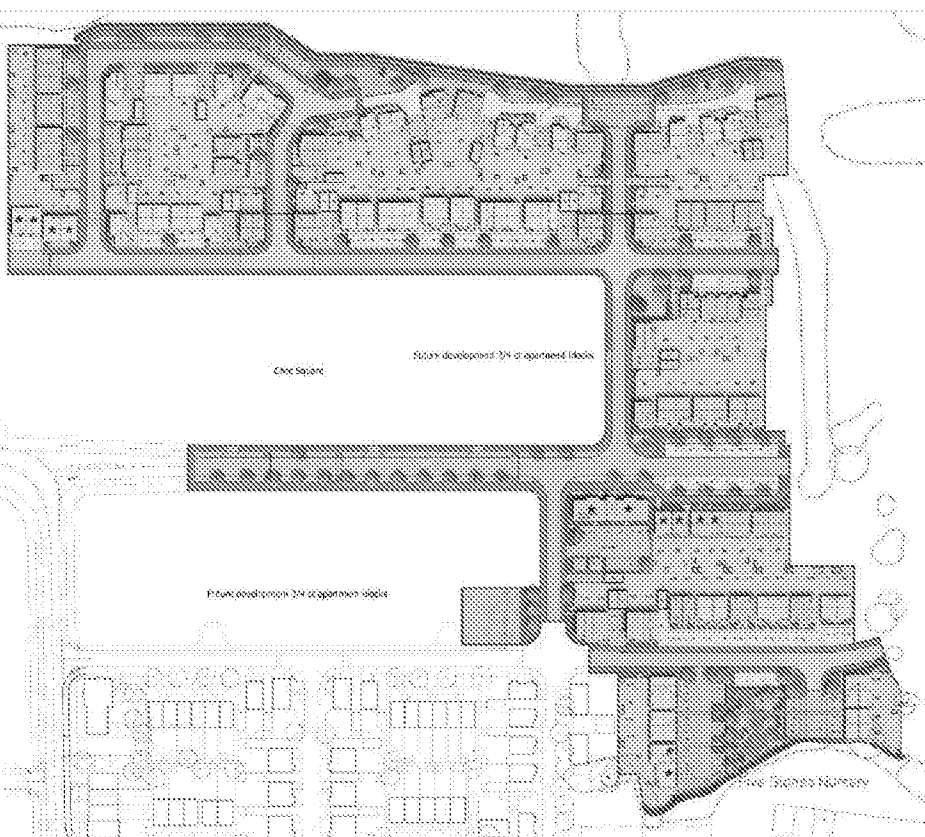


PERSIMMON

Together we make a home

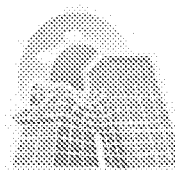
LITTLEHAMPTON PHASE 2 - PARCELS C1 & PART PARCELS B2, B4, C2



ENERGY STATEMENT

28th March 2017

SECA/DC/ES/35067
ARUN DISTRICT COUNCIL LU/121/17/RES



Southern Energy
Consultants
Energy & Sustainability Solutions

About Southern Energy Consultants Ltd

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

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

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

Report prepared by:
QA:

David Cook
Steve Smith

28th March 2017

Report type:

Planning Application Supporting Document

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1.0 Introduction

1.1 This Energy Statement has been commissioned by Persimmon Homes (the Client) and carried out by Southern Energy Consultants as part of a comprehensive analysis of available opportunities to reduce carbon dioxide emissions and energy consumption across Phase 2 of their development at Littlehampton. The site falls under the West Sussex District Council jurisdiction and the Client has secured planning consent for the development of 126 dwellings of mixed type and tenure.

1.2 This Statement provides a response to Planning Condition 31 of the Consent (Application Reference: LU/47/11). Condition 31 is entitled 'Energy' and states the following:

"At least 10% of the energy supply of the development shall be secured from decentralised and renewable or low carbon energy sources (as described in the glossary at Annex 2 of the National Planning Policy Framework, March 2012). Details and a timetable of how this is to be achieved for each phase or sub phase of development, including details of physical works on site, shall be submitted to and approved in writing by the Local Planning Authority before any development in that phase or sub phase begins. The development shall be implemented in accordance with the approved details and timetable and retained as operational thereafter, unless otherwise agreed in writing by the Local Planning Authority."

1.3 The Client intends to deliver a 10% reduction in the energy demand standard set by Part L1a of Building Regulations – the Target Fabric Energy Efficiency (measured in kWh/m²/year) – through the adoption of best practice energy efficiency measures. The Client's proposed approach for minimising the energy demand from new dwellings at Phase 2 of the Littlehampton development is supported by national planning policy guidance and will reduce fuel bills for future occupants. At a national level, planning policy guidance is stimulated by the Climate Change Act (2008) and fully espoused within the National Planning Policy Framework (2012) (NPPF). The Climate Change Act requires the UK Government to "ensure that the net UK carbon account for the year 2050 is at least 80% lower than the 1990 baseline". This legal commitment sets the overriding objective for sustainable energy provision in the UK: the reduction of carbon dioxide emissions. It is therefore the minimisation of carbon dioxide emissions and energy demand that must be given primacy over the maximisation of low carbon and renewable energy generation: a focus on the latter can restrict the

strategies to most effectively meet the former. In 2012, the NPPF was published. This document asserts that:

“At the heart of the NPPF is a presumption in favour of sustainable development which should be seen as a golden thread running through both plan-making and decision-taking. For decision-taking this means:

- *Approving development proposals that accord with the development plan without delay; and*
- *Where the development plan is absent, silent or relevant, policies are out-of-date granting permission unless*
 - *Any adverse impacts of doing so would significantly and demonstrably outweigh the benefits when assessed against the policies in this Framework taken as a whole; or*
 - *Specific policies in this Framework indicate development should be restricted.”*

1.4 Paragraph 95 of the NPPF proceeds to state that:

“To support the move to a low carbon future, local planning authorities should:

- *Plan for new development in locations and ways which reduce greenhouse gas emissions;*
- *Actively support energy efficiency improvements to existing buildings”*

1.5 In the light of the requirements set by Planning Condition 31 and the NPPF, this Statement will set out an array of best practice energy efficiency proposals, sufficient for the 126 dwellings proposed for Phase 2 of the Littlehampton development to deliver reductions in energy demand of at least 10% compared to a Part L1a (2013) compliant baseline for Target Fabric Energy Efficiency.

2.0 Energy Demand Baseline and Energy Efficiency Proposals

Building Regulations (2013) Baseline

2.1 In order that an energy assessment can be conducted, a Building Regulation (2013) baseline for energy demand first has to be calculated for the 126 dwellings. The predicted energy demand for the dwellings has been calculated by an accredited energy assessor using SAP (2012) methodology and Elmhurst approved software. This baseline will then be used as a standard to demonstrate the reductions in energy demand that will result from energy efficiency measures.

2.2 The Building Regulations (2013) baseline for the development identifies predicted annual energy demand, relative to the Target Fabric Energy Efficiency standard, of **565,501 kWh/year**. Table 1 below sets out the baseline energy demand for each dwelling type, with detailed examples of SAP calculations provided in the Appendix to this Statement.

Table 1: Baseline Energy Demand (kWh/year) for Phase 2, Littlehampton

	Number of Dwellings	Energy Demand (kWh/year)	Total Energy Demand (kWh/year)
Private			
Alnwick	13	3,149	40,937
Hanbury	16	3,771	60,336
Souter	18	4,401	79,218
Hatfield	8	4,484	35,872
Clayton	5	5,397	26,985
Greyfriars	6	4,801	28,806
Leicester	6	5,251	31,506
Lumley	5	6,248	31,240
Chedworth	2	6,150	12,300
Wolvesey	8	6,109	48,872
Corfe	3	7,137	21,411
Sub-total			417,483
Affordable			
WP2420A	20	3,717	74,340
WP3520A/C	4	4,195	16,780
WP3625A	6	6,032	36,192
2B4P	4	3,451	13,804
2B3P	2	3,451	6,902
Sub-total			148,018
TOTAL			565,501

2.3 In accordance with the Client's intentions set out in the Introduction, this Statement will now continue by detailing the range of best practice energy efficiency measures to deliver a reduction of

at least 10% compared to the baseline scenario. This amounts to a required reduction of at least 56,550 kWh/year.

Best Practice Energy Efficiency Measures

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

Table 2: Insulation Enhancement Proposals for Main Thermal Elements

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	0.25	16.67
Roof (joists)	0.20	0.11	45.00
Roof (rafters)	0.20	0.15	25.00
Ground floor	0.25	0.11	45.00
Windows	2.00	1.30	35.00

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

Table 3: Fabric Enhancement Construction Specification

Construction Element	Delivered U-Value	Insulation Specification
Main external walls	0.25	'Space 4' timber frame construction including phenolic foam insulation.
Roof (joists)	0.10	One layer of 100mm Isover insulation quilt laid between ceiling joists and one layer of 300mm Isover laid over to provide a total thickness of 400mm.
Ground floor	0.11	Thermalite Floorblock Beam Infil (100mm), 75mm screed and 150mm Kingspan Thermafloor TF70 rigid insulation.
Windows	1.40	PVCu double-glazed windows to specialist BFRC approved manufacturers design and specification, with 0.72 'g' value.

2.6 The performance standards and fabric measures detailed in Tables 2 and 3 will result in a reduced space heating requirement for the development. The specified boiler for all dwellings will be the Ideal Logic ES 35 Combi, which has SEDBUK energy efficiency of 88.9%. The dwellings will also benefit from the installation of optimum start thermostats and advanced Time and Temperature Zone controls. With regards to the latter, it will be possible for future occupants to minimise the energy demand and carbon dioxide emissions associated with the heating operation of their home in two defined localities. The general southerly orientation of the dwellings will also greatly assist in delivering passive solar gains, further reducing annual carbon dioxide emissions from space heating.

2.7 Air tightness standards will be improved by the Applicant adopting Accredited Construction Details (including Space 4 specific psi values) for non-repeating thermal bridges. These details incorporate an improvement over Building Regulations (2013) requirements by reducing air leakage loss and convective bypass of insulation. The Applicant will reduce the dwelling's design air permeability from 10m³/hm² to 5m³/hm² to further reduce space heating requirements.

2.8 It is not proposed to provide any mechanical cooling to the proposed dwellings. Instead it is the intention of the Applicant to reduce the need for active cooling as far as possible. This will be achieved through the specification of mainly non-mechanical measures such as good thermal insulation and an air tight build. Ventilation to the dwellings will be facilitated via the installation of highly efficient intermittent extract fans. In addition, the development will adopt a range of passive ventilation measures. Openable windows will be installed as a necessary fixture to facilitate natural ventilation. These will help facilitate cross-ventilation, convective-ventilation and night purging.

2.9 All of the internal lighting throughout the development will be of the dedicated low energy type. Although not assessed under Building Regulations Part L1a, external lighting will also be low energy and some will be controlled through PIR sensors or daylight cut-off devices.

Energy Demand After Energy Efficiency Proposals

2.10 The energy efficiency measures detailed in Paragraphs 2.4 to 2.9 will reduce the predicted energy demand at the Littlehampton, Phase 2 development from **565,501 kWh/year** to **504,370 kWh/year**. A full dwelling type breakdown is provided in Table 4 below and detailed calculation examples are provided in the Appendix. Note that as these are the actual calculations rather than theoretical baseline standards necessary to pass Part L1a of Building Regulations, energy demand is calculated with reference to the Dwelling (not Target) Fabric Energy Efficiency.

Table 4: Energy Demand After Energy Efficiency Measures (kWh/year) at Littlehampton, Phase 2

	Number of Dwellings	Energy Demand (kWh/year)	Total Energy Demand (kWh/year)
Private			
Alnwick	13	2,794	36,322
Hanbury	16	3,324	53,184
Souter	18	3,917	70,506
Hatfield	8	4,031	32,248
Clayton	5	4,830	24,150
Greyfriars	6	4,273	25,638
Leicester	6	4,723	28,338

Lumley	5	5,573	27,865
Chedworth	2	5,498	10,996
Wolvesey	8	5,461	43,688
Corfe	3	6,381	19,143
Sub-total			372,078
Affordable			
WP2420A	20	3,327	66,540
WP3520A/C	4	3,763	15,052
WP3625A	6	5,368	32,208
2B4P	4	3,082	12,328
2B3P	2	3,082	6,164
Sub-total			132,292
TOTAL			504,370

- 2.11 The Client's raft of best practice energy efficiency measures have reduced the development's regulated energy demand by **61,131 kWh/year** compared to the baseline compliance scenario. Proportionally compared to the baseline, this is a reduction of **10.81%**.

