
Ext. temp.	Jan 4.3000	Feb 4.9000	Mar 6.5000	Apr 8.9000	May 11.7000	Jun 14.6000	Jul 16.6000	Aug 16.4000	Sep 14.1000	Oct 10.6000	Nov 7.1000	Dec 4.2000
Heat loss rate W												
Utilisation	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)
Useful loss	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)
Total gains	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)
Month fracti	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)
Space cooling kWh						1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling	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)
Cooled fraction												653.6386 (104)
									fc = cooled area / (4) =			1.0000 (105)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

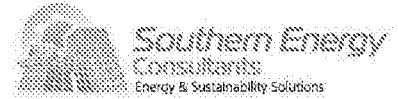


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

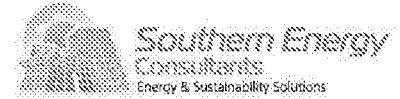
Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Opening Type 1			1.9500	1.2000	2.3400			(26)				
Opening Type 2 (Uw = 1.40)			18.2700	1.3258	24.2216			(27)				
Heat Loss Floor 1			39.5000	0.1500	5.9250			(28a)				
External Wall 1	90.5000	20.2200	70.2800	0.1700	11.9476			(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) =		48.7792			(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) =		58.5589 (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	92.1648	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464 (39)
Average = Sum(39)m / 12 =												91.2313 (39)
HLP	Jan 1.1666	Feb 1.1538	Mar 1.1538	Apr 1.1538	May 1.1538	Jun 1.1538	Jul 1.1538	Aug 1.1538	Sep 1.1538	Oct 1.1538	Nov 1.1538	Dec 1.1538 (40)
HLP (average)												1.1548 (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)

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	(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)
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)
													(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	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)

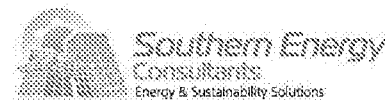
Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	23.8100	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	
alpha	2.5873	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	
util living area	0.8795	0.8445	0.7771	0.6733	0.5420	0.3808	0.2645	0.2612	0.4482	0.6675	0.8207	0.8920	(86)
MIT	19.4339	19.6643	20.0645	20.4711	20.7734	20.9361	20.9828	20.9843	20.9005	20.5898	20.0065	19.4018	(87)
Th 2	19.9468	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	(88)
util rest of house	0.8635	0.8252	0.7501	0.6351	0.4886	0.3130	0.1860	0.1787	0.3765	0.6182	0.7942	0.8771	(89)
MIT 2	18.5691	18.7952	19.1724	19.5432	19.8032	19.9250	19.9521	19.9530	19.9037	19.6584	19.1287	18.5478	(90)
Living area fraction									FLA = Living area / (4) =			0.2899	(91)
MIT	18.8198	19.0471	19.4310	19.8122	20.0844	20.2181	20.2509	20.2519	20.1926	19.9284	19.3831	18.7954	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6698	18.8971	19.2810	19.6622	19.9344	20.0681	20.1009	20.1019	20.0426	19.7784	19.2331	18.6454	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	699.4894	754.4465	767.3607	719.8712	573.6215	382.6594	225.2002	207.4894	398.0855	566.1694	641.5626	658.0329	(94)
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	1213.7936	1193.7529	1073.7927	889.7886	641.1643	398.1331	227.9458	209.8121	423.1599	690.7417	960.0572	1179.9253	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	382.6424	295.2139	227.9854	122.3405	50.2519	0.0000	0.0000	0.0000	0.0000	92.6818	229.3161	388.2879	(98)
Space heating												1788.7198	(98)
RHI space heating demand												1789	(98)

FULL SAP CALCULATION PRINTOUT

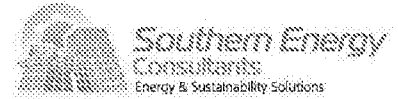
Calculation Type: New Build (As Designed)



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) =											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			39.5000	0.1500	5.9250		(28a)
External Wall 1	90.5000	20.2200	70.2800	0.1700	11.9476		(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) =	48.7792			(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) =	58.5589 (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	92.5110	92.1648	91.8185	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464 (39)
Average = Sum(39)m / 12 =												91.4010 (39)
HLP	1.1710	1.1666	1.1623	1.1538	1.1538	1.1538	1.1538	1.1538	1.1538	1.1538	1.1538	1.1538 (40)
HLP (average)												1.1570 (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

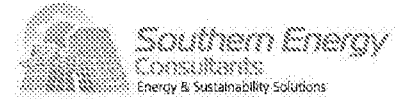
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.12r02

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	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
	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	23.7209	23.8100	23.8998	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	
alpha	2.5814	2.5873	2.5933	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	
util living area	0.9110	0.8696	0.8151	0.7340	0.6244	0.4908	0.3711	0.3991	0.5640	0.7559	0.8740	0.9211	(86)
MIT	19.0916	19.4307	19.8402	20.2802	20.6329	20.8589	20.9501	20.9380	20.7875	20.3312	19.6417	19.0342	(87)
Th 2	19.9432	19.9468	19.9503	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	(88)
util rest of house	0.8993	0.8534	0.7925	0.7012	0.5773	0.4251	0.2904	0.3177	0.5000	0.7186	0.8555	0.9106	(89)
MIT 2	18.2343	18.5628	18.9564	19.3730	19.6882	19.8733	19.9359	19.9293	19.8222	19.4305	18.7819	18.1890	(90)
Living area fraction	18.4828	18.8144	19.2126	19.6360	19.9620	20.1590	20.2299	20.2217	20.1020	19.6915	19.0311	18.4340	(92)
MIT	18.3328	18.6644	19.0626	19.4860	19.8120	20.0090	20.0799	20.0717	19.9520	19.5415	18.8811	18.2840	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	669.1289	750.1626	771.7084	731.7142	625.7905	454.7759	306.6299	321.0154	473.7648	605.2627	634.1351	638.2112	(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	1298.1907	1268.5914	1153.4805	964.8746	739.3822	493.0086	317.1822	334.6616	533.3888	814.9898	1073.8051	1283.7069	(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	468.0219	348.3842	284.0384	167.8755	84.5122	0.0000	0.0000	0.0000	0.0000	156.0370	316.5624	480.2488	(98)
Space heating												2305.6804	(98)
Space heating per m ²												29.1858	(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													2544.9011 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	468.0219	348.3842	284.0384	167.8755	84.5122	0.0000	0.0000	0.0000	0.0000	156.0370	316.5624	480.2488	(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)	516.5805	384.5300	313.5082	185.2930	93.2806	0.0000	0.0000	0.0000	0.0000	172.2262	349.4066	530.0760	(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													87.1000 (216)
(217)m	89.7045	89.5922	89.4135	89.0897	88.5283	87.1000	87.1000	87.1000	87.1000	88.9942	89.5065	89.7419	(217)
Fuel for water heating, kWh/month	172.4686	151.1669	156.6256	137.5039	133.1179	117.2659	109.1679	124.5519	125.8237	142.9040	154.5099	167.1065	(219)
Water heating fuel used												1692.2128	(219)
Annual totals kWh/year													
Space heating fuel - main system												2544.9011	(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)
Total delivered energy for all uses													4707.5471 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2544.9011	3.4800	88.5626 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1692.2128	3.4800	58.8890 (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)
Total energy cost			329.5017 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200 (256)
Energy cost factor (ECF)	1.1161 (257)
SAP value	84.4310
SAP rating (Section 12)	84 (258)
SAP band	B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2544.9011	0.2160	549.6986 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1692.2128	0.2160	365.5180 (264)
Space and water heating			915.2166 (265)
Pumps and fans	128.2500	0.5190	66.5617 (267)
Energy for lighting	342.1832	0.5190	177.5931 (268)
Total kg/year			1159.3714 (272)
CO2 emissions per m2			14.6800 (273)
EI value			87.4713
EI rating			87 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9060 = 3.841$, 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	$3.48 / 0.8858 = 3.929$, stars = 4
Water heating environmental impact	$0.216 / 0.8858 = 0.2438$, stars = 4

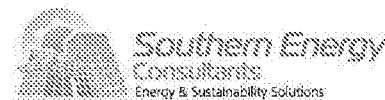
Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design
System) version 4.12r02