3.0 Conclusion

- 3.1 This Energy Statement has set out the Client's detailed energy strategy pertaining to Phase 2 of their development at Littlehampton. The strategy has been developed to comply in full with the requirements of Planning Condition 31 and the NPPF by delivering a 10% reduction in energy demand compared to the target standard set by Part L1a of Building Regulations (2013). The focus of the strategy has been to reduce energy consumption at the point of demand by introducing a robust fabric specification and efficient heating and ventilation systems. SAP calculations, carried out by an accredited energy assessor, have verified that the Client's proposed approach will deliver a **10.81%** reduction in energy demand compared to the baseline scenario. Once dwellings are built, as built compliance reports will be compiled to verify that the development has been built out in accordance with the energy efficiency measures proposed in this Statement.

Appendix

Example SAP calculations:

Plot 13 (Alnwick)

Plot 18 (Hanbury)

Southern Energy
Services
Residential & Commercial Energy Solutions

Property Reference	SECLIT013			Issued on Date	23/03/2017
Survey Reference	001	Prop Type Ref	Ainwick		
Property	Plot 13, Littlehampton, Phase 2, Littlehampton, West Sussex, BN17				
SAP Rating	83 B	DER	19.04	TER	19.93
Environmental	86 B	% DER<TER	4.44		
CO ₂ Emissions (t/year)	0.96	DFEE	47.13	TREE	53.12
General Requirements Compliance	Pass	% DFEE<TFEE	11.28		
Surveyor	Stephen Smith, Tel: 01635 261582			Surveyor ID	D168-0001
Client	Persimmon Homes South East				

SAP2012 - 9.92 input data (DesignData) -

SAP2012 Input Data (House) 23/03/2017

FullRefNo: 001

Regs Region:	England
SAP Region:	South East England
Postcode:	BN17
DwellingOrientation:	West
Property Type:	House, End-Terrace
Storeys:	2
Date Built:	2015
Sheltered Sides:	2
Sunlight Shade:	Average or unknown
Measurements	Perimeter, Floor Area, Storey Height
1st Storey:	17.5, 30.69, 2.31
2nd Storey:	17.5, 28.59, 2.54
Fixed	23.95, 23.95, 23.95

[illegible]

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

SAP2012 - 9.92 input data (DesignData) -

31. Party wall, P4 Party wall - Roof (insulation at ceiling level), Table K1 - Default, No, 7.26, 0.24, 0.24, 1.74, Default
32. Party wall, P5 Party wall - Roof (insulation at rafter level), , No, 0, 0, 0, 0.00,
33. External roof, R1 Head of roof window, , No, 0, 0, 0, 0.00,
34. External roof, R2 Sill of roof window, , No, 0, 0, 0, 0.00,
35. External roof, R3 Jamb of roof window, , No, 0, 0, 0, 0.00,
36. External roof, R4 Ridge (vaulted ceiling), , No, 0, 0, 0, 0.00,
37. External roof, R5 Ridge (inverted), , No, 0, 0, 0, 0.00,
38. External roof, R6 Flat ceiling, , No, 0, 0, 0, 0.00,
39. External roof, R7 Flat ceiling (inverted), , No, 0, 0, 0, 0.00,
40. External roof, R8 Roof to wall (rafter), , No, 0, 0, 0, 0.00,
41. External roof, R9 Roof to wall (flat ceiling), , No, 0, 0, 0, 0.00,
Pressure Test: True
Designed q50: 5
AsBuilt q50: 15
Property Tested: False
Mechanical Ventilation: None
Chimneys MHS: 0
Chimneys SHS: 0
Chimneys Other: 0
Chimneys Total: 0
Open Flues MHS: 0
Open Flues SHS: 0
Open Flues Other: 0
Open Flues Total: 0
Intermittent Fans: 3
Passive Vents: 0
Flueless Gas Fires: 0
Cooling System: None
Light Fittings: 20
LEL Fittings: 20
Percentage of LEL Fittings: 100
External Lights Fitted: Yes
External LELs Fitted: Yes
Electricity Tariff: Standard
Main Heating 1
Description
Percentage 100
Sedbuk ID 17045
Fuel Type Mains gas
MHS Mains gas BGW Post 98 Combi condens. with auto ign.
SAP Code 104
Boiler Efficiency Type Split Efficiencies
Efficiency Winter 89.8
Efficiency Summer 87.3
Controls by PCDF 0
MHS Controls CBI Time and temperature zone control
Boiler Interlock Yes
Compensator 0
Delayed Start Stat Yes
Ctrl SAP Code 2110
Flue Type Balanced
Fan Assisted Flue Yes
Pumped Pump in heated space
Heat Pump Age 2013 or later
Heat Emitter Radiators
Flow Temperature Normal (> 45°C)
Combi boiler type Standard Combi
Combi keep hot type None
Main Heating 2 None
Heating Systems Interaction Each system heats separate parts of dwelling
Smoke Control Area Unknown
Community Heating None
Secondary Heating None
Water Heating
Type MainHeating1
WHS HWP From main heating 1
Low Water Usage Yes
SAP Code 901
Showers in Property Non-electric only
Hot Water Cylinder None
Flue Gas Heat Recovery System None
Waste Water Heat Recovery none
PV Unit None
Wind Turbine None
Terrain Type: Urban
Small Scale Hydro None
Special Features None

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

DWELLING AS DESIGNED

End-Terrace House, total floor area 59 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) 19.93 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 19.04 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 53.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 47.1 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest
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Regs Region: England

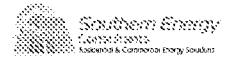
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.03r08

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



SAP2012 - 9.92 input data (DesignData) -

External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.20 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging			
Thermal bridging calculated using user-specified y-value of 0.044			

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

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

Secondary heating system:	None		

5 Cylinder insulation			
Hot water storage	No cylinder		

6 Controls			
Space heating controls:	Time and temperature zone control		OK

Hot water controls:	No cylinder		

Boiler interlock	Yes		OK

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

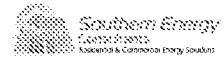
8 Mechanical ventilation			
Not applicable			

9 Summertime temperature			
Overheating risk (South East England):	Medium		OK
Based on:			
Overshading:	Average		
Windows facing North:	0.44 m², No overhang		
Windows facing East:	5.69 m², No overhang		
Windows facing West:	3.65 m², No overhang		
Air change rate:	3.00 ach		
Blinds/curtains:	None		

10 Key features			
Party wall U-value	0.00 W/m²K		
Roof U-value	0.11 W/m²K		
Floor 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	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 143.5125 (5)

2. Ventilation rate

	main heating	+	secondary heating	+	other	=	total	m3 per hour				
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000 (6a)				
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)				
Number of intermittent fans							3 * 10 =	30.0000 (7a)				
Number of passive vents							0 * 10 =	0.0000 (7b)				
Number of flueless gas fires							0 * 40 =	0.0000 (7c)				
Air changes per hour												
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =						30.0000 / (5) =	0.2090 (8)				
Pressure test							Yes					
Measured/design q50							5.0000					
Infiltration rate							0.4590	(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) =	0.3902 (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	0.4975	0.4877	0.4780	0.4292	0.4194	0.3707	0.3707	0.3609	0.3902	0.4194	0.4390	0.4585 (22b)
Effective ac	0.6237	0.6189	0.6142	0.5921	0.5880	0.5687	0.5687	0.5651	0.5761	0.5880	0.5963	0.6051 (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	1.3000	2.5350			(26)				
Opening Type 2 (Uw = 1.30)			9.7800	1.2357	12.0856			(27)				
Heat Loss Floor 1			30.6900	0.1100	3.3759			(28a)				
External Wall 1	84.8800	11.7300	73.1500	0.2500	18.2875			(29a)				
External Roof 1	28.5900		28.5900	0.1100	3.1449			(30)				
External Roof 2	2.1000		2.1000	0.2000	0.4200			(30)				
Total net area of external elements Aum(A, m2)			146.2600					(31)				
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.8489			(33)				
Party Wall 1			36.3800	0.0000	0.0000			(32)				
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								100.0000 (35)				
Thermal bridges (User defined value 0.044 * total exposed area)								6.4354 (36)				
Total fabric heat loss						(33) + (36) =		46.2843 (37)				
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 29.5401	Feb 29.3125	Mar 29.0894	Apr 28.0417	May 27.8457	Jun 26.9331	Jul 26.9331	Aug 26.7642	Sep 27.2846	Oct 27.8457	Nov 28.2422	Dec 28.6568 (38)
Heat transfer coeff	75.8244	75.5968	75.3737	74.3260	74.1300	73.2174	73.2174	73.0484	73.5689	74.1300	74.5265	74.9411 (39)
Average = Sum(39)m / 12 =												74.3251 (39)
HLP	Jan 1.2791	Feb 1.2752	Mar 1.2715	Apr 1.2538	May 1.2505	Jun 1.2351	Jul 1.2351	Aug 1.2323	Sep 1.2410	Oct 1.2505	Nov 1.2572	Dec 1.2642 (40)
HLP (average)												1.2538 (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												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy content (annual)	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Distribution loss	Total = Sum(45)m = 1270.9623 (45)											
	19.7657	17.2872	17.8389	15.5524	14.9229	12.8773	11.9327	13.6930	13.8565	16.1484	17.6273	19.1421 (46)
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	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	25.9089	23.2912	25.6110	24.5859	25.2608	24.2791	24.9846	25.1637	24.4463	25.4661	24.8752	25.8513 (61)
Total heat required for water heating calculated for each month	157.6805	138.5395	144.5369	128.2684	124.7466	110.1278	104.5360	116.4501	116.8230	133.1222	142.3903	153.4650 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	157.6805	138.5395	144.5369	128.2684	124.7466	110.1278	104.5360	Solar input (sum of months) = Sum(63)m = 0.0000 (63)				
Heat gains from water heating, kWh/month	50.2913	44.1429	45.9456	40.6209	39.3942	34.6145	32.6970	36.6437	36.8268	42.1622	45.2926	48.8944 (65)
	Total per year (kWh/year) = Sum(64)m = 1570.6864 (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	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.8223	14.0532	11.4288	8.6524	6.4677	5.4603	5.9001	7.6692	10.2935	13.0700	15.2546	16.2620	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	171.1275	172.9032	168.4284	158.9019	146.8764	135.5742	128.0236	126.2478	130.7227	140.2492	152.2746	163.5769	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	(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)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	(71)
Water heating gains (Table 5)	67.5958	65.6888	61.7548	56.4179	52.9492	48.0757	43.9476	49.2522	51.1484	56.6696	62.9063	65.7183	(72)
Total internal gains	309.9637	308.0633	297.0301	279.3903	261.7115	244.5282	233.2893	238.5873	247.5827	265.4069	285.8537	300.9753	(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				0.4400	10.6334		0.7200		0.7000		0.7700		1.6341 (74)
East				5.6900	19.6403		0.7200		0.7000		0.7700		39.0322 (76)
West				3.6500	19.6403		0.7200		0.7000		0.7700		25.0382 (80)
Solar gains	65.7046	128.4584	211.7162	309.5599	380.4134	389.9587	371.0303	317.9565	246.4432	152.4385	81.9043	54.0507	(83)
Total gains	375.6683	436.5217	508.7464	588.9502	642.1248	634.4870	604.3196	556.5438	494.0258	417.8453	367.7580	355.0260	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.7169	21.7822	21.8467	22.1547	22.2132	22.4901	22.4901	22.5421	22.3826	22.2132	22.0950	21.9728	
alpha	2.4478	2.4521	2.4564	2.4770	2.4809	2.4993	2.4993	2.5028	2.4922	2.4809	2.4730	2.4649	
util living area	0.9635	0.9466	0.9120	0.8430	0.7376	0.6001	0.4750	0.5222	0.7233	0.8863	0.9488	0.9679	(86)
MIT	18.3913	18.6779	19.1811	19.8281	20.3715	20.7428	20.8972	20.8669	20.5608	19.8333	19.0037	18.3462	(87)
Th 2	19.8573	19.8603	19.8632	19.8772	19.8798	19.8920	19.8920	19.8943	19.8873	19.8798	19.8745	19.8690	(88)
util rest of house	0.9578	0.9382	0.8979	0.8170	0.6920	0.5264	0.3737	0.4209	0.6589	0.8616	0.9394	0.9628	(89)
MIT 2	16.3934	16.8084	17.5318	18.4510	19.1888	19.6626	19.8269	19.8041	19.4583	18.4812	17.2929	16.3344	(90)
Living area fraction	16.8336	17.2202	17.8951	18.7544	19.4493	19.9006	20.0627	20.0383	19.7012	18.7791	17.6698	16.7777	(92)
MIT	16.8336	17.2202	17.8951	18.7544	19.4493	19.9006	20.0627	20.0383	19.7012	18.7791	17.6698	16.7777	(92)
Temperature adjustment	16.6836	17.0702	17.7451	18.6044	19.2993	19.7506	19.9127	19.8883	19.5512	18.6291	17.5198	16.6277	(93)

8. Space heating requirement

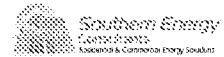
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9335	0.9086	0.8623	0.7804	0.6647	0.5160	0.3758	0.4203	0.6361	0.8251	0.9104	0.9405	(94)
Useful gains	350.6706	396.6143	438.7035	459.6371	426.8426	327.3848	227.0892	233.9048	314.2475	344.7483	334.8121	333.8885	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
Month Fracti	938.9762	920.0317	847.5872	721.2904	563.3390	377.1130	242.5504	254.8113	401.0375	595.1947	776.5512	931.3420	(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	437.6994	351.7365	304.2095	188.3904	101.5533	0.0000	0.0000	0.0000	0.0000	186.3322	318.0522	444.5054	(98)
Space heating												2332.4788	(98)
Space heating per m2											(98) / (4) =	39.3468	(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 %)													89.8000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2597.4151 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	437.6994	351.7365	304.2095	188.3904	101.5533	0.0000	0.0000	0.0000	0.0000	186.3322	318.0522	444.5054	(98)
Space heating efficiency (main heating system 1)	89.8000	89.8000	89.8000	89.8000	89.8000	0.0000	0.0000	0.0000	0.0000	89.8000	89.8000	89.8000	(210)
Space heating fuel (main heating system)	487.4158	391.6887	338.7634	209.7888	113.0884	0.0000	0.0000	0.0000	0.0000	207.4968	354.1784	494.9948	(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	157.6805	138.5395	144.5369	128.2684	124.7466	110.1278	104.5360	116.4501	116.8230	133.1222	142.3903	153.4650	(64)
Efficiency of water heater (217)m	89.1241	89.0792	88.9793	88.7703	88.4045	87.3000	87.3000	87.3000	87.3000	88.7410	89.0117	87.3000	(216)
Fuel for water heating, kWh/month	176.9225	155.5240	162.4388	144.4948	141.1090	126.1487	119.7434	133.3907	133.8179	150.0121	159.9680	172.1525	(219)
Water heating fuel used												1775.7223	(219)
Annual totals kWh/year													
Space heating fuel - main system												2597.4151	(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)												279.4265	(232)
Total delivered energy for all uses												4727.5640	(238)

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

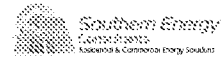
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2597.4151	0.2160	561.0417 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1775.7223	0.2160	383.5560 (264)
Space and water heating			944.5977 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	279.4265	0.5190	145.0224 (268)
Total CO2, kg/year			1128.5450 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			19.0400 (273)

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

DER		19.0400 ZC1
Total Floor Area	TFA	59.2800
Assumed number of occupants	N	1.9612
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		17.1064 ZC2
CO2 emissions from cooking, equation (L16)		2.8014 ZC3
Total CO2 emissions		38.9478 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		38.9478 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 143.5125 (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) = 0.2090 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4590 (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) =	0.3902 (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	0.4975	0.4877	0.4780	0.4292	0.4194	0.3707	0.3707	0.3609	0.3902	0.4194	0.4390	0.4585 (22b)
Effective ac	0.6237	0.6189	0.6142	0.5921	0.5880	0.5687	0.5687	0.5651	0.5761	0.5880	0.5963	0.6051 (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	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.30)			9.7800	1.2357	12.0856		(27)
Heat Loss Floor 1			30.6900	0.1100	3.3759		(28a)
External Wall 1	84.8800	11.7300	73.1500	0.2500	18.2875		(29a)
External Roof 1	28.5900		28.5900	0.1100	3.1449		(30)
External Roof 2	2.1000		2.1000	0.2000	0.4200		(31)
Total net area of external elements Aum(A, m ²)			146.2600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.8489		(33)
Party Wall 1			36.3800	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (User defined value 0.044 * total exposed area)							6.4354 (36)
Total fabric heat loss						(33) + (36) =	46.2843 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	29.5401	29.3125	29.0894	28.0417	27.8457	26.9331	26.9331	26.7642	27.2846	27.8457	28.2422	28.6568 (38)
Heat transfer coeff	75.8244	75.5968	75.3737	74.3260	74.1300	73.2174	73.2174	73.0484	73.5689	74.1300	74.5265	74.9411 (39)
Average = Sum(39)m / 12 =												74.3251 (39)
HLP	1.2791	1.2752	1.2715	1.2538	1.2505	1.2351	1.2351	1.2323	1.2410	1.2505	1.2572	1.2642 (40)
HLP (average)												1.2538 (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												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m												
19.7657	17.2872	17.8389	15.5524	14.9229	12.8773	11.9327	13.6930	13.8565	16.1484	17.6273	19.1421 (46)	
Water storage loss:												
Store volume												150.0000 (47)

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b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)											0.0191	(51)	
Volume factor from Table 2a											0.9283	(52)	
Temperature factor from Table 2b											0.5400	(53)	
Enter (49) or (54) in (55)											1.4364	(55)	
Total storage loss													
	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(56)
If cylinder contains dedicated solar storage													
	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	43.0918	44.5282	43.0918	44.5282	(57)	
Primary loss													
	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	(59)	
Total heat required for water heating calculated for each month													
	199.5622	176.4785	186.7165	169.2863	167.2764	151.4525	147.3420	159.0770	157.9805	175.4467	183.1189	195.4044	(62)
Solar input											0.0000	(63)	
											0.0000	(63)	
											0.0000	(63)	
											0.0000	(63)	
Solar input (sum of months) = Sum(63)m =											0.0000	(63)	
Output from w/h													
	199.5622	176.4785	186.7165	169.2863	167.2764	151.4525	147.3420	159.0770	157.9805	175.4467	183.1189	195.4044	(64)
Total per year (kWh/year) = Sum(64)m =											2069.1418	(64)	
Heat gains from water heating, kWh/month													
	98.0465	87.3042	93.7753	86.9575	87.3115	81.0277	80.6833	84.5852	83.1983	90.0281	91.5568	96.6640	(65)

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.8223	14.0532	11.4288	8.6524	6.4677	5.4603	5.9001	7.6692	10.2935	13.0700	15.2546	16.2620 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	171.1275	172.9032	168.4284	158.9019	146.8764	135.5742	128.0236	126.2478	130.7227	140.2492	152.2746	163.5769 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060 (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)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482 (71)
Water heating gains (Table 5)	131.7830	129.9170	126.0421	120.7743	117.3542	112.5385	108.4453	113.6898	115.5532	121.0056	127.1622	129.9248 (72)
Total internal gains	374.1508	372.2915	361.3174	343.7466	326.1164	308.9911	297.7871	303.0248	311.9875	329.7428	350.1096	365.1818 (73)

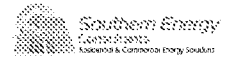
[Jan]					Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					0.4400	10.6334	0.7200	0.7000	0.7700		1.6341 (74)	
East					5.6900	19.6403	0.7200	0.7000	0.7700		39.0322 (76)	
West					3.6500	19.6403	0.7200	0.7000	0.7700		25.0307 (80)	
Solar gains	65.7046	128.4584	211.7162	309.5599	380.4134	389.9587	371.0303	317.9565	246.4432	152.4385	81.9043	54.0507 (83)
Total gains	439.8554	500.7499	573.0336	653.3065	706.5298	698.9498	668.8174	620.9814	558.4307	482.1813	432.0138	419.2325 (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	21.7169	21.7822	21.8467	22.1547	22.2132	22.4901	22.4901	22.5421	22.3826	22.2132	22.0950	21.9728
alpha	2.4478	2.4521	2.4564	2.4770	2.4809	2.4993	2.4993	2.5028	2.4922	2.4809	2.4730	2.4649
util living area												
	0.9496	0.9301	0.8909	0.8152	0.7039	0.5624	0.4381	0.4807	0.6789	0.8547	0.9296	0.9546 (86)
MIT	18.5521	18.8297	19.3157	19.9331	20.4406	20.7790	20.9146	20.8901	20.6245	19.9550	19.1567	18.5103 (87)
Th 2	19.8573	19.8603	19.8632	19.8772	19.8798	19.8920	19.8920	19.8943	19.8873	19.8798	19.8745	19.8690 (88)
util rest of house												
	0.9420	0.9196	0.8742	0.7865	0.6565	0.4896	0.3419	0.3837	0.6119	0.8255	0.9173	0.9478 (89)
MIT 2	17.6496	17.9237	18.3991	18.9984	19.4646	19.7595	19.8558	19.8445	19.6418	19.0356	18.2595	17.6166 (90)
Living area fraction												
MIT	17.8485	18.1233	18.6010	19.2043	19.6796	19.9841	20.0891	20.0748	19.8583	19.2381	18.4572	17.8135 (91)
Temperature adjustment												
adjusted MIT	17.8485	18.1233	18.6010	19.2043	19.6796	19.9841	20.0891	20.0748	19.8583	19.2381	18.4572	17.8135 (93)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9242	0.8991	0.8515	0.7665	0.6471	0.4961	0.3599	0.4005	0.6100	0.8053	0.8973	0.9310 (94)
Useful gains	406.5275	450.2272	487.9628	500.7795	457.1747	346.7363	240.7066	248.7147	340.6358	388.2856	387.6332	390.3248 (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	1027.3026	999.6376	912.0986	765.8807	591.5308	394.2106	255.4597	268.4399	423.6299	640.3445	846.4134	1020.2112 (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	461.8567	369.2038	315.5571	190.8729	99.9609	0.0000	0.0000	0.0000	0.0000	187.5319	330.3217	468.6355 (98)
Space heating												2423.9405 (98)
Space heating per m2												40.8897 (99)
										(98) / (4) =		