FULL SAP CALCULATION PRINTOUT

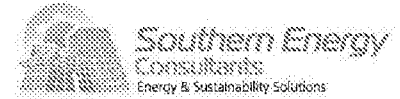
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CALCULATION OF ENERGY RATINGS 09 Jan 2014

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)
											Air changes per hour	
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	0.1700	11.9476		(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)	=	48.7792		(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)	= 58.5589 (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	92.1648	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464 (39)
Average = Sum(39)m / 12 =												91.2313 (39)
HLP	1.1666	1.1538	1.1538	1.1538	1.1538	1.1538	1.1538	1.1538	1.1538	1.1538	1.1538	1.1538 (40)
HLP (average)												1.1548 (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

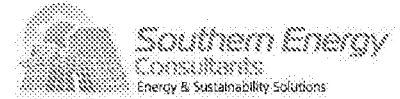
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.12r02

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)
								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)

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 (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	(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)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	23.8100	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	
alpha	2.5873	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	
util living area	0.8795	0.8445	0.7771	0.6733	0.5420	0.3808	0.2645	0.2612	0.4482	0.6675	0.8207	0.8920	(86)
MIT	19.4339	19.6643	20.0645	20.4711	20.7734	20.9361	20.9828	20.9843	20.9005	20.5898	20.0065	19.4018	(87)
Th 2	19.9468	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	(88)
util rest of house	0.8635	0.8252	0.7501	0.6351	0.4886	0.3130	0.1860	0.1787	0.3765	0.6182	0.7942	0.8771	(89)
MIT 2	18.5691	18.7952	19.1724	19.5432	19.8032	19.9250	19.9521	19.9530	19.9037	19.6584	19.1287	18.5478	(90)
Living area fraction									fLA = Living area / (4) =			0.2899	(91)
MIT	18.8198	19.0471	19.4310	19.8122	20.0844	20.2181	20.2509	20.2519	20.1926	19.9284	19.3831	18.7954	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6698	18.8971	19.2810	19.6622	19.9344	20.0681	20.1009	20.1019	20.0426	19.7784	19.2331	18.6454	(93)

8. Space heating requirement

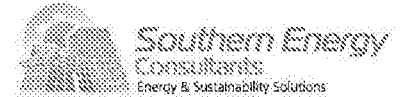
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.8403	0.8024	0.7305	0.6234	0.4874	0.3205	0.1971	0.1904	0.3826	0.6090	0.7729	0.8544	(94)
Useful gains	699.4894	754.4465	767.3607	719.8712	573.6215	382.6594	225.2002	207.4894	398.0855	566.1694	641.5626	658.0329	(95)
Ext temp.	5.5000	5.8000	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	1213.7936	1193.7529	1073.7927	889.7886	641.1643	398.1331	227.9458	209.8121	423.1599	690.7417	960.0572	1179.9253	(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	382.6424	295.2139	227.9854	122.3405	50.2519	0.0000	0.0000	0.0000	0.0000	92.6818	229.3161	388.2879	(98)
Space heating												1788.7198	(98)
Space heating per m2										(98) / (4) =		22.6420	(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													1974.3045	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	382.6424	295.2139	227.9854	122.3405	50.2519	0.0000	0.0000	0.0000	0.0000	92.6818	229.3161	388.2879	(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)	422.3426	325.8431	251.6395	135.0337	55.4657	0.0000	0.0000	0.0000	0.0000	102.2978	253.1083	428.5739	(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	89.5638	89.4693	89.2355	88.8144	88.1176	87.1000	87.1000	87.1000	87.1000	88.5419	89.2508	89.5969	(217)	
Fuel for water heating, kWh/month	172.7395	151.3745	156.9380	137.9302	133.7383	117.2659	109.1679	124.5519	125.8237	143.6339	154.9525	167.3769	(219)	
Water heating fuel used												1695.4933	(219)	
Annual totals kWh/year														
Space heating fuel - main system												1974.3045	(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)
Total delivered energy for all uses													4140.2309	(238)

10a. Fuel costs - using BEDF prices (461)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1974.3045	3.9700	78.3799 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1695.4933	3.9700	67.3111 (247)
Mechanical ventilation fans	53.2500	18.2700	9.7288 (249)
Pumps and fans for heating	75.0000	18.2700	13.7025 (249)
Energy for lighting	342.1832	18.2700	62.5169 (250)
Additional standing charges			90.0000 (251)
Total energy cost			321.6391 (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	1974.3045	0.2160	426.4498 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1695.4933	0.2160	366.2266 (264)
Space and water heating			792.6763 (265)
Pumps and fans	128.2500	0.5190	66.5617 (267)
Energy for lighting	342.1832	0.5190	177.5931 (268)
Total kg/year			1036.8311 (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	1974.3045	1.2200	2408.6514 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1695.4933	1.2200	2068.5019 (264)
Space and water heating			4477.1533 (265)
Pumps and fans	128.2500	3.0700	393.7273 (267)
Energy for lighting	342.1832	3.0700	1050.5024 (268)
Primary energy kWh/year			5921.3830 (272)
Primary energy kWh/m2/year			74.9542 (273)

SAP 2012 EPC IMPROVEMENTS

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-183 kg (17.6%)
U Solar photovoltaic panels	+ 10.8	-£ 380	-1079 kg (126.3%)
V2 Wind turbine	+ 22.3	-£ 653	-1856 kg (825.1%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£29	2.32 kg/m²	B 86 B 89
Solar photovoltaic panels	£380	13.66 kg/m²	A 96 A 99
Wind turbine	£653	23.49 kg/m²	A 119 A 119
Total Savings	£1062	39.46 kg/m²	

Potential energy efficiency rating: A 119
 Potential environmental impact rating: A 119

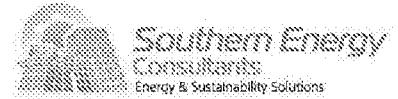
Fuel prices for cost data on this page from database revision number 461 TEST (26 May 2020)
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£86	£95	-£9
Mains gas	£236	£197	£38
Space heating	£192	£192	-£0
Water heating	£67	£38	£29
Lighting	£63	£63	£0
Generated (PV)	-£0	-£380	£380
Generated (wind)	-£0	-£653	£653
Total cost of fuels	£322	-£741	£1062
Total cost of uses	£322	-£740	£1062
Delivered energy	52 kWh/m²	-31 kWh/m²	83 kWh/m²
Carbon dioxide emissions	1.0 tonnes	-2.1 tonnes	3.1 tonnes
CO2 emissions per m²	13 kg/m²	-26 kg/m²	39 kg/m²
Primary energy	75 kWh/m²	-158 kWh/m²	233 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 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	0.1700	11.9476			(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) =		48.7792			(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) =		58.5589 (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	92.5110	92.1648	91.8185	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	(39)
Average = Sum(39)m / 12 =												91.4010	(39)
HLP	Jan 1.1710	Feb 1.1666	Mar 1.1623	Apr 1.1538	May 1.1538	Jun 1.1538	Jul 1.1538	Aug 1.1538	Sep 1.1538	Oct 1.1538	Nov 1.1538	Dec 1.1538	(40)
HLP (average)												1.1570	(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)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
Energy conte	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 content (annual)	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)
Distribution loss (46)m = 0.15 x (45)m										Total = Sum(45)m =		1451.2285 (45)
	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)
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												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	(63)
								Solar input (sum of months) = Sum(63)m =				-841.9491	(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	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)
								Total per year (kWh/year) = Sum(64)m =				686.5110	(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)

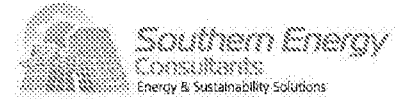
[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				6.4200	10.6334	0.7200	0.7000	0.7700	23.8435 (74)			
South				11.8500	46.7521	0.7200	0.7000	0.7700	193.5009 (78)			
Solar gains	217.3444	362.4708	481.1083	580.6157	642.9738	636.8966	614.4969	514.7853	396.0519	258.7786	187.0797 (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)