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

8c. Space cooling requirement

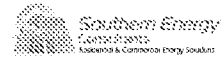
Not applicable

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

DER		22.1500	ZC1
Total Floor Area	TFA	59.2800	
Assumed number of occupants	N	1.9612	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		17.1064	ZC2
CO2 emissions from cooking, equation (L16)		2.8014	ZC3
Total CO2 emissions		42.0578	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m ² /year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		42.0578	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	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 143.5125 (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					2 * 10 = 20.0000 (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)					20.0000 / (5) = 0.1394 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3894 (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) =	0.3310 (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	0.4220	0.4137	0.4054	0.3641	0.3558	0.3144	0.3144	0.3061	0.3310	0.3558	0.3723	0.3889 (22b)
Effective ac	0.5890	0.5856	0.5822	0.5663	0.5633	0.5494	0.5494	0.5469	0.5548	0.5633	0.5693	0.5756 (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)			9.7800	1.3258	12.9659			(27)				
Heat Loss Floor 1			30.6900	0.1300	3.9897			(28a)				
External Wall 1	84.8800	11.7300	73.1500	0.1800	13.1670			(29a)				
External Roof 1	28.5900		28.5900	0.1300	3.7167			(30)				
External Roof 2	2.1000		2.1000	0.1300	0.2730			(30)				
Total net area of external elements Aum(A, m2)			146.2600					(31)				
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	36.0623			(33)				
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								6.4629 (36)				
Total fabric heat loss						(33) + (36) =		42.5252 (37)				
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 27.8959	Feb 27.7322	Mar 27.5717	Apr 26.8179	May 26.6769	Jun 26.0204	Jul 26.0204	Aug 25.8988	Sep 26.2732	Oct 26.6769	Nov 26.9622	Dec 27.2605 (38)
Heat transfer coeff	70.4211	70.2574	70.0969	69.3431	69.2021	68.5456	68.5456	68.4240	68.7984	69.2021	69.4874	69.7857 (39)
Average = Sum(39)m / 12 =												69.3424 (39)
HLP	Jan 1.1879	Feb 1.1852	Mar 1.1825	Apr 1.1698	May 1.1674	Jun 1.1563	Jul 1.1563	Aug 1.1543	Sep 1.1606	Oct 1.1674	Nov 1.1722	Dec 1.1772 (40)
HLP (average)												1.1697 (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												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m	19.7657	17.2872	17.8389	15.5524	14.9229	12.8773	11.9327	13.6930	13.8565	16.1484	17.6273	19.1421 (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 TARGET EMISSIONS 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	0.0000 (57)	
Combi loss	45.2803	39.4111	41.9872	39.0393	38.6941	35.8524	37.0475	38.6941	39.0393	41.9872	42.2262	45.2803 (61)	
Total heat required for water heating calculated for each month													
177.0519	154.6594	160.9131	142.7218	138.1799	121.7011	116.5989	129.9805	131.4160	149.6433	159.7413	172.8941	172.8941 (62)	
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 (63)	
Solar input								Solar input (sum of months) = Sum(63)m =					0.0000 (63)
177.0519	154.6594	160.9131	142.7218	138.1799	121.7011	116.5989	129.9805	131.4160	149.6433	159.7413	172.8941	172.8941 (64)	
Total per year (kWh/year) = Sum(64)m =													1755.5013 (64)
Heat gains from water heating, kWh/month													
55.1341	48.1728	50.0397	44.2343	42.7526	37.5078	35.7127	40.0263	40.4751	46.2925	49.6303	53.7516	53.7516 (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	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.8223	14.0532	11.4288	6.6524	6.4677	5.4603	5.9001	7.6692	10.2935	13.0700	15.2546	16.2620	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	171.1275	172.9032	168.4284	158.9019	146.8764	135.5742	128.0236	126.2478	130.7227	140.2492	152.2746	163.5769	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	(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)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	(71)
Water heating gains (Table 5)	74.1050	71.6858	67.2576	61.4365	57.4631	52.0942	48.0010	53.7987	56.2154	62.2210	68.9310	72.2468	(72)
Total internal gains	316.4729	314.0603	302.5329	284.4088	266.2253	248.5467	237.3427	243.1338	252.6497	270.9583	291.8783	307.5038	(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				0.4400	10.6334	0.6300		0.7000		0.7700		1.4299 (74)
East				5.6900	19.6403	0.6300		0.7000		0.7700		34.1532 (76)
West				3.6500	19.6403	0.6300		0.7000		0.7700		21.9085 (80)
Solar gains	57.4915	112.4011	185.2517	270.8649	332.8617	341.2139	324.6515	278.2120	215.6378	133.3837	71.6662	47.2944 (83)
Total gains	373.9644	426.4614	487.7846	555.2737	599.0870	589.7606	561.9942	521.3457	468.2875	404.3420	363.5446	354.7982 (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	58.4578	58.5941	58.7282	59.3666	59.4876	60.0574	60.0574	60.1641	59.8366	59.4876	59.2434	58.9901	
alpha	4.8972	4.9063	4.9152	4.9578	4.9658	5.0038	5.0038	5.0109	4.9891	4.9658	4.9496	4.9327	
util living area	0.9975	0.9948	0.9857	0.9522	0.8607	0.6917	0.5253	0.5837	0.8387	0.9742	0.9950	0.9981	(86)
MIT	19.7366	19.8872	20.1565	20.5102	20.7980	20.9513	20.9899	20.9835	20.8704	20.4855	20.0467	19.7100	(87)
Th 2	19.9297	19.9319	19.9340	19.9443	19.9462	19.9551	19.9551	19.9568	19.9517	19.9462	19.9423	19.9383	(88)
util rest of house	0.9967	0.9930	0.9806	0.9345	0.8115	0.5991	0.4064	0.4613	0.7644	0.9613	0.9930	0.9974	(89)
MIT 2	18.2521	18.4733	18.8652	19.3733	19.7508	19.9233	19.9515	19.9501	19.8484	19.3492	18.7143	18.2194	(90)
Living area fraction	18.5792	18.7848	19.1497	19.6238	19.9815	20.1498	20.1803	20.1778	20.0735	19.5995	19.0078	18.5478	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5792	18.7848	19.1497	19.6238	19.9815	20.1498	20.1803	20.1778	20.0735	19.5995	19.0078	18.5478	(93)

8. Space heating requirement

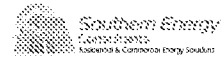
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9950	0.9902	0.9754	0.9278	0.8134	0.6175	0.4328	0.4883	0.7744	0.9556	0.9904	0.9961	(94)
Ext temp.	372.1091	422.2881	475.8050	515.1815	487.2935	364.1949	243.2087	254.5558	362.6303	386.3723	360.0401	353.4230	(95)
Heat loss rate 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	1005.5543	975.5080	886.7022	743.6210	573.0951	380.4141	245.4122	258.4888	410.9693	622.7863	827.4436	1001.2722	(97)
Space heating kWh	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 per m ²	471.2832	371.7638	305.7075	164.4764	63.8364	0.0000	0.0000	0.0000	0.0000	175.8920	336.5306	481.9998	(98)
												2371.4896	(98)
												40.0049	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

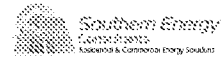
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2539.0681 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	471.2832	371.7638	305.7075	164.4764	63.8364	0.0000	0.0000	0.0000	0.0000	175.8920	336.5306	481.9998	(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)	504.5859	398.0340	327.3099	176.0990	68.3473	0.0000	0.0000	0.0000	0.0000	188.3212	360.3111	516.0598	(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	177.0519	154.6594	160.9131	142.7218	138.1799	121.7011	116.5989	129.9805	131.4160	149.6433	159.7413	172.8941	(64)
Efficiency of water heater (217)m	87.3980	87.1785	86.6420	85.4091	83.2387	80.3000	80.3000	80.3000	80.3000	85.4589	86.8825	87.4947	(217)
Fuel for water heating, kWh/month	202.5811	177.4054	185.7219	167.1038	166.0043	151.5581	145.2042	161.8686	163.6563	175.1055	183.8590	197.6053	(219)
Water heating fuel used												2077.6735	(219)
Annual totals kWh/year													
Space heating fuel - main system												2539.0681	(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)												279.4265	(232)
Total delivered energy for all uses												4971.1681	(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	2539.0681	0.2160	548.4387 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2077.6735	0.2160	449.7775 (264)
Space and water heating			997.2162 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	279.4265	0.5190	145.0224 (268)
Total CO2, kg/m2/year			1181.1635 (272)
Emissions per m2 for space and water heating			16.8221 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.4464 (272b)
Emissions per m2 for pumps and fans			0.6566 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.8221 * 1.00) + 2.4464 + 0.6566, rounded to 2 d.p.			19.9300 (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	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 143.5125 (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					2 * 10 = 20.0000 (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)					20.0000 / (5) = 0.1394 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3894 (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) =	0.3310 (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	0.4220	0.4137	0.4054	0.3641	0.3558	0.3144	0.3144	0.3061	0.3310	0.3558	0.3723	0.3889 (22b)
Effective ac	0.5890	0.5856	0.5822	0.5663	0.5633	0.5494	0.5494	0.5469	0.5548	0.5633	0.5693	0.5756 (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	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.30)			9.7800	1.2357	12.0856		(27)
Heat Loss Floor 1			30.6900	0.1100	3.3759		(28a)
External Wall 1	84.8800	11.7300	73.1500	0.2500	18.2875		(29a)
External Roof 1	28.5900		28.5900	0.1100	3.1449		(30)
External Roof 2	2.1000		2.1000	0.2000	0.4200		(31)
Total net area of external elements Aum(A, m ²)			146.2600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.8489		(33)
Party Wall 1			36.3800	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (User defined value 0.044 * total exposed area)							6.4354 (36)
Total fabric heat loss						(33) + (36) =	46.2843 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	27.8959	27.7322	27.5717	26.8179	26.6769	26.0204	26.0204	25.8988	26.2732	26.6769	26.9622	27.2605 (38)
Heat transfer coeff	74.1802	74.0165	73.8560	73.1022	72.9612	72.3046	72.3046	72.1831	72.5575	72.9612	73.2465	73.5447 (39)
Average = Sum(39)m / 12 =												73.1015 (39)
HLP	1.2514	1.2486	1.2459	1.2332	1.2308	1.2197	1.2197	1.2177	1.2240	1.2308	1.2356	1.2406 (40)
HLP (average)												1.2332 (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												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (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												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	28.0015	24.4903	25.2718	22.0325	21.1407	18.2428	16.9047	19.3984	19.6300	22.8769	24.9720	27.1179 (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	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.8223	14.0532	11.4288	8.6524	6.4677	5.4603	5.9001	7.6692	10.2935	13.0700	15.2546	16.2620	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	171.1275	172.9032	168.4284	158.9019	146.8764	135.5742	128.0236	126.2478	130.7227	140.2492	152.2746	163.5769	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	(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)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	(71)
Water heating gains (Table 5)	37.6364	36.4438	33.9674	30.6007	28.4150	25.3373	22.7213	26.0731	27.2640	30.7486	34.6833	36.4488	(72)
Total internal gains	277.0042	275.8184	266.2427	250.5731	234.1772	218.7899	209.0631	212.4081	220.6982	236.4858	254.6306	268.7058	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	0.4400	10.6334	0.7200	0.7000	0.7700	1.6341 (74)
East	5.6900	19.6403	0.7200	0.7000	0.7700	39.0322 (76)
West	3.6500	19.6403	0.7200	0.7000	0.7700	25.0382 (80)

Solar gains	65.7046	128.4584	211.7162	309.5599	380.4134	389.9587	371.0303	317.9565	246.4432	152.4385	81.9043	54.0507 (83)
Total gains	342.7088	404.2767	477.9589	560.1330	614.5906	608.7486	580.0934	530.3647	467.1414	388.9243	336.5349	322.7566 (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	22.1982	22.2473	22.2956	22.5255	22.5691	22.7740	22.7740	22.8124	22.6946	22.5691	22.4812	22.3900	
alpha	2.4799	2.4832	2.4864	2.5017	2.5046	2.5183	2.5183	2.5208	2.5130	2.5046	2.4987	2.4927	
util living area	0.9698	0.9538	0.9207	0.8535	0.7491	0.6125	0.4864	0.5370	0.7397	0.8989	0.9570	0.9737 (86)	
MIT	18.3608	18.6510	19.1599	19.8093	20.3604	20.7355	20.8941	20.8610	20.5442	19.8003	18.9626	18.3080 (87)	
Th 2	19.8791	19.8813	19.8835	19.8936	19.8954	19.9043	19.9043	19.9059	19.9009	19.8954	19.8916	19.8876 (88)	
util rest of house	0.9650	0.9465	0.9079	0.8288	0.7048	0.5394	0.3847	0.4354	0.6772	0.8764	0.9490	0.9696 (89)	
MIT 2	17.4772	17.7650	18.2660	18.8993	19.4123	19.7418	19.8579	19.8407	19.5936	18.9065	18.0840	17.4308 (90)	
Living area fraction									fLA = Living area / (4) =			0.2203 (91)	
MIT	17.6719	17.9602	18.4629	19.0998	19.6212	19.9608	20.0862	20.0655	19.8030	19.1034	18.2776	17.6240 (92)	
Temperature adjustment												0.0000	
adjusted MIT	17.6719	17.9602	18.4629	19.0998	19.6212	19.9608	20.0862	20.0655	19.8030	19.1034	18.2776	17.6240 (93)	

8. Space heating requirement

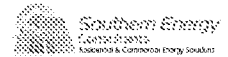
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9519	0.9299	0.8871	0.8078	0.6924	0.5435	0.4027	0.4515	0.6708	0.8562	0.9331	0.9577 (94)	
Ext temp.	326.2225	375.9181	424.0036	452.4640	425.5234	330.8300	233.6124	239.4415	313.3514	332.9822	314.0372	309.0968 (95)	
Ext temp.	4.3000	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	991.9296	966.6688	883.5349	745.6278	577.9395	387.6075	252.0684	264.5876	413.7974	620.4184	818.7169	987.2663 (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	495.2861	396.9845	341.8913	211.0779	113.3976	0.0000	0.0000	0.0000	0.0000	213.8526	363.3693	504.5581 (98)	
Space heating												2640.4175 (98)	
Space heating per m ²												44.5415 (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	679.6637	535.0544	548.5913	0.0000	0.0000	0.0000	0.0000 (100)	
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7653	0.8239	0.7939	0.0000	0.0000	0.0000	0.0000 (101)	
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	520.1334	440.8543	435.5458	0.0000	0.0000	0.0000	0.0000 (102)	
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	785.0861	750.1758	693.2656	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													

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

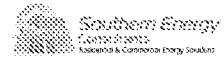


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	190.7659	230.1352	191.7436	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									FC = cooled area / (4) =			612.6447 (104)
Intermittency factor (Table 10b)												1.0000 (105)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	47.6915	57.5338	47.9359	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												153.1612 (107)
Energy for space heating												2.5837 (108)
Energy for space cooling												44.5415 (99)
Total												2.5837 (108)
Dwelling Fabric Energy Efficiency (DFEE)												47.1251 (109)
												47.1 (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	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 143.5125 (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					2 * 10 = 20.0000 (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) =					20.0000 / (5) = 0.1394 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.3894 (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) =	0.3310 (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	0.4220	0.4137	0.4054	0.3641	0.3558	0.3144	0.3144	0.3061	0.3310	0.3558	0.3723	0.3889 (22b)
Effective ac	0.5890	0.5856	0.5822	0.5663	0.5633	0.5494	0.5494	0.5469	0.5548	0.5633	0.5693	0.5756 (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)			9.7800	1.3258	12.9659			(27)				
Heat Loss Floor 1			30.6900	0.1300	3.9897			(28a)				
External Wall 1	84.8800	11.7300	73.1500	0.1800	13.1670			(29a)				
External Roof 1	28.5900		28.5900	0.1300	3.7167			(30)				
External Roof 2	2.1000		2.1000	0.1300	0.2730			(30)				
Total net area of external elements Aum(A, m2)			146.2600					(31)				
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	36.0623			(33)				
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								6.4629 (36)				
Total fabric heat loss						(33) + (36) =		42.5252 (37)				
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 27.8959	Feb 27.7322	Mar 27.5717	Apr 26.8179	May 26.6769	Jun 26.0204	Jul 26.0204	Aug 25.8988	Sep 26.2732	Oct 26.6769	Nov 26.9622	Dec 27.2605 (38)
Heat transfer coeff	70.4211	70.2574	70.0969	69.3431	69.2021	68.5456	68.5456	68.4240	68.7984	69.2021	69.4874	69.7857 (39)
Average = Sum(39)m / 12 =												69.3424 (39)
HLP	Jan 1.1879	Feb 1.1852	Mar 1.1825	Apr 1.1698	May 1.1674	Jun 1.1563	Jul 1.1563	Aug 1.1543	Sep 1.1606	Oct 1.1674	Nov 1.1722	Dec 1.1772 (40)
HLP (average)												1.1697 (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												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (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 TARGET 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	28.0015	24.4903	25.2718	22.0325	21.1407	18.2428	16.9047	19.3984	19.6300	22.8769	24.9720	27.1179 (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	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	98.0603	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	15.8223	14.0532	11.4288	8.6524	6.4677	5.4603	5.9001	7.6692	10.2935	13.0700	15.2546	16.2620	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	171.1275	172.9032	168.4284	158.9019	146.8764	135.5742	128.0236	126.2478	130.7227	140.2492	152.2746	163.5769	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	32.8060	(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)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	(71)
Water heating gains (Table 5)	37.6364	36.4438	33.9674	30.6007	28.4150	25.3373	22.7213	26.0731	27.2640	30.7486	34.6833	36.4488	(72)
Total internal gains	277.0042	275.8184	266.2427	250.5731	234.1772	218.7899	209.0631	212.4081	220.6982	236.4858	254.6306	268.7058	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	0.4400	10.6334	0.6300	0.7000	0.7700	1.4299 (74)
East	5.6900	19.6403	0.6300	0.7000	0.7700	34.1532 (76)
West	3.6500	19.6403	0.6300	0.7000	0.7700	21.9085 (80)

Solar gains	57.4915	112.4011	185.2517	270.8649	332.8617	341.2139	324.6515	278.2120	215.6378	133.3837	71.6662	47.2944	(83)
Total gains	334.4958	388.2194	451.4944	521.4380	567.0389	560.0038	533.7146	490.6201	436.3360	369.8695	326.2968	316.0002	(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	58.4578	58.5941	58.7282	59.3666	59.4876	60.0574	60.0574	60.1641	59.8366	59.4876	59.2434	58.9901	
alpha	4.8972	4.9063	4.9152	4.9578	4.9658	5.0038	5.0038	5.0109	4.9891	4.9658	4.9496	4.9327	
util living area	0.9985	0.9965	0.9896	0.9620	0.8804	0.7183	0.5505	0.6148	0.8661	0.9818	0.9969	0.9989	(86)
MIT	19.6751	19.8284	20.1029	20.4673	20.7720	20.9424	20.9877	20.9792	20.8469	20.4369	19.9892	19.6494	(87)
Th 2	19.9297	19.9319	19.9340	19.9443	19.9462	19.9551	19.9551	19.9568	19.9517	19.9462	19.9423	19.9383	(88)
util rest of house	0.9980	0.9953	0.9858	0.9472	0.8350	0.6258	0.4272	0.4885	0.7978	0.9723	0.9956	0.9985	(89)
MIT 2	18.7231	18.8776	19.1519	19.5150	19.7927	19.9289	19.9520	19.9509	19.8655	19.4927	19.0468	18.7042	(90)
Living area fraction										fLA = Living area / (4) =		0.2203	(91)
MIT	18.9328	19.0871	19.3614	19.7248	20.0085	20.1521	20.1802	20.1775	20.0817	19.7007	19.2545	18.9125	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9328	19.0871	19.3614	19.7248	20.0085	20.1521	20.1802	20.1775	20.0817	19.7007	19.2545	18.9125	(93)

8. Space heating requirement

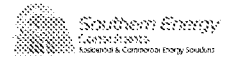
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9973	0.9940	0.9830	0.9434	0.8381	0.6446	0.4547	0.5166	0.8077	0.9694	0.9944	0.9979	(94)
Useful gains	333.5805	385.8899	443.8377	491.9141	475.2364	360.9994	242.6638	253.4333	352.4484	358.5353	324.4824	315.3456	(95)
Ext temp.	4.3000	4.9000	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	1030.4611	996.7488	901.5457	750.6247	574.9637	380.5752	245.4063	258.4686	411.5349	629.7891	844.5815	1026.7182	(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	518.4791	410.4972	340.5347	186.2717	74.1971	0.0000	0.0000	0.0000	0.0000	201.8129	374.4714	529.2612	(98)
Space heating												2635.5253	(98)
Space heating per m ²										(98) / (4) =		44.4589	(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	644.3283	507.2372	520.0223	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8800	0.9345	0.9101	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	566.9860	474.0114	473.2656	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	728.1116	695.9669	646.8109	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	116.0104	165.1349	129.1177	0.0000	0.0000	0.0000	0.0000	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

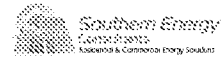


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												410.2631 (104)
Cooled fraction												1.0000 (105)
Intermittency factor (Table 10b)												
	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	29.0026	41.2837	32.2794	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												102.5658 (107)
Space cooling per m2												1.7302 (108)
Energy for space heating												44.4589 (99)
Energy for space cooling												1.7302 (108)
Total												46.1891 (109)
Target Fabric Energy Efficiency (TFEE)												53.1 (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	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 143.5125 (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) = 0.2090 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4590 (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) =	0.3902 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.3000	4.8000	4.6000	4.3000	4.4000	4.1000	4.2000	4.0000	4.2000	4.6000	4.6000	4.9000 (22)
Wind factor	1.3250	1.2000	1.1500	1.0750	1.1000	1.0250	1.0500	1.0000	1.0500	1.1500	1.1500	1.2250 (22a)
Adj infilt rate	0.5170	0.4682	0.4487	0.4194	0.4292	0.3999	0.4097	0.3902	0.4097	0.4487	0.4487	0.4780 (22b)
Effective ac	0.6336	0.6096	0.6007	0.5880	0.5921	0.5800	0.5839	0.5761	0.5839	0.6007	0.6007	0.6142 (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	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.30)			9.7800	1.2357	12.0856		(27)
Heat Loss Floor 1			30.6900	0.1100	3.3759		(28a)
External Wall 1	84.8800	11.7300	73.1500	0.2500	18.2875		(29a)
External Roof 1	28.5900		28.5900	0.1100	3.1449		(30)
External Roof 2	2.1000		2.1000	0.2000	0.4200		(31)
Total net area of external elements Aum(A, m ²)			146.2600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.8489		(33)
Party Wall 1			36.3800	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (User defined value 0.044 * total exposed area)							6.4354 (36)
Total fabric heat loss						(33) + (36) =	46.2843 (37)

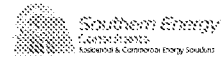
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	30.0087	28.8709	28.4473	27.8457	28.0417	27.4671	27.6542	27.2846	27.6542	28.4473	28.4473	29.0894 (38)
Heat transfer coeff	76.2930	75.1552	74.7316	74.1300	74.3260	73.7514	73.9385	73.5689	73.9385	74.7316	74.7316	75.3737 (39)
Average = Sum(39)m / 12 =												74.5558 (39)
HLP	1.2870	1.2678	1.2607	1.2505	1.2538	1.2441	1.2473	1.2410	1.2473	1.2607	1.2607	1.2715 (40)
HLP (average)												1.2577 (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												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m												
19.7657	17.2872	17.8389	15.5524	14.9229	12.8773	11.9327	13.6930	13.8565	16.1484	17.6273	19.1421 (46)	
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

	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	25.9089	23.2912	25.6110	24.5859	25.2608	24.2791	24.9846	25.1637	24.4463	25.4661	24.8752	25.8513 (61)
Total heat required for water heating calculated for each month	157.6805	138.5395	144.5369	128.2684	124.7466	110.1278	104.5360	116.4501	116.8230	133.1222	142.3903	153.4650 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	157.6805	138.5395	144.5369	128.2684	124.7466	110.1278	104.5360	116.4501	116.8230	133.1222	142.3903	153.4650 (64)
RHI water heating demand												1570.6864 (64)
Heat gains from water heating, kWh/month	50.2913	44.1429	45.9456	40.6209	39.3942	34.6145	32.6970	36.6437	36.8268	42.1622	45.2926	48.8944 (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	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.5557	35.1330	28.5721	21.6309	16.1694	13.6509	14.7502	19.1729	25.7338	32.6750	38.1366	40.6551	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	255.4141	258.0645	251.3856	237.1670	219.2185	202.3495	191.0799	188.4295	195.1085	209.3271	227.2756	244.1446	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	(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)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	(71)
Water heating gains (Table 5)	67.5958	65.6888	61.7548	56.4179	52.9492	48.0757	43.9476	49.2522	51.1484	56.6696	62.9063	65.7183	(72)
Total internal gains	453.5182	449.8389	432.6651	406.1684	379.2897	355.0286	340.7303	347.8072	362.9432	389.6243	419.2710	441.4705	(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												0.4400	14.2444	0.7200	0.7000	0.7700	2.1891 (74)
East												5.6900	26.6336	0.7200	0.7000	0.7700	52.9306 (76)
West												3.6500	26.6336	0.7200	0.7000	0.7700	33.9537 (80)
Solar gains	89.0734	146.9598	240.7243	364.5493	431.4103	475.3815	449.1703	388.2078	299.6556	188.1651	106.9648	70.5357	(83)				
Total gains	542.5916	596.7987	673.3894	770.7177	810.7000	830.4100	789.9006	736.0150	662.5988	577.7894	526.2358	512.0062	(84)				