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	23.7209	23.8100	23.8998	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760
alpha	2.5814	2.5873	2.5933	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051
util living area												
	0.9110	0.8696	0.8151	0.7340	0.6244	0.4908	0.3711	0.3991	0.5640	0.7559	0.8740	0.9211 (86)
MIT	19.0916	19.4307	19.8402	20.2802	20.6329	20.8589	20.9501	20.9380	20.7875	20.3312	19.6417	19.0342 (87)
Th 2	19.9432	19.9468	19.9503	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572 (88)
util rest of house												
	0.8993	0.8534	0.7925	0.7012	0.5773	0.4251	0.2904	0.3177	0.5000	0.7186	0.8555	0.9106 (89)
MIT 2	18.2343	18.5628	18.9564	19.3730	19.6882	19.8733	19.9359	19.9293	19.8222	19.4305	18.7819	18.1890 (90)
Living area fraction												
MIT	18.4828	18.8144	19.2126	19.6360	19.9620	20.1590	20.2299	20.2217	20.1020	19.6915	19.0311	18.4340 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.3328	18.6644	19.0626	19.4860	19.8120	20.0090	20.0799	20.0717	19.9520	19.5415	18.8811	18.2840 (93)

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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	0.8772	0.8300	0.7706	0.6849	0.5703	0.4285	0.3003	0.3270	0.4996	0.7019	0.8327	0.8895	(94)
Useful gains	669.1289	750.1626	771.7084	731.7142	625.7905	454.7759	306.6299	321.0154	473.7648	605.2627	634.1351	638.2112	(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	1298.1907	1268.5914	1153.4805	964.8746	739.3822	493.0086	317.1822	334.6616	533.3888	814.9898	1073.8051	1283.7069	(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	468.0219	348.3842	284.0384	167.8755	84.5122	0.0000	0.0000	0.0000	0.0000	156.0370	316.5624	480.2488	(98)
Space heating												2305.6804	(98)
Space heating per m2											(98) / (4) =	29.1858	(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													2544.9011 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	468.0219	348.3842	284.0384	167.8755	84.5122	0.0000	0.0000	0.0000	0.0000	156.0370	316.5624	480.2488	(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)	516.5805	384.5300	313.5082	185.2930	93.2806	0.0000	0.0000	0.0000	0.0000	172.2262	349.4066	530.0760	(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	(217)m	89.8140	89.8286	89.8805	90.0590	90.4769	87.1000	87.1000	87.1000	89.4324	89.6749	89.8332	(216)
Fuel for water heating, kWh/month	145.0744	105.4146	78.6124	32.7667	3.2745	0.0000	0.0000	12.7487	38.2594	83.9671	121.9258	144.1933	(219)
Water heating fuel used												766.2369	(219)
Annual totals kWh/year													
Space heating fuel - main system												2544.9011	(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 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Wind generation												-3575.5408	(234)
Total delivered energy for all uses												-1471.2090	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2544.9011	3.4800	88.5626	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	766.2369	3.4800	26.6650	(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	-1727.2394	13.1900	-227.8229	(252)
Wind Turbine	-3575.5408	13.1900	-471.6138	(252)
Total energy cost			-395.5640	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	-1.3398	(257)
SAP value		118.6904	
SAP rating (Section 12)		119	(258)
SAP band		A	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



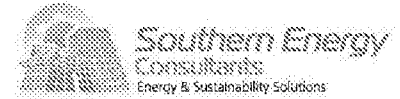
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	2544.9011	0.2160	549.6986 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	766.2369	0.2160	165.5072 (264)
Space and water heating			715.2058 (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	-1727.2394	0.5190	-896.4372 (269)
Wind Turbine	-3575.5408	0.5190	-1855.7056 (269)
Total kg/year			-1766.8323 (272)
CO2 emissions per m2			-22.3600 (273)
EI value			119.0932
EI rating			119 (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	0.1700	11.9476			(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) =		48.7792			(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) =		58.5589 (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	92.1648	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464	91.1464 (39)
Average = Sum(39)m / 12 =												91.2313 (39)
HLP	Jan 1.1666	Feb 1.1538	Mar 1.1538	Apr 1.1538	May 1.1538	Jun 1.1538	Jul 1.1538	Aug 1.1538	Sep 1.1538	Oct 1.1538	Nov 1.1538	Dec 1.1538 (40)
HLP (average)												1.1548 (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)

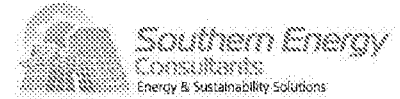
[Jan]					Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W		
North					6.4200	14.6401	0.7200	0.7000	0.7700	32.8278 (74)		
South					11.8500	16.3950	0.7200	0.7000	0.7700	254.1060 (78)		
Solar gains	286.9338	398.9165	530.1005	667.0634	722.5578	769.7183	736.0206	675.1727	607.0133	463.4255	327.3405	239.7463 (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)

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	23.8100	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760	24.0760
alpha	2.5873	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051	2.6051
util living area	0.8795	0.8445	0.7771	0.6733	0.5420	0.3808	0.2645	0.2612	0.4482	0.6675	0.8207	0.8920 (86)
MIT	19.4339	19.6643	20.0645	20.4711	20.7734	20.9361	20.9828	20.9843	20.9005	20.5898	20.0065	19.4018 (87)
Th 2	19.9468	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572	19.9572 (88)
util rest of house	0.8635	0.8252	0.7501	0.6351	0.4886	0.3130	0.1860	0.1787	0.3765	0.6182	0.7942	0.8771 (89)
MIT 2	18.5691	18.7952	19.1724	19.5432	19.8032	19.9250	19.9521	19.9530	19.9037	19.6584	19.1287	18.5478 (90)
Living area fraction	0.2899								fLa = Living area / (4) =			0.2899 (91)
MIT	18.8198	19.0471	19.4310	19.8122	20.0844	20.2181	20.2509	20.2519	20.1926	19.9284	19.3831	18.7954 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.6698	18.8971	19.2810	19.6622	19.9344	20.0681	20.1009	20.1019	20.0426	19.7784	19.2331	18.6454 (93)

Regs Region: England
Elmhurst Energy Systems
SAP2012 Calculator (Design
System) version 4.12r02

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	0.8403	0.8024	0.7305	0.6234	0.4874	0.3205	0.1971	0.1904	0.3826	0.6090	0.7729	0.8544	(94)
Useful gains	699.4894	754.4465	767.3607	719.8712	573.6215	382.6594	225.2002	207.4894	398.0855	566.1694	641.5626	658.0329	(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	1213.7936	1193.7529	1073.7927	889.7886	641.1643	398.1331	227.9458	209.8121	423.1599	690.7417	960.0572	1179.9253	(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	382.6424	295.2139	227.9854	122.3405	50.2519	0.0000	0.0000	0.0000	0.0000	92.6818	229.3161	388.2879	(98)
Space heating												1788.7198	(98)
Space heating per m2											(98) / (4) =	22.6420	(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													1974.3045 (211)
Space heating requirement	382.6424	295.2139	227.9854	122.3405	50.2519	0.0000	0.0000	0.0000	0.0000	92.6818	229.3161	388.2879	(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)	422.3426	325.8431	251.6395	135.0337	55.4657	0.0000	0.0000	0.0000	0.0000	102.2978	253.1083	428.5739	(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	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	89.7107	89.7262	89.7506	89.9708	90.4559	87.1000	87.1000	87.1000	87.1000	89.0425	89.4720	89.7162	(216)
Fuel for water heating, kWh/month	139.6723	105.2446	78.2578	28.6520	2.2931	0.0000	0.0000	4.5065	31.7961	80.2295	117.1792	140.5498	(219)
Water heating fuel used												728.3808	(219)
Annual totals kWh/year													
Space heating fuel - main system												1974.3045	(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 * 2.50 * 1299 * 0.80) =										-2078.5905		-2078.5905	(233)
Wind generation												-3575.5408	(234)
Total delivered energy for all uses												-2431.0129	(238)

10a. Fuel costs - using BEDF prices (461)