7. Mean internal temperature (heating season)

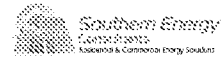
Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.5835	21.9102	22.0344	22.2132	22.1547	22.3272	22.2708	22.3826	22.2708	22.0344	22.0344	21.8467	
alpha	2.4389	2.4607	2.4690	2.4809	2.4770	2.4885	2.4847	2.4922	2.4847	2.4690	2.4690	2.4564	
util living area	0.9110	0.8907	0.8394	0.7417	0.6102	0.4492	0.3376	0.3413	0.5546	0.7562	0.8739	0.9185	(86)
MIT	19.0637	19.2531	19.6906	20.2253	20.6444	20.8832	20.9584	20.9601	20.7995	20.3594	19.6669	19.0467	(87)
Th 2	19.8510	19.8661	19.8718	19.8798	19.8772	19.8849	19.8824	19.8873	19.8824	19.8718	19.8718	19.8632	(88)
util rest of house	0.8975	0.8747	0.8161	0.7052	0.5539	0.3730	0.2450	0.2428	0.4748	0.7090	0.8518	0.9059	(89)
MIT 2	17.3535	17.6286	18.2457	18.9791	19.5176	19.7952	19.8617	19.8688	19.7158	19.1759	18.2282	17.3379	(90)
Living area fraction	17.7303	17.9865	18.5640	19.2537	19.7659	20.0349	20.1033	20.1092	19.9545	19.4366	18.5451	17.7143	(92)
Temperature adjustment	17.5803	17.8365	18.4140	19.1037	19.6159	19.8849	19.9533	19.9592	19.8045	19.2866	18.3951	17.5643	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.8614	0.8376	0.7791	0.6761	0.5396	0.3730	0.2511	0.2494	0.4687	0.6801	0.8146	0.8710	(94)
Ext temp.	467.4085	499.8667	524.6487	521.1043	437.4735	309.7797	198.3292	183.5534	310.5793	392.9681	428.6596	445.9686	(95)
Heat loss rate W	5.7000	5.9000	7.4000	9.7000	12.7000	15.4000	17.2000	17.4000	15.1000	12.2000	8.7000	5.8000	(96)
Month fracti	906.3826	897.0880	823.0938	697.0949	514.0283	330.7658	203.5780	188.2811	347.8459	529.5948	724.5334	886.7216	(97)
Space heating kWh	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)
RHI space heating demand	326.5967	266.9327	222.0431	126.7132	56.9567	0.0000	0.0000	0.0000	0.0000	101.6503	213.0292	327.9202	(98)
												1641.8422	(98)
												1642	(98)

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	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 143.5125 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	0	0	0 * 40 =	0.0000 (6a)
Number of open flues	0	0	0	0 * 20 =	0.0000 (6b)
Number of intermittent fans				3 * 10 =	30.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)				30.0000 / (5) =	0.2090 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4590 (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) =	0.3902 (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	0.4975	0.4877	0.4780	0.4292	0.4194	0.3707	0.3707	0.3609	0.3902	0.4194	0.4390	0.4585 (22b)
Effective ac	0.6237	0.6189	0.6142	0.5921	0.5880	0.5687	0.5687	0.5651	0.5761	0.5880	0.5963	0.6051 (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	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.30)			9.7800	1.2357	12.0856		(27)
Heat Loss Floor 1			30.6900	0.1100	3.3759		(28a)
External Wall 1	84.8800	11.7300	73.1500	0.2500	18.2875		(29a)
External Roof 1	28.5900		28.5900	0.1100	3.1449		(30)
External Roof 2	2.1000		2.1000	0.2000	0.4200		(31)
Total net area of external elements Aum(A, m ²)			146.2600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.8489		(33)
Party Wall 1			36.3800	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (User defined value 0.044 * total exposed area)							6.4354 (36)
Total fabric heat loss						(33) + (36) =	46.2843 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	29.5401	29.3125	29.0894	28.0417	27.8457	26.9331	26.9331	26.7642	27.2846	27.8457	28.2422	28.6568 (38)
Heat transfer coeff	75.8244	75.5968	75.3737	74.3260	74.1300	73.2174	73.2174	73.0484	73.5689	74.1300	74.5265	74.9411 (39)
Average = Sum(39)m / 12 =												74.3251 (39)
HLP	1.2791	1.2752	1.2715	1.2538	1.2505	1.2351	1.2351	1.2323	1.2410	1.2505	1.2572	1.2642 (40)
HLP (average)												1.2538 (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												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m												
	19.7657	17.2872	17.8389	15.5524	14.9229	12.8773	11.9327	13.6930	13.8565	16.1484	17.6273	19.1421 (46)
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 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 (56)
Combi loss	25.9089	23.2912	25.6110	24.5859	25.2608	24.2791	24.9846	25.1637	24.4463	25.4661	24.8752	25.8513 (57)
Total heat required for water heating calculated for each month	157.6805	138.5395	144.5369	128.2684	124.7466	110.1278	104.5360	116.4501	116.8230	133.1222	142.3903	153.4650 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	157.6805	138.5395	144.5369	128.2684	124.7466	110.1278	104.5360	116.4501	116.8230	133.1222	142.3903	153.4650 (64)
Heat gains from water heating, kWh/month	50.2913	44.1429	45.9456	40.6209	39.3942	34.6145	32.6970	36.6437	36.8268	42.1622	45.2926	48.8944 (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	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.5557	35.1330	28.5721	21.6309	16.1694	13.6509	14.7502	19.1729	25.7338	32.6750	38.1366	40.6551	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	255.4141	258.0645	251.3856	237.1670	219.2185	202.3495	191.0799	188.4295	195.1085	209.3271	227.2756	244.1446	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	(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)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	(71)
Water heating gains (Table 5)	67.5958	65.6888	61.7548	56.4179	52.9492	48.0757	43.9476	49.2522	51.1484	56.6696	62.9063	65.7183	(72)
Total internal gains	453.5182	449.8389	432.6651	406.1684	379.2897	355.0286	340.7303	347.8072	362.9432	389.6243	419.2710	441.4705	(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				0.4400	10.6334		0.7200		0.7000		0.7700		1.6341 (74)	
East				5.6900	19.6403		0.7200		0.7000		0.7700		39.0322 (76)	
West				3.6500	19.6403		0.7200		0.7000		0.7700		25.0382 (80)	
Solar gains	65.7046	128.4584	211.7162	309.5599	380.4134	389.9587	371.0303	317.9565	246.4432	152.4385	81.9043	54.0507	(83)	
Total gains	519.2228	578.2973	644.3813	715.7283	759.7030	744.9873	711.7606	665.7638	609.3864	542.0628	501.1753	495.5212	(84)	

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.7169	21.7822	21.8467	22.1547	22.2132	22.4901	22.4901	22.5421	22.3826	22.2132	22.0950	21.9728	
alpha	2.4478	2.4521	2.4564	2.4770	2.4809	2.4993	2.4993	2.5028	2.4922	2.4809	2.4730	2.4649	
util living area	0.9302	0.9083	0.8664	0.7884	0.6774	0.5377	0.4162	0.4550	0.6460	0.8246	0.9068	0.9366	(86)
MIT	18.7405	19.0017	19.4538	20.0252	20.4909	20.8010	20.9241	20.9031	20.6670	20.0566	19.3104	18.6955	(87)
Th 2	19.8573	19.8603	19.8632	19.8772	19.8798	19.8920	19.8920	19.8943	19.8873	19.8798	19.8745	19.8690	(88)
util rest of house	0.9202	0.8953	0.8471	0.7574	0.6288	0.4659	0.3233	0.3612	0.5781	0.7917	0.8914	0.9274	(89)
MIT 2	16.8919	17.2662	17.9089	18.7105	19.3310	19.7188	19.8453	19.8308	19.5727	18.7761	17.7240	16.8343	(90)
Living area fraction	17.2991	17.6485	18.2493	19.0002	19.5865	19.9572	20.0830	20.0670	19.8138	19.0582	18.0735	17.2444	(92)
MIT	17.2991	17.6485	18.2493	19.0002	19.5865	19.9572	20.0830	20.0670	19.8138	19.0582	18.0735	17.2444	(92)
Temperature adjustment	17.1491	17.4985	18.0993	18.8502	19.4365	19.8072	19.9330	19.9170	19.6638	18.9082	17.9235	17.0944	(93)

8. Space heating requirement

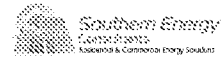
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8870	0.8593	0.8093	0.7240	0.6073	0.4600	0.3270	0.3632	0.5628	0.7566	0.8556	0.8958	(94)
Useful gains	460.5629	496.9222	521.4944	518.1605	461.4048	342.6666	232.7189	241.8184	342.9383	410.1459	428.8240	443.8759	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	974.2765	952.4079	874.2795	739.5564	573.5094	381.2606	244.0318	256.9111	409.3243	615.8891	806.6386	966.3170	(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	382.2030	306.0864	262.4721	159.4050	83.4058	0.0000	0.0000	0.0000	0.0000	153.0729	272.0264	388.6961	(98)
Space heating												2007.3678	(98)
Space heating per m2												33.8625	(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 %)													89.8000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2235.3762 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	382.2030	306.0864	262.4721	159.4050	83.4058	0.0000	0.0000	0.0000	0.0000	153.0729	272.0264	388.6961	(98)
Space heating efficiency (main heating system 1)	89.8000	89.8000	89.8000	89.8000	89.8000	0.0000	0.0000	0.0000	0.0000	89.8000	89.8000	89.8000	(210)
Space heating fuel (main heating system)	425.6158	340.8535	292.2852	177.5111	92.8795	0.0000	0.0000	0.0000	0.0000	170.4599	302.9248	432.8465	(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	157.6805	138.5395	144.5369	128.2684	124.7466	110.1278	104.5360	116.4501	116.8230	133.1222	142.3903	153.4650	(64)
Efficiency of water heater (217)m	89.0552	89.0058	88.8960	88.6676	88.2848	87.3000	87.3000	87.3000	87.3000	88.6196	88.9250	87.3000	(216)
Fuel for water heating, kWh/month	177.0594	155.6522	162.5910	144.6617	141.3002	126.1487	119.7434	133.3907	133.8179	150.2177	160.1240	172.2818	(219)
Water heating fuel used												1776.9886	(219)
Annual totals kWh/year													
Space heating fuel - main system												2235.3762	(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)												279.4265	(232)
Total delivered energy for all uses												4366.7913	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2235.3762	3.4800	77.7911 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1776.9886	3.4800	61.8392 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	279.4265	13.1900	36.8564 (250)
Additional standing charges			120.0000 (251)
Total energy cost			306.3792 (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] =	1.2340 (257)
SAP value		82.7860
SAP rating (Section 12)		83 (258)
SAP band		B

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

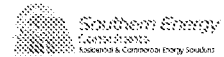
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2235.3762	0.2160	482.8413 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1776.9886	0.2160	383.8295 (264)
Space and water heating			866.6708 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	279.4265	0.5190	145.0224 (268)
Total kg/year			1050.6182 (272)
CO2 emissions per m2			17.7200 (273)
EI value			86.4995
EI rating			86 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.8980 = 3.875$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.8980 = 0.2405$, stars = 4
Water heating energy efficiency	$3.48 / 0.8831 = 3.941$, stars = 4
Water heating environmental impact	$0.216 / 0.8831 = 0.2446$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 143.5125 (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) = 0.2090 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4590 (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) =	0.3902 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.3000	4.8000	4.6000	4.3000	4.4000	4.1000	4.2000	4.0000	4.2000	4.6000	4.6000	4.9000 (22)
Wind factor	1.3250	1.2000	1.1500	1.0750	1.1000	1.0250	1.0500	1.0000	1.0500	1.1500	1.1500	1.2250 (22a)
Adj infilt rate	0.5170	0.4682	0.4487	0.4194	0.4292	0.3999	0.4097	0.3902	0.4097	0.4487	0.4487	0.4780 (22b)
Effective ac	0.6336	0.6096	0.6007	0.5880	0.5921	0.5800	0.5839	0.5761	0.5839	0.6007	0.6007	0.6142 (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	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.30)			9.7800	1.2357	12.0856		(27)
Heat Loss Floor 1			30.6900	0.1100	3.3759		(28a)
External Wall 1	84.8800	11.7300	73.1500	0.2500	18.2875		(29a)
External Roof 1	28.5900		28.5900	0.1100	3.1449		(30)
External Roof 2	2.1000		2.1000	0.2000	0.4200		(30)
Total net area of external elements Aum(A, m ²)			146.2600				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		39.8489		(33)
Party Wall 1			36.3800	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (User defined value 0.044 * total exposed area)							6.4354 (36)
Total fabric heat loss						(33) + (36) =	46.2843 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	30.0087	28.8709	28.4473	27.8457	28.0417	27.4671	27.6542	27.2846	27.6542	28.4473	28.4473	29.0894 (38)
Heat transfer coeff	76.2930	75.1552	74.7316	74.1300	74.3260	73.7514	73.9385	73.5689	73.9385	74.7316	74.7316	75.3737 (39)
Average = Sum(39)m / 12 =												74.5558 (39)
HLP	1.2870	1.2678	1.2607	1.2505	1.2538	1.2441	1.2473	1.2410	1.2473	1.2607	1.2607	1.2715 (40)
HLP (average)												1.2577 (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												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m												
19.7657	17.2872	17.8389	15.5524	14.9229	12.8773	11.9327	13.6930	13.8565	16.1484	17.6273	19.1421 (46)	
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