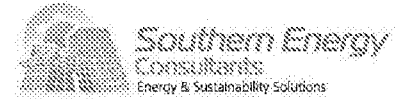
	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1974.3045	3.9700	78.3799	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	728.3808	3.9700	28.9167	(247)
Mechanical ventilation fans	53.2500	18.2700	9.7288	(249)
Pumps and fans for heating	75.0000	18.2700	13.7025	(249)
Pump for solar water heating	50.0000	18.2700	9.1350	(249)
Energy for lighting	342.1832	18.2700	62.5169	(250)
Additional standing charges			90.0000	(251)
Energy saving/generation technologies				
PV Unit	-2078.5905	18.2700	-379.7585	(252)
Wind Turbine	-3575.5408	18.2700	-653.2513	(252)
Total energy cost			-740.6300	(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	1974.3045	0.2160	426.4498	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	728.3808	0.2160	157.3303	(264)
Space and water heating			583.7800	(265)
Pumps and fans	178.2500	0.5190	92.5117	(267)
Energy for lighting	342.1832	0.5190	177.5931	(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	-2078.5905	0.5190	-1078.7885 (269)
Wind Turbine	-3575.5408	0.5190	-1855.7056 (269)
Total kg/year			-2080.6093 (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	1974.3045	1.2200	2408.6514 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	728.3808	1.2200	888.6246 (264)
Space and water heating			3297.2760 (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	-2078.5905	3.0700	-6381.2728 (269)
Wind Turbine	-3575.5408	3.0700	-10976.9101 (269)
Primary energy kWh/year			-12463.1772 (272)
Primary energy kWh/m2/year			-157.7617 (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	58.56 (37)
Summer heat loss coefficient	579.96 (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	2.18	2.08	1.99	(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	18.88	20.78	20.79	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

FULL SAP CALCULATION PRINTOUT

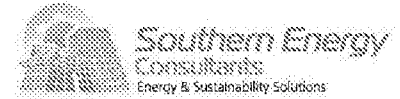
Calculation Type: New Build (As Designed)



Property Reference	SECLID033			Issued on Date	06/06/2020
Assessment Reference	001	Prop Type Ref	Type C3H3		
Property	Plot 33, Lidsey Road, Woodgate, West Sussex, PO20				
SAP Rating	85 B	DER	15.47	TG1	17.46
Environmental	87 B	% DER<TER	11.38		
CO ₂ Emissions (t/year)	1.20	DREE	42.20	TTEE	51.60
General Requirements Compliance	Pass	% DPEE<TTEE	18.22		
Assessor Details	Mr. Stephen Smith, Southern Energy Consultants Limited, Tel: [REDACTED]			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) 15.47 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)51.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)42.2 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.17 (max. 0.30)	0.17 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.15 (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:

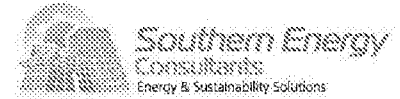
Overshading: Average
Windows facing North: 11.85 m², No overhang
Windows facing South: 6.42 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K

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	0.1700	13.3076		(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) =		52.2192		(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) =	61.9989 (37)

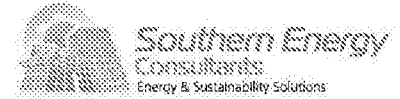
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 40.8285	Feb 40.4121	Mar 39.9957	Apr 39.1875	May 39.1875	Jun 39.1875	Jul 39.1875	Aug 39.1875	Sep 39.1875	Oct 39.1875	Nov 39.1875	Dec 39.1875 (38)
Heat transfer coeff	102.8274	102.4110	101.9947	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864 (39)
Average = Sum(39)m / 12 =												101.4926 (39)
HLP	Jan 1.0824	Feb 1.0780	Mar 1.0736	Apr 1.0651	May 1.0651	Jun 1.0651	Jul 1.0651	Aug 1.0651	Sep 1.0651	Oct 1.0651	Nov 1.0651	Dec 1.0651 (40)
HLP (average)												1.0683 (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 =													1592.6629

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	25.6633	25.7676	25.8728	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	
alpha	2.7109	2.7178	2.7249	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	
util living area	0.9674	0.9479	0.9149	0.8503	0.7445	0.6043	0.4745	0.5225	0.7192	0.8835	0.9512	0.9721	(86)
MIT	18.7334	19.0324	19.4758	20.0201	20.4901	20.7978	20.9243	20.8994	20.6558	20.0449	19.2965	18.6937	(87)
Th 2	20.0152	20.0188	20.0224	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	(88)
util rest of house	0.9626	0.9404	0.9022	0.8273	0.7036	0.5378	0.3843	0.4318	0.6607	0.8605	0.9428	0.9679	(89)
MIT 2	17.9385	18.2354	18.6724	19.2020	19.6377	19.9017	19.9945	19.9801	19.7934	19.2363	18.5073	17.9092	(90)
Living area fraction	18.1301	18.4275	18.8661	19.3992	19.8432	20.1177	20.2186	20.2017	20.0013	19.4312	18.6975	18.0983	(91)
MIT	17.9801	18.2775	18.7161	19.2492	19.6932	19.9677	20.0686	20.0517	19.8513	19.2812	18.5475	17.9483	(92)
Temperature adjustment													
adjusted MIT	17.9801	18.2775	18.7161	19.2492	19.6932	19.9677	20.0686	20.0517	19.8513	19.2812	18.5475	17.9483	(93)

8. Space heating requirement

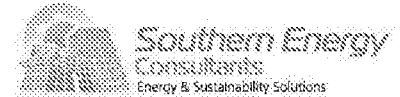
Utilisation	0.9491	0.9230	0.8812	0.8054	0.6878	0.5332	0.3882	0.4340	0.6485	0.8387	0.9260	0.9558	(94)
Useful gains	529.9800	612.1106	664.5263	680.6850	626.2459	479.3567	332.2952	343.5330	469.4034	531.0051	513.3668	501.1041	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1406.6875	1370.0034	1245.9770	1047.2009	808.8022	543.1386	350.9797	369.4981	581.9555	878.4210	1158.3348	1391.1403	(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	652.2704	509.3040	432.5993	263.8914	135.8218	0.0000	0.0000	0.0000	0.0000	258.4774	464.3770	662.1869	(98)
Space heating													
Space heating per m2													(98) / (4) = 35.5677 (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													3729.5013 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	652.2704	509.3040	432.5993	263.8914	135.8218	0.0000	0.0000	0.0000	0.0000	258.4774	464.3770	662.1869	(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)	719.9452	562.1457	477.4827	291.2709	149.9137	0.0000	0.0000	0.0000	0.0000	285.2952	512.5574	730.8906	(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	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	89.8737	89.8058	89.6787	89.4144	88.8882	87.1000	87.1000	87.1000	87.1000	89.3684	89.7341	87.1000	(216)
Fuel for water heating, kWh/month	182.6861	160.0348	165.6977	145.3422	140.6265	124.3529	115.7351	132.0878	133.4496	150.9672	163.5342	177.0191	(219)
Water heating fuel used												1791.5332	(219)
Annual totals kWh/year													
Space heating fuel - main system												3729.5013	(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)
Total delivered energy for all uses													6055.0450 (238)

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

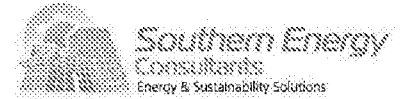
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3729.5013	0.2160	805.5723	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1791.5332	0.2160	386.9712	(264)
Space and water heating			1192.5434	(265)
Pumps and fans	139.0348	0.5190	72.1590	(267)
Energy for lighting	394.9758	0.5190	204.9924	(268)
Total CO2, kg/year			1469.6949	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.4700	(273)

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

DER			15.4700	2C1
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	2C2
CO2 emissions from cooking, equation (L16)			1.9317	2C3
Total CO2 emissions			32.8701	2C4
Residual CO2 emissions offset from biofuel CHP			0.0000	2C5
Additional allowable electricity generation, kWh/m²/year			0.0000	2C6
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000	2C7
Net CO2 emissions			32.8701	2C8

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	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	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

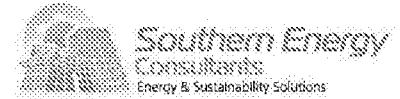
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.12r02

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	0.0000 (57)
Total heat required for water heating calculated for each month	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)
Solar input	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)
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	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)
	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)

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	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)	88.6001	86.3353	81.6322	74.5677	69.7451	63.2286	58.2606	65.2975	68.2307	75.5191	82.9917	86.3448	(72)
Total internal gains	425.2698	423.0777	408.1804	383.3864	358.0496	333.7309	318.4429	325.4072	338.5345	363.5525	391.5393	412.6945	(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	555.5080	646.8991	724.5971	800.5356	854.0147	840.2978	800.8084	745.7754	688.7906	613.1908	547.7755	524.0599 (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	0.9982	0.9958	0.9891	0.9652	0.8919	0.7343	0.5641	0.6229	0.8609	0.9779	0.9962	0.9987	(86)
MIT	19.7581	19.9148	20.1611	20.4859	20.7735	20.9427	20.9881	20.9807	20.8637	20.4961	20.0669	19.7305	(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	0.9976	0.9944	0.9851	0.9517	0.8499	0.6446	0.4427	0.4996	0.7929	0.9668	0.9946	0.9983	(89)
MIT 2	18.3110	18.5412	18.9005	19.3717	19.7579	19.9542	19.9887	19.9866	19.8777	19.3938	18.7713	18.2766	(90)
Living area fraction	18.6599	18.8723	19.2044	19.6403	20.0027	20.1925	20.2296	20.2262	20.1154	19.6595	19.0836	18.6271	(92)
Temperature adjustment	18.6599	18.8723	19.2044	19.6403	20.0027	20.1925	20.2296	20.2262	20.1154	19.6595	19.0836	18.6271	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9965	0.9922	0.9810	0.9459	0.8508	0.6638	0.4722	0.5293	0.8027	0.9619	0.9925	0.9974	(94)
Ext temp.	553.5542	641.8382	710.8636	757.2452	726.5957	557.7522	378.1056	394.7634	552.8877	589.8572	543.6834	522.6733	(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	1555.0196	1509.5121	1369.3838	1145.1621	883.4464	589.3921	382.5237	402.5269	636.3148	963.9724	1280.3973	1548.1272	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating per m2	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)
												3785.8166	(98)
												39.8507	(99)

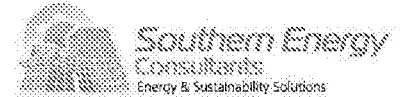
8c. Space cooling requirement

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

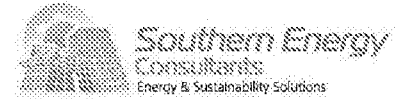
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													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	(216)
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 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	0.1700	13.3076		(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) =	52.2192		(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) =	61.9989 (37)

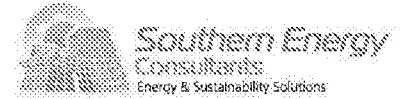
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	45.7054	45.4523	45.2043	44.0390	43.8210	42.8061	42.8061	42.6181	43.1970	43.8210	44.2620	44.7231 (38)
Heat transfer coeff	107.7044	107.4513	107.2032	106.0379	105.8199	104.8050	104.8050	104.6171	105.1959	105.8199	106.2610	106.7220 (39)
Average = Sum(39)m / 12 =												106.0369 (39)
HLP	1.1337	1.1311	1.1285	1.1162	1.1139	1.1032	1.1032	1.1012	1.1073	1.1139	1.1185	1.1234 (40)
HLP (average)												1.1162 (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)

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	24.5012	24.5589	24.6158	24.8863	24.9375	25.1790	25.1790	25.2243	25.0855	24.9375	24.8340	24.7267	
alpha	2.6334	2.6373	2.6411	2.6591	2.6625	2.6786	2.6786	2.6816	2.6724	2.6625	2.6556	2.6484	
util living area	0.9716	0.9540	0.9238	0.8639	0.7637	0.6249	0.4950	0.5446	0.7404	0.8961	0.9575	0.9758	(86)
MIT	18.5689	18.8696	19.3262	19.9059	20.4153	20.7656	20.9095	20.8808	20.6048	19.9411	19.1496	18.5134	(87)
Th 2	19.9734	19.9755	19.9777	19.9876	19.9895	19.9982	19.9982	19.9998	19.9949	19.9895	19.9857	19.9818	(88)
util rest of house	0.9673	0.9470	0.9119	0.8416	0.7231	0.5566	0.4000	0.4499	0.6819	0.8744	0.9499	0.9721	(89)
MIT 2	17.7470	18.0452	18.4951	19.0632	19.5398	19.8501	19.9567	19.9414	19.7232	19.1091	18.3327	17.6980	(90)
Living area fraction	17.9451	18.2440	18.6955	19.2663	19.7509	20.0708	20.1864	20.1679	19.9357	19.3097	18.5296	17.8946	(91)
MIT	17.9451	18.2440	18.6955	19.2663	19.7509	20.0708	20.1864	20.1679	19.9357	19.3097	18.5296	17.8946	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9451	18.2440	18.6955	19.2663	19.7509	20.0708	20.1864	20.1679	19.9357	19.3097	18.5296	17.8946	(93)

8. Space heating requirement

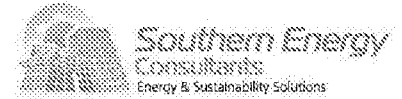
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9556	0.9317	0.8933	0.8229	0.7123	0.5620	0.4189	0.4670	0.6780	0.8564	0.9355	0.9617	(94)
Ext temp.	504.7671	590.4840	648.9080	674.5730	631.5412	492.9572	350.2052	359.1987	475.0681	520.3893	492.2540	475.9065	(95)
Ext temp.	4.3000	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	1469.6416	1433.8256	1307.3929	1099.2243	851.9431	573.3639	375.8688	394.1842	613.8910	921.6560	1214.5218	1461.5115	(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	717.8666	566.7256	489.9128	305.7489	163.9790	0.0000	0.0000	0.0000	0.0000	298.5424	520.0328	733.2901	(98)
Space heating												3796.0983	(98)
Space heating per m ²												39.9589	(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	985.1670	775.5570	795.0897	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7753	0.8344	0.8059	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	763.7573	647.1358	640.7920	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	261.9170	320.0054	267.9302	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												849.8526	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

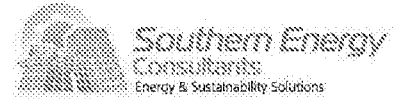


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	65.4792	80.0014	66.9826	0.0000	0.0000	0.0000 (107)
Space cooling											212.4632 (107)
Space cooling per m2											2.2365 (108)
Energy for space heating											39.9589 (99)
Energy for space cooling											2.2365 (108)
Total											42.1954 (109)
Dwelling Fabric Energy Efficiency (DFEE)											42.2 (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	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												

Regs Region: England

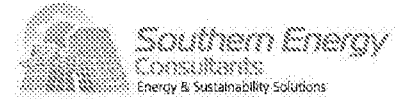
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.1202

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)	
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)	
Temperature adjustment														
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		

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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												43.5381	(99)

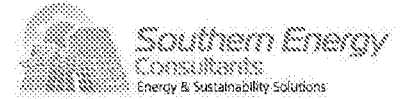
8c. Space cooling requirement

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)

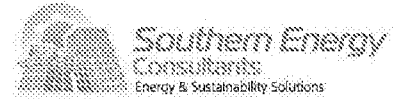


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	=	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	0.1700	13.3076		(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) =		52.2192		(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) =	61.9989 (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	102.4110	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864 (39)
Average = Sum(39)m / 12 =												101.2885 (39)
HLP	Jan 1.0780	Feb 1.0651	Mar 1.0651	Apr 1.0651	May 1.0651	Jun 1.0651	Jul 1.0651	Aug 1.0651	Sep 1.0651	Oct 1.0651	Nov 1.0651	Dec 1.0651 (40)
HLP (average)												1.0662 (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 =
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)
												1592.6629 (64)
												1593 (64)

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)