	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	25.9089	23.2912	25.6110	24.5859	25.2608	24.2791	24.9846	25.1637	24.4463	25.4661	24.8752	25.8513 (61)
Total heat required for water heating calculated for each month	157.6805	138.5395	144.5369	128.2684	124.7466	110.1278	104.5360	116.4501	116.8230	133.1222	142.3903	153.4650 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	157.6805	138.5395	144.5369	128.2684	124.7466	110.1278	104.5360	116.4501	116.8230	133.1222	142.3903	153.4650 (64)
Heat gains from water heating, kWh/month	50.2913	44.1429	45.9456	40.6209	39.3942	34.6145	32.6970	36.6437	36.8268	42.1622	45.2926	48.8944 (65)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum(64)m = 1570.6864 (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	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.5557	35.1330	28.5721	21.6309	16.1694	13.6509	14.7502	19.1729	25.7338	32.6750	38.1366	40.6551	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	255.4141	258.0645	251.3856	237.1670	219.2185	202.3495	191.0799	188.4295	195.1085	209.3271	227.2756	244.1446	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	(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)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	(71)
Water heating gains (Table 5)	67.5958	65.6888	61.7548	56.4179	52.9492	48.0757	43.9476	49.2522	51.1484	56.6696	62.9063	65.7183	(72)
Total internal gains	453.5182	449.8389	432.6651	406.1684	379.2897	355.0286	340.7303	347.8072	362.9432	389.6243	419.2710	441.4705	(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				0.4400	14.2444	0.7200		0.7000	0.7700		2.1891 (74)	
East				5.6900	26.6336	0.7200		0.7000	0.7700		52.9306 (76)	
West				3.6500	26.6336	0.7200		0.7000	0.7700		33.9537 (80)	
Solar gains	89.0734	146.9598	240.7243	364.5493	431.4103	475.3815	449.1703	388.2078	299.6556	188.1651	106.9648	70.5357 (83)
Total gains	542.5916	596.7987	673.3894	770.7177	810.7000	830.4100	789.9006	736.0150	662.5988	577.7894	526.2358	512.0062 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.5835	21.9102	22.0344	22.2132	22.1547	22.3272	22.2708	22.3826	22.2708	22.0344	22.0344	21.8467	
alpha	2.4389	2.4607	2.4690	2.4809	2.4770	2.4885	2.4847	2.4922	2.4847	2.4690	2.4690	2.4564	
util living area	0.9110	0.8907	0.8394	0.7417	0.6102	0.4492	0.3376	0.3413	0.5546	0.7562	0.8739	0.9185	(86)
MIT	19.0637	19.2531	19.6906	20.2253	20.6444	20.8832	20.9584	20.9601	20.7995	20.3594	19.6669	19.0467	(87)
Th 2	19.8510	19.8661	19.8718	19.8798	19.8772	19.8849	19.8824	19.8873	19.8824	19.8718	19.8718	19.8632	(88)
util rest of house	0.8975	0.8747	0.8161	0.7052	0.5539	0.3730	0.2450	0.2428	0.4748	0.7090	0.8518	0.9059	(89)
MIT 2	17.3535	17.6286	18.2457	18.9791	19.5176	19.7952	19.8617	19.8688	19.7158	19.1759	18.2282	17.3379	(90)
Living area fraction	17.7303	17.9865	18.5640	19.2537	19.7659	20.0349	20.1033	20.1092	19.9545	19.4366	18.5451	17.7143	(92)
MIT	17.5803	17.8365	18.4140	19.1037	19.6159	19.8849	19.9533	19.9592	19.8045	19.2866	18.3951	17.5643	(93)
Temperature adjustment													
adjusted MIT													

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8614	0.8376	0.7791	0.6761	0.5396	0.3730	0.2511	0.2494	0.4687	0.6801	0.8146	0.8710	(94)
Useful gains	467.4085	499.8667	524.6487	521.1043	437.4735	309.7797	198.3292	183.5534	310.5793	392.9681	428.6596	445.9686	(95)
Ext temp.	5.7000	5.9000	7.4000	9.7000	12.7000	15.4000	17.2000	17.4000	15.1000	12.2000	8.7000	5.8000	(96)
Heat loss rate W	906.3826	897.0880	823.0938	697.0949	514.0283	330.7658	203.5780	188.2811	347.8459	529.5948	724.5334	886.7216	(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	326.5967	266.9327	222.0431	126.7132	56.9567	0.0000	0.0000	0.0000	0.0000	101.6503	213.0292	327.9202	(98)
Space heating												1641.8422	(98)
Space heating per m2												27.6964	(99)
										(98) / (4) =			

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 %)													89.8000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													1828.3320 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	326.5967	266.9327	222.0431	126.7132	56.9567	0.0000	0.0000	0.0000	0.0000	101.6503	213.0292	327.9202	(98)
Space heating efficiency (main heating system 1)	89.8000	89.8000	89.8000	89.8000	89.8000	0.0000	0.0000	0.0000	0.0000	89.8000	89.8000	89.8000	(210)
Space heating fuel (main heating system)	363.6935	297.2524	247.2641	141.1061	63.4262	0.0000	0.0000	0.0000	0.0000	113.1963	237.2263	365.1673	(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	157.6805	138.5395	144.5369	128.2684	124.7466	110.1278	104.5360	116.4501	116.8230	133.1222	142.3903	153.4650	(64)
Efficiency of water heater	88.9704	88.9299	88.7974	88.5247	88.0685	87.3000	87.3000	87.3000	87.3000	88.3651	88.7814	88.9876	(216)
Fuel for water heating, kWh/month	177.2280	155.7851	162.7715	144.8956	141.6472	126.1487	119.7434	133.3907	133.8179	150.6502	160.3829	172.4567	(219)
Water heating fuel used												1778.9179	(219)
Annual totals kWh/year													
Space heating fuel - main system												1828.3320	(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)												279.4265	(232)
Total delivered energy for all uses												3961.6765	(238)

10a. Fuel costs - using BEDF prices (408)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1828.3320	4.2000	76.7899 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1778.9179	4.2000	74.7146 (247)
Pumps and fans for heating	75.0000	15.5400	11.6550 (249)
Energy for lighting	279.4265	15.5400	43.4229 (250)
Additional standing charges			90.0000 (251)
Total energy cost			296.5824 (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	1828.3320	0.2160	394.9197 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1778.9179	0.2160	384.2463 (264)
Space and water heating			779.1660 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	279.4265	0.5190	145.0224 (268)
Total kg/year			963.1134 (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	1828.3320	1.2200	2230.5651 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1778.9179	1.2200	2170.2799 (264)
Space and water heating			4400.8450 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	279.4265	3.0700	857.8394 (268)
Primary energy kWh/year			5488.9343 (272)
Primary energy kWh/m2/year			92.5934 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 83
Current environmental impact rating: B 86

(For testing purposes):

A Not considered
B Not considered

Regs Region: England

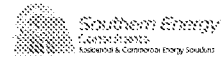
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.03r08

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.4	-£ 32	-176 kg (18.3%)
U Solar photovoltaic panels	+ 12.8	-£ 319	-1066 kg (135.5%)

Recommended measures	Typical annual savings		Energy efficiency	Environmental impact
Solar water heating	£32	2.97 kg/m²	B 84	B 89
Solar photovoltaic panels	£319	17.98 kg/m²	A 97	A 100
Total Savings	£351	20.95 kg/m²		

Potential energy efficiency rating: A 97
 Potential environmental impact rating: A 100

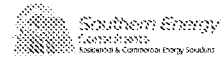
Fuel prices for cost data on this page from database revision number 408 TEST (23 Feb 2017)
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£55	£63	-£8
Mains gas	£242	£202	£39
Space heating	£178	£178	£0
Water heating	£75	£43	£32
Lighting	£43	£43	£0
Generated (PV)	-£0	-£319	£319
Total cost of fuels	£297	-£54	£350
Total cost of uses	£296	-£55	£351
Delivered energy	67 kWh/m²	17 kWh/m²	50 kWh/m²
Carbon dioxide emissions	1.0 tonnes	-0.3 tonnes	1.2 tonnes
CO2 emissions per m²	16 kg/m²	-5 kg/m²	21 kg/m²
Primary energy	93 kWh/m²	-30 kWh/m²	123 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	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 143.5125 (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) = 0.2090 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4590 (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) =	0.3902 (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	0.4975	0.4877	0.4780	0.4292	0.4194	0.3707	0.3707	0.3609	0.3902	0.4194	0.4390	0.4585 (22b)
Effective ac	0.6237	0.6189	0.6142	0.5921	0.5880	0.5687	0.5687	0.5651	0.5761	0.5880	0.5963	0.6051 (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	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.30)			9.7800	1.2357	12.0856		(27)
Heat Loss Floor 1			30.6900	0.1100	3.3759		(28a)
External Wall 1	84.8800	11.7300	73.1500	0.2500	18.2875		(29a)
External Roof 1	28.5900		28.5900	0.1100	3.1449		(30)
External Roof 2	2.1000		2.1000	0.2000	0.4200		(30)
Total net area of external elements Aum(A, m ²)			146.2600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.8489		(33)
Party Wall 1			36.3800	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (User defined value 0.044 * total exposed area)							6.4354 (36)
Total fabric heat loss						(33) + (36) =	46.2843 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	29.5401	29.3125	29.0894	28.0417	27.8457	26.9331	26.9331	26.7642	27.2846	27.8457	28.2422	28.6568 (38)
Heat transfer coeff	75.8244	75.5968	75.3737	74.3260	74.1300	73.2174	73.2174	73.0484	73.5689	74.1300	74.5265	74.9411 (39)
Average = Sum(39)m / 12 =												74.3251 (39)
HLP	1.2791	1.2752	1.2715	1.2538	1.2505	1.2351	1.2351	1.2323	1.2410	1.2505	1.2572	1.2642 (40)
HLP (average)												1.2538 (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												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m												
19.7657	17.2872	17.8389	15.5524	14.9229	12.8773	11.9327	13.6930	13.8565	16.1484	17.6273	19.1421 (46)	
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	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	25.9089	23.2912	25.6110	24.5859	25.2608	24.2791	24.9846	25.1637	24.4463	25.4661	24.8752	25.8513 (61)
Total heat required for water heating calculated for each month	157.6805	138.5395	144.5369	128.2684	124.7466	110.1278	104.5360	116.4501	116.8230	133.1222	142.3903	153.4650 (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												1.4270 (H8)
Utilisation factor												0.5038 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												80.7786 (H14)
Volume ratio Veff/V												0.9285 (H15)
Solar storage volume factor												0.9852 (H16)
Solar input												-791.4917 (H17)
Solar input	-22.9517	-38.2998	-65.2289	-87.4196	-107.9995	-106.1807	-104.7775	-91.5446	-71.6978	-48.9612	-27.2240	-19.2066 (63)
Solar input (sum of months) = Sum(63)m =												-791.4917 (63)
Output from w/h	134.7288	100.2398	79.3080	40.8489	16.7471	3.9471	0.0000	24.9055	45.1252	84.1611	115.1663	134.2584 (64)
Total per year (kWh/year) = Sum(64)m =												779.4361 (64)
Heat gains from water heating, kWh/month	50.2913	44.1429	45.9456	40.6209	39.3942	34.6145	32.6970	36.6437	36.8268	42.1622	45.2926	48.8944 (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	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.5557	35.1330	28.5721	21.6309	16.1694	13.6509	14.7502	19.1729	25.7338	32.6750	38.1366	40.6551	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	255.4141	258.0645	251.3856	237.1670	219.2185	202.3495	191.0799	188.4295	195.1085	209.3271	227.2756	244.1446	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	(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)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	(71)
Water heating gains (Table 5)	67.5958	65.6888	61.7548	56.4179	52.9492	48.0757	43.9476	49.2522	51.1484	56.6696	62.9063	65.7183	(72)
Total internal gains	453.5182	449.8389	432.6651	406.1684	379.2897	355.0286	340.7303	347.8072	362.9432	389.6243	419.2710	441.4705	(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				0.4400	10.6334	0.7200	0.7000	0.7700	1.6341 (74)			
East				5.6900	19.6403	0.7200	0.7000	0.7700	39.0322 (76)			
West				3.6500	19.6403	0.7200	0.7000	0.7700	25.0382 (80)			
Solar gains	65.7046	128.4584	211.7162	309.5599	380.4134	389.9587	371.0303	317.9565	246.4432	152.4385	81.9043	54.0507 (83)
Total gains	519.2228	578.2973	644.3813	715.7283	759.7030	744.9873	711.7606	665.7638	609.3864	542.0628	501.1753	495.5212 (84)