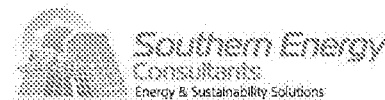
[Jan				Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				11.8500	14.6401	0.7200	0.7000	0.7700	60.5934 (74)			
South				6.4200	61.3950	0.7200	0.7000	0.7700	137.6676 (78)			
Solar gains	198.2610	285.2397	406.1191	559.7953	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	25.7676	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795
alpha	2.7178	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386
util living area	0.9148	0.8918	0.8379	0.7387	0.5978	0.4229	0.2973	0.3008	0.5219	0.7456	0.8715	0.9227 (86)
MIT	19.3636	19.5579	19.9561	20.4042	20.7510	20.9316	20.9818	20.9823	20.8778	20.5156	19.9213	19.3534 (87)
Th 2	20.0188	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294 (88)
util rest of house	0.9030	0.8774	0.8163	0.7047	0.5462	0.3541	0.2158	0.2131	0.4485	0.7022	0.8510	0.9116 (89)
MIT 2	18.5579	18.7528	19.1346	19.5511	19.8551	19.9935	20.0236	20.0243	19.9602	19.6632	19.1097	18.5570 (90)
Living area fraction									fLa = Living area / (4) =			0.2411 (91)
MIT	18.7521	18.9469	19.3326	19.7568	20.0710	20.2196	20.2546	20.2552	20.1814	19.8686	19.3053	18.7490 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.6021	18.7969	19.1826	19.6068	19.9210	20.0696	20.1046	20.1052	20.0314	19.7186	19.1553	18.5990 (93)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8819	0.8554	0.7946	0.6883	0.5400	0.3571	0.2222	0.2201	0.4486	0.6867	0.8289	0.8914 (94)
Useful gains	712.3812	761.4226	784.5120	760.0400	624.3085	423.0226	250.1079	230.2707	432.8793	589.8190	654.2719	674.6609 (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	1341.7985	1315.1109	1182.1233	982.1946	710.4335	442.1437	253.4304	233.2561	468.6363	760.7850	1057.9336	1305.1992 (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	468.2864	372.0785	295.8229	159.9513	64.0770	0.0000	0.0000	0.0000	0.0000	127.1987	290.6365	469.1205 (98)
Space heating RHI space heating demand												2247.1719 (98) 2247 (98)

FULL SAP CALCULATION PRINTOUT

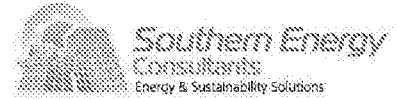
Calculation Type: New Build (As Designed)



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) =											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	0.1700	13.3076		(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) =	52.2192			(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) =	61.9989 (37)

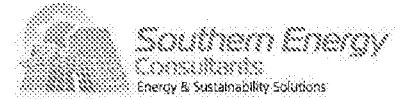
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 40.8285	Feb 40.4121	Mar 39.9957	Apr 39.1875	May 39.1875	Jun 39.1875	Jul 39.1875	Aug 39.1875	Sep 39.1875	Oct 39.1875	Nov 39.1875	Dec 39.1875 (38)
Heat transfer coeff	102.8274	102.4110	101.9947	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864 (39)
Average = Sum(39)m / 12 =												101.4926 (39)
HLP	Jan 1.0824	Feb 1.0780	Mar 1.0736	Apr 1.0651	May 1.0651	Jun 1.0651	Jul 1.0651	Aug 1.0651	Sep 1.0651	Oct 1.0651	Nov 1.0651	Dec 1.0651 (40)
HLP (average)												1.0683 (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	25.6633	25.7676	25.8728	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795		
alpha	2.7109	2.7178	2.7249	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386		
util living area	0.9360	0.9103	0.8693	0.7951	0.6827	0.5409	0.4154	0.4550	0.6418	0.8216	0.9103	0.9429	(86)	
MIT	19.0601	19.3310	19.7263	20.2007	20.5965	20.8473	20.9456	20.9287	20.7454	20.2428	19.5795	19.0212	(87)	
Th 2	20.0152	20.0188	20.0224	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	(88)	
util rest of house	0.9274	0.8985	0.8519	0.7673	0.6391	0.4762	0.3330	0.3712	0.5805	0.7912	0.8966	0.9352	(89)	
MIT 2	18.2577	18.5241	18.9096	19.3655	19.7254	19.9352	20.0050	19.9955	19.8603	19.4152	18.7795	18.2301	(90)	
Living area fraction	18.4511	18.7186	19.1065	19.5668	19.9354	20.1551	20.2317	20.2205	20.0736	19.6147	18.9723	18.4208	(92)	
MIT	18.3011	18.5686	18.9565	19.4168	19.7854	20.0051	20.0817	20.0705	19.9236	19.4647	18.8223	18.2708	(93)	

8. Space heating requirement

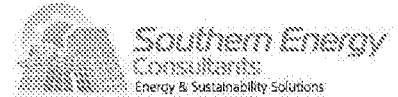
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9082	0.8772	0.8294	0.7475	0.6271	0.4745	0.3376	0.3750	0.5732	0.7707	0.8754	0.9172	(94)
Ext temp.	688.7810	754.9377	782.0008	763.2446	673.0836	498.9501	339.0541	353.2617	506.2358	620.6004	647.5300	660.1562	(95)
Heat loss rate 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	1439.6954	1399.8127	1270.4931	1064.1610	818.1304	546.9193	352.3044	371.4019	589.2726	896.9879	1186.1382	1423.7756	(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	558.6803	433.3560	363.4383	216.6598	107.9148	0.0000	0.0000	0.0000	0.0000	205.6323	387.7979	568.1329	(98)
Space heating per m2													(98) / (4) = 29.9117 (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												3136.4374	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	558.6803	433.3560	363.4383	216.6598	107.9148	0.0000	0.0000	0.0000	0.0000	205.6323	387.7979	568.1329	(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)	616.6450	478.3179	401.1460	239.1389	119.1113	0.0000	0.0000	0.0000	0.0000	226.9672	428.0330	627.0782	(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	89.7806	89.7023	89.5556	89.2553	88.6874	87.1000	87.1000	87.1000	87.1000	89.1803	89.6115	87.1000	(216)
Fuel for water heating, kWh/month	182.8757	160.2194	165.9253	145.6014	140.9449	124.3529	115.7351	132.0878	133.4496	151.2856	163.7581	177.1960	(219)
Water heating fuel used												1793.4317	(219)
Annual totals kWh/year													
Space heating fuel - main system												3136.4374	(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)
Total delivered energy for all uses												5463.8797	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3136.4374	3.4800	109.1480 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1793.4317	3.4800	62.4114 (247)
Mechanical ventilation fans	64.0348	13.1900	8.4462 (249)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	394.9758	13.1900	52.0973 (250)
Additional standing charges			120.0000 (251)
Total energy cost			361.9954 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200 (256)
Energy cost factor (ECF)	1.0860 (257)
SAP value	84.8505
SAP rating (Section 12)	85 (258)
SAP band	B

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

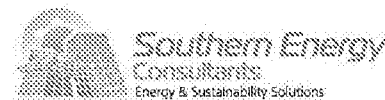
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3136.4374	0.2160	677.4705 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1793.4317	0.2160	387.3813 (264)
Space and water heating			1064.8517 (265)
Pumps and fans	139.0348	0.5190	72.1590 (267)
Energy for lighting	394.9758	0.5190	204.9924 (268)
Total kg/year			1342.0032 (272)
CO2 emissions per m2			14.1300 (273)
EI value			87.1551
EI rating			87 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9060 = 3.841$, 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	$3.48 / 0.8867 = 3.925$, stars = 4
Water heating environmental impact	$0.216 / 0.8867 = 0.2436$, stars = 4

FULL SAP CALCULATION PRINTOUT

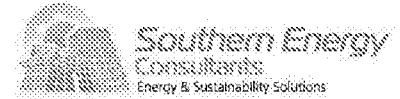
Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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) =		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		
	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)	
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	0.1700	13.3076		(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)	=	52.2192		(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) =	61.9989 (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	102.4110	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864 (39)
Average = Sum(39)m / 12 =												101.2885 (39)
HLP	Jan 1.0780	Feb 1.0651	Mar 1.0651	Apr 1.0651	May 1.0651	Jun 1.0651	Jul 1.0651	Aug 1.0651	Sep 1.0651	Oct 1.0651	Nov 1.0651	Dec 1.0651 (40)
HLP (average)												1.0662 (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)

Regs Region: England

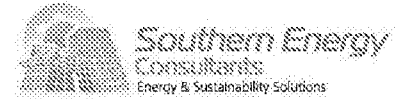
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.12r02

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	25.7676	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	
alpha	2.7178	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	
util living area	0.9148	0.8918	0.8379	0.7387	0.5978	0.4229	0.2973	0.3008	0.5219	0.7456	0.8715	0.9227	(86)
MIT	19.3636	19.5579	19.9561	20.4042	20.7510	20.9316	20.9818	20.9823	20.8778	20.5156	19.9213	19.3534	(87)
Th 2	20.0188	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	(88)
util rest of house	0.9030	0.8774	0.8163	0.7047	0.5462	0.3541	0.2158	0.2131	0.4485	0.7022	0.8510	0.9116	(89)
MIT 2	18.5579	18.7528	19.1346	19.5511	19.8551	19.9935	20.0236	20.0243	19.9602	19.6632	19.1097	18.5570	(90)
Living area fraction	18.7521	18.9469	19.3326	19.7568	20.0710	20.2196	20.2546	20.2552	20.1814	19.8686	19.3053	18.7490	(91)
MIT	18.6021	18.7969	19.1826	19.6068	19.9210	20.0696	20.1046	20.1052	20.0314	19.7186	19.1553	18.5990	(92)
Temperature adjustment												-0.1500	
adjusted MIT												18.5990	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.8819	0.8554	0.7946	0.6883	0.5400	0.3571	0.2222	0.2201	0.4486	0.6867	0.8289	0.8914	(94)
Ext temp.	712.3812	761.4226	784.5120	760.0400	624.3085	423.0226	250.1079	230.2707	432.8793	589.8190	654.2719	674.6609	(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	1341.7985	1315.1109	1182.1233	982.1946	710.4335	442.1437	253.4304	233.2561	468.6363	760.7850	1057.9336	1305.1992	(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	468.2864	372.0785	295.8229	159.9513	64.0770	0.0000	0.0000	0.0000	0.0000	127.1987	290.6365	469.1205	(98)
Space heating per m2												2247.1719	(98)
												(98) / (4) =	23.6544 (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													2480.3221 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	468.2864	372.0785	295.8229	159.9513	64.0770	0.0000	0.0000	0.0000	0.0000	127.1987	290.6365	469.1205	(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)	516.8725	410.6827	326.5153	176.5467	70.7252	0.0000	0.0000	0.0000	0.0000	140.3959	320.7908	517.7930	(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	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	89.6647	89.5968	89.3989	88.9969	88.2554	87.1000	87.1000	87.1000	87.1000	88.7641	89.3948	87.1000	(216)
Fuel for water heating, kWh/month	183.1121	160.4080	166.2163	146.0241	141.6347	124.3529	115.7351	132.0878	133.4496	151.9950	164.1550	177.4394	(219)
Water heating fuel used													1796.6100 (219)
Annual totals kWh/year													
Space heating fuel - main system													2480.3221 (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)
Total delivered energy for all uses													4810.9427 (238)

10a. Fuel costs - using BEDF prices (461)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2480.3221	3.9700	98.4688 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1796.6100	3.9700	71.3254 (247)
Mechanical ventilation fans	64.0348	18.2700	11.6991 (249)
Pumps and fans for heating	75.0000	18.2700	13.7025 (249)
Energy for lighting	394.9758	18.2700	72.1621 (250)
Additional standing charges			90.0000 (251)
Total energy cost			357.3579 (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	2480.3221	0.2160	535.7496 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1796.6100	0.2160	388.0678 (264)
Space and water heating			923.8174 (265)
Pumps and fans	139.0348	0.5190	72.1590 (267)
Energy for lighting	394.9758	0.5190	204.9924 (268)
Total kg/year			1200.9688 (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	2480.3221	1.2200	3025.9930 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1796.6100	1.2200	2191.8642 (264)
Space and water heating			5217.8573 (265)
Pumps and fans	139.0348	3.0700	426.8367 (267)
Energy for lighting	394.9758	3.0700	1212.5757 (268)
Primary energy kWh/year			6857.2697 (272)
Primary energy kWh/m2/year			72.1818 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85
Current environmental impact rating: B 87

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 31	-191 kg (15.9%)
U Solar photovoltaic panels	+ 9.5	-£ 380	-1079 kg (106.8%)
V2 Wind turbine	+ 19.7	-£ 653	-1856 kg (2715.8%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£31	2.01 kg/m²	B 86 B 89
Solar photovoltaic panels	£380	11.36 kg/m²	A 96 A 97
Wind turbine	£653	19.53 kg/m²	A 115 A 115
Total Savings	£1064	32.89 kg/m²	

Potential energy efficiency rating: A 115
 Potential environmental impact rating: A 115

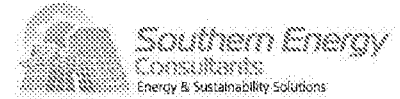
Fuel prices for cost data on this page from database revision number 461 TEST (26 May 2020)
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£98	£107	-£9
Mains gas	£260	£220	£40
Space heating	£214	£214	£0
Water heating	£71	£41	£31
Lighting	£72	£72	£0
Generated (PV)	-£0	-£380	£380
Generated (wind)	-£0	-£653	£653
Total cost of fuels	£358	-£706	£1064
Total cost of uses	£357	-£706	£1064
Delivered energy	51 kWh/m²	-19 kWh/m²	70 kWh/m²
Carbon dioxide emissions	1.2 tonnes	-1.9 tonnes	3.1 tonnes
CO2 emissions per m²	13 kg/m²	-20 kg/m²	33 kg/m²
Primary energy	72 kWh/m²	-122 kWh/m²	194 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	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					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)

	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	0.2709	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	0.1700	13.3076		(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) =	52.2192			(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) =	61.9989 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(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	102.8274	102.4110	101.9947	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864 (39)
Average = Sum(39)m / 12 =												101.4926 (39)
HLP	1.0824	1.0780	1.0736	1.0651	1.0651	1.0651	1.0651	1.0651	1.0651	1.0651	1.0651	1.0651 (40)
HLP (average)												1.0683 (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)

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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 (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)

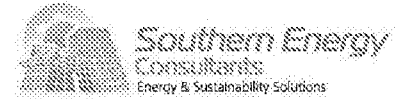
[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W		
North					11.8500	10.6334	0.7200	0.7000	0.7700	44.0103		
South					6.4200	46.7521	0.7200	0.7000	0.7700	104.8334 (74)		
Solar gains	148.8436	255.7959	361.6191	476.7419	566.8173	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	25.6633	25.7676	25.8728	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795
alpha	2.7109	2.7178	2.7249	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386
util living area												
	0.9360	0.9103	0.8693	0.7951	0.6827	0.5409	0.4154	0.4550	0.6418	0.8216	0.9103	0.9429 (86)
MIT	19.0601	19.3310	19.7263	20.2007	20.5965	20.8473	20.9456	20.9287	20.7454	20.2428	19.5795	19.0212 (87)
Th 2	20.0152	20.0188	20.0224	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294 (88)
util rest of house												
	0.9274	0.8985	0.8519	0.7673	0.6391	0.4762	0.3330	0.3712	0.5805	0.7912	0.8966	0.9352 (89)
MIT 2	18.2577	18.5241	18.9096	19.3655	19.7254	19.9352	20.0050	19.9955	19.8603	19.4152	18.7795	18.2301 (90)
Living area fraction									f _{LA} = Living area / (4) =			0.2411 (91)
MIT	18.4511	18.7186	19.1065	19.5668	19.9354	20.1551	20.2317	20.2205	20.0736	19.6147	18.9723	18.4208 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.3011	18.5686	18.9565	19.4168	19.7854	20.0051	20.0817	20.0705	19.9236	19.4647	18.8223	18.2708 (93)

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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	0.9082	0.8772	0.8294	0.7475	0.6271	0.4745	0.3376	0.3750	0.5732	0.7707	0.8754	0.9172	(94)
Useful gains	688.7810	754.9377	782.0008	763.2446	673.0836	498.9501	339.0541	353.2617	506.2358	620.6004	647.5300	660.1562	(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	1439.6954	1399.8127	1270.4931	1064.1610	818.1304	546.9193	352.3044	371.4019	589.2726	896.9879	1186.1382	1423.7756	(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	558.6803	433.3560	363.4383	216.6598	107.9148	0.0000	0.0000	0.0000	0.0000	205.6323	387.7979	568.1329	(98)
Space heating												2841.6123	(98)
Space heating per m2											(98) / (4) =	29.9117	(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													3136.4374	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	558.6803	433.3560	363.4383	216.6598	107.9148	0.0000	0.0000	0.0000	0.0000	205.6323	387.7979	568.1329	(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)	616.6450	478.3179	401.1460	239.1389	119.1113	0.0000	0.0000	0.0000	0.0000	226.9672	428.0330	627.0782	(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	89.8799	89.9122	89.9656	90.1030	90.3778	87.1000	87.1000	87.1000	87.1000	89.5788	89.7639	89.8934	(216)	
Fuel for water heating, kWh/month	154.7808	113.3171	85.9734	38.2553	7.7822	0.0000	0.0000	17.2847	43.5358	90.9111	130.3524	153.6943	(219)	
Water heating fuel used												835.8872	(219)	
Annual totals kWh/year														
Space heating fuel - main system												3136.4374	(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 * 2.50 * 1080 * 0.80) =										-1727.2394			-1727.2394	(233)
Wind generation													-3575.5408	(234)
Total delivered energy for all uses													-746.4450	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3136.4374	3.4800	109.1480	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	835.8872	3.4800	29.0889	(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	-1727.2394	13.1900	-227.8229	(252)
Wind Turbine	-3575.5408	13.1900	-471.6138	(252)
Total energy cost			-364.1688	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	-1.0925	(257)
SAP value		115.2405	
SAP rating (Section 12)		115	(258)
SAP band		A	

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.12r02

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



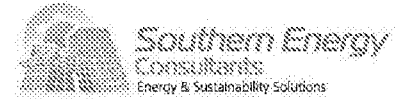
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	3136.4374	0.2160	677.4705 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	835.8872	0.2160	180.5516 (264)
Space and water heating			858.0221 (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	-1727.2394	0.5190	-896.4372 (269)
Wind Turbine	-3575.5408	0.5190	-1855.7056 (269)
Total kg/year			-1591.0193 (272)
CO2 emissions per m2			-16.7500 (273)
EI value			115.2283
EI rating			115 (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	=	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	0.1700	13.3076		(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) =		52.2192		(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) =	61.9989 (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	102.4110	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864	101.1864 (39)
Average = Sum(39)m / 12 =												101.2885 (39)
HLP	Jan 1.0780	Feb 1.0651	Mar 1.0651	Apr 1.0651	May 1.0651	Jun 1.0651	Jul 1.0651	Aug 1.0651	Sep 1.0651	Oct 1.0651	Nov 1.0651	Dec 1.0651 (40)
HLP (average)												1.0662 (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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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)

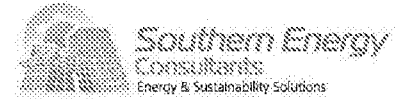
[Jan]				Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				11.8500	14.6401	0.7200	0.7000	0.7700	60.5934 (74)			
South				6.4200	61.3950	0.7200	0.7000	0.7700	137.6676 (78)			
Solar gains	198.2610	285.2397	406.1191	559.7953	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, nll,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	25.7676	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795	26.0795
alpha	2.7178	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386	2.7386
util living area												
	0.9148	0.8918	0.8379	0.7387	0.5978	0.4229	0.2973	0.3008	0.5219	0.7456	0.8715	0.9227 (86)
MIT	19.3636	19.5579	19.9561	20.4042	20.7510	20.9316	20.9818	20.9823	20.8778	20.5156	19.9213	19.3534 (87)
Th 2	20.0188	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294	20.0294 (88)
util rest of house												
	0.9030	0.8774	0.8163	0.7047	0.5462	0.3541	0.2158	0.2131	0.4485	0.7022	0.8510	0.9116 (89)
MIT 2	18.5579	18.7528	19.1346	19.5511	19.8551	19.9935	20.0236	20.0243	19.9602	19.6632	19.1097	18.5570 (90)
Living area fraction									fLa = Living area / (4) =			0.2411 (91)
MIT	18.7521	18.9469	19.3326	19.7568	20.0710	20.2196	20.2546	20.2552	20.1814	19.8686	19.3053	18.7490 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.6021	18.7969	19.1826	19.6068	19.9210	20.0696	20.1046	20.1052	20.0314	19.7186	19.1553	18.5990 (93)

Regs Region: England
Elmhurst Energy Systems
SAP2012 Calculator (Design
System) version 4.12r02

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	0.8819	0.8554	0.7946	0.6883	0.5400	0.3571	0.2222	0.2201	0.4486	0.6867	0.8289	0.8914	(94)
Useful gains	712.3812	761.4226	784.5120	760.0400	624.3085	423.0226	250.1079	230.2707	432.8793	589.8190	654.2719	674.6609	(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													
	1341.7985	1315.1109	1182.1233	982.1946	710.4335	442.1437	253.4304	233.2561	468.6363	760.7850	1057.9336	1305.1992	(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													
	468.2864	372.0785	295.8229	159.9513	64.0770	0.0000	0.0000	0.0000	0.0000	127.1987	290.6365	469.1205	(98)
Space heating													
Space heating per m2													(98) / (4) =
													23.6544 (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													2480.3221	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	468.2864	372.0785	295.8229	159.9513	64.0770	0.0000	0.0000	0.0000	0.0000	127.1987	290.6365	469.1205	(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)	516.8725	410.6827	326.5153	176.5467	70.7252	0.0000	0.0000	0.0000	0.0000	140.3959	320.7908	517.7930	(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	89.7977	89.8265	89.8567	90.0236	90.3017	87.1000	87.1000	87.1000	87.1000	89.2423	89.5967	89.7957	(216)	
Fuel for water heating, kWh/month	149.1014	112.9770	85.3411	33.6792	6.3558	0.0000	0.0000	8.4255	36.5890	86.8420	125.3219	149.8430	(219)	
Water heating fuel used														
Annual totals kWh/year													794.4759	(219)
Space heating fuel - main system													2480.3221	(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 * 2.50 * 1299 * 0.80) =													-2078.5905	(233)
Wind generation													-3575.5408	(234)
Total delivered energy for all uses													-1795.3226	(238)

10a. Fuel costs - using BEDF prices (461)

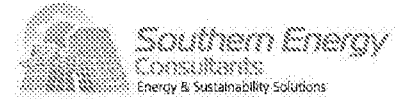
	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2480.3221	3.9700	98.4688	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	794.4759	3.9700	31.5407	(247)
Mechanical ventilation fans	64.0348	18.2700	11.6991	(249)
Pumps and fans for heating	75.0000	18.2700	13.7025	(249)
Pump for solar water heating	50.0000	18.2700	9.1350	(249)
Energy for lighting	394.9758	18.2700	72.1621	(250)
Additional standing charges			90.0000	(251)
Energy saving/generation technologies				
PV Unit	-2078.5905	18.2700	-379.7585	(252)
Wind Turbine	-3575.5408	18.2700	-653.2513	(252)
Total energy cost			-706.3016	(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	2480.3221	0.2160	535.7496	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	794.4759	0.2160	171.6068	(264)
Space and water heating			707.3564	(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

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

Energy saving/generation technologies			
PV Unit	-2078.5905	0.5190	-1078.7885 (269)
Wind Turbine	-3575.5408	0.5190	-1855.7056 (269)
Total kg/year			-1924.0362 (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	2480.3221	1.2200	3025.9930 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	794.4759	1.2200	969.2607 (264)
Space and water heating			3995.2537 (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	-2078.5905	3.0700	-6381.2728 (269)
Wind Turbine	-3575.5408	3.0700	-10976.9101 (269)
Primary energy kWh/year			-11570.0168 (272)
Primary energy kWh/m2/year			-121.7897 (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	62.00 (37)
Summer heat loss coefficient	689.00 (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)

Summer gain/loss ratio	1.81	1.71	1.59	(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	18.51	20.41	20.39	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature: Not significant

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