7. Mean internal temperature (heating season)

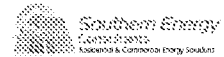
Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.7169	21.7822	21.8467	22.1547	22.2132	22.4901	22.4901	22.5421	22.3826	22.2132	22.0950	21.9728	
alpha	2.4478	2.4521	2.4564	2.4770	2.4809	2.4993	2.4993	2.5028	2.4922	2.4809	2.4730	2.4649	
util living area	0.9302	0.9083	0.8664	0.7884	0.6774	0.5377	0.4162	0.4550	0.6460	0.8246	0.9068	0.9366	(86)
MIT	18.7405	19.0017	19.4538	20.0252	20.4909	20.8010	20.9241	20.9031	20.6670	20.0566	19.3104	18.6955	(87)
Th 2	19.8573	19.8603	19.8632	19.8772	19.8798	19.8920	19.8920	19.8943	19.8873	19.8798	19.8745	19.8690	(88)
util rest of house	0.9202	0.8953	0.8471	0.7574	0.6288	0.4659	0.3233	0.3612	0.5781	0.7917	0.8914	0.9274	(89)
MIT 2	16.8919	17.2662	17.9089	18.7105	19.3310	19.7188	19.8453	19.8308	19.5727	18.7761	17.7240	16.8343	(90)
Living area fraction													0.2203 (91)
MIT	17.2991	17.6465	18.2493	19.0002	19.5865	19.9572	20.0830	20.0670	19.8138	19.0582	18.0735	17.2444	(92)
Temperature adjustment													-0.1500
adjusted MIT	17.1491	17.4985	18.0993	18.8502	19.4365	19.8072	19.9330	19.9170	19.6638	18.9082	17.9235	17.0944	(93)

8. Space heating requirement

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Utilisation	0.8870	0.8593	0.8093	0.7240	0.6073	0.4600	0.3270	0.3632	0.5628	0.7566	0.8556	0.8958 (94)
Useful gains	460.5629	496.9222	521.4944	518.1605	461.4048	342.6666	232.7189	241.8184	342.9383	410.1459	428.8240	443.8759 (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	974.2765	952.4079	874.2795	739.5564	573.5094	381.2606	244.0318	256.9111	409.3243	615.8891	806.6386	966.3170 (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	382.2030	306.0864	262.4721	159.4050	83.4058	0.0000	0.0000	0.0000	0.0000	153.0729	272.0264	388.6961 (98)
Space heating												2007.3678 (98)
Space heating per m2												(98) / (4) = 33.8625 (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 %)												89.8000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												2235.3762 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	382.2030	306.0864	262.4721	159.4050	83.4058	0.0000	0.0000	0.0000	0.0000	153.0729	272.0264	388.6961 (98)
Space heating efficiency (main heating system 1)	89.8000	89.8000	89.8000	89.8000	89.8000	0.0000	0.0000	0.0000	0.0000	89.8000	89.8000	89.8000 (210)
Space heating fuel (main heating system)	425.6158	340.8535	292.2852	177.5111	92.8795	0.0000	0.0000	0.0000	0.0000	170.4599	302.9248	432.8465 (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	134.7288	100.2398	79.3080	40.8489	16.7471	3.9471	0.0000	24.9055	45.1252	84.1611	115.1663	134.2584 (64)
Efficiency of water heater	89.1347	89.1700	89.2072	89.2785	89.3720	87.3000	87.3000	87.3000	87.3000	88.8969	89.0416	87.3000 (216)
Fuel for water heating, kWh/month	151.1519	112.4142	88.9031	45.7544	18.7387	4.5213	0.0000	28.5286	51.6898	94.6727	129.3399	150.6074 (219)
Water heating fuel used												876.3221 (219)
Annual totals kWh/year												
Space heating fuel - main system												2235.3762 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
pump for solar water heating												50.0000 (230g)
Total electricity for the above, kWh/year												125.0000 (231)
Electricity for lighting (calculated in Appendix L)												279.4265 (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)
Total delivered energy for all uses												1788.8854 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2235.3762	3.4800	77.7911 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	876.3221	3.4800	30.4960 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Pump for solar water heating	50.0000	13.1900	6.5950 (249)
Energy for lighting	279.4265	13.1900	36.8564 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-1727.2394	13.1900	-227.8229 (252)
Total energy cost			53.8081 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.2167 (257)
SAP value		96.9768
SAP rating (Section 12)		97 (258)
SAP band		A

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	2235.3762	0.2160	482.8413 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	876.3221	0.2160	189.2856 (264)

Regs Region: England

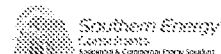
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.03r08

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

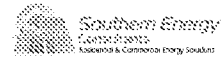


CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Space and water heating			672.1268 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	279.4265	0.5190	145.0224 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			-14.4131 (272)
CO2 emissions per m2			-0.2400 (273)
EI value			100.1852
EI rating			100 (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	30.6900 (1b)	x 2.3100 (2b)	= 70.8939 (1b) - (3b)
First floor	28.5900 (1c)	x 2.5400 (2c)	= 72.6186 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	59.2800		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 143.5125 (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) = 0.2090 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4590 (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) =	0.3902 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.3000	4.8000	4.6000	4.3000	4.4000	4.1000	4.2000	4.0000	4.2000	4.6000	4.6000	4.9000 (22)
Wind factor	1.3250	1.2000	1.1500	1.0750	1.1000	1.0250	1.0500	1.0000	1.0500	1.1500	1.1500	1.2250 (22a)
Adj infilt rate	0.5170	0.4682	0.4487	0.4194	0.4292	0.3999	0.4097	0.3902	0.4097	0.4487	0.4487	0.4780 (22b)
Effective ac	0.6336	0.6096	0.6007	0.5880	0.5921	0.5800	0.5839	0.5761	0.5839	0.6007	0.6007	0.6142 (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	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.30)			9.7800	1.2357	12.0856		(27)
Heat Loss Floor 1			30.6900	0.1100	3.3759		(28a)
External Wall 1	84.8800	11.7300	73.1500	0.2500	18.2875		(29a)
External Roof 1	28.5900		28.5900	0.1100	3.1449		(30)
External Roof 2	2.1000		2.1000	0.2000	0.4200		(30)
Total net area of external elements Aum(A, m ²)			146.2600				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.8489		(33)
Party Wall 1			36.3800	0.0000	0.0000		(32)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							100.0000 (35)
Thermal bridges (User defined value 0.044 * total exposed area)							6.4354 (36)
Total fabric heat loss						(33) + (36) =	46.2843 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	30.0087	28.8709	28.4473	27.8457	28.0417	27.4671	27.6542	27.2846	27.6542	28.4473	28.4473	29.0894 (38)
Heat transfer coeff	76.2930	75.1552	74.7316	74.1300	74.3260	73.7514	73.9385	73.5689	73.9385	74.7316	74.7316	75.3737 (39)
Average = Sum(39)m / 12 =												74.5558 (39)
HLP	1.2870	1.2678	1.2607	1.2505	1.2538	1.2441	1.2473	1.2410	1.2473	1.2607	1.2607	1.2715 (40)
HLP (average)												1.2577 (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												1.9612 (42)
Average daily hot water use (litres/day)												80.7786 (43)
Daily hot water use	88.8565	85.6253	82.3942	79.1631	75.9319	72.7008	72.7008	75.9319	79.1631	82.3942	85.6253	88.8565 (44)
Energy conte	131.7716	115.2483	118.9259	103.6825	99.4858	85.8487	79.5514	91.2864	92.3767	107.6561	117.5151	127.6138 (45)
Energy content (annual)										Total = Sum(45)m =		1270.9623 (45)
Distribution loss (46)m = 0.15 x (45)m												
19.7657	17.2872	17.8389	15.5524	14.9229	12.8773	11.9327	13.6930	13.8565	16.1484	17.6273	19.1421 (46)	
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

	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	25.9089	23.2912	25.6110	24.5859	25.2608	24.2791	24.9846	25.1637	24.4463	25.4661	24.8752	25.8513 (61)
Total heat required for water heating calculated for each month	157.6805	138.5395	144.5369	128.2684	124.7466	110.1278	104.5360	116.4501	116.8230	133.1222	142.3903	153.4650 (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												1283.7868 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2156.7619 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.6970 (H8)
Utilisation factor												0.4453 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												80.7786 (H14)
Volume ratio Veff/V												0.9285 (H15)
Solar storage volume factor												0.9852 (H16)
Solar input												-831.9053 (H17)
Solar input	-26.9611	-38.0270	-64.6062	-90.1225	-107.6097	-113.8954	-111.5410	-98.0071	-76.0898	-52.5143	-30.8186	-21.7126 (63)
Solar input (sum of months) = Sum(63)m =												-831.9053 (63)
Output from w/h	130.7194	100.5126	79.9307	38.1459	17.1369	0.0000	0.0000	18.4430	40.7332	80.6080	111.5717	131.7525 (64)
Total per year (kWh/year) = Sum(64)m =												749.5537 (64)
Heat gains from water heating, kWh/month	50.2913	44.1429	45.9456	40.6209	39.3942	34.6145	32.6970	36.6437	36.8268	42.1622	45.2926	48.8944 (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	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	117.6723	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	39.5557	35.1330	28.5721	21.6309	16.1694	13.6509	14.7502	19.1729	25.7338	32.6750	38.1366	40.6551	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	255.4141	258.0645	251.3856	237.1670	219.2185	202.3495	191.0799	188.4295	195.1085	209.3271	227.2756	244.1446	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	48.7284	(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)	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	-78.4482	(71)
Water heating gains (Table 5)	67.5958	65.6888	61.7548	56.4179	52.9492	48.0757	43.9476	49.2522	51.1484	56.6696	62.9063	65.7183	(72)
Total internal gains	453.5182	449.8389	432.6651	406.1684	379.2897	355.0286	340.7303	347.8072	362.9432	389.6243	419.2710	441.4705	(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				0.4400	14.2444	0.7200	0.7000	0.7700	2.1891 (74)			
East				5.6900	26.6336	0.7200	0.7000	0.7700	52.9306 (76)			
West				3.6500	26.6336	0.7200	0.7000	0.7700	33.9537 (80)			
Solar gains	89.0734	146.9598	240.7243	364.5493	431.4103	475.3815	449.1703	388.2078	299.6556	188.1651	106.9648	70.5357 (83)
Total gains	542.5916	596.7987	673.3894	770.7177	810.7000	830.4100	789.9006	736.0150	662.5988	577.7894	526.2358	512.0062 (84)

7. Mean internal temperature (heating season)

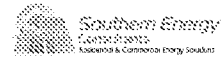
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	21.5835	21.9102	22.0344	22.2132	22.1547	22.3272	22.2708	22.3826	22.2708	22.0344	22.0344	21.8467
alpha	2.4389	2.4607	2.4690	2.4809	2.4770	2.4885	2.4847	2.4922	2.4847	2.4690	2.4690	2.4564
util living area	0.9110	0.8907	0.8394	0.7417	0.6102	0.4492	0.3376	0.3413	0.5546	0.7562	0.8739	0.9185 (86)
MIT	19.0637	19.2531	19.6906	20.2253	20.6444	20.8832	20.9584	20.9601	20.7995	20.3594	19.6669	19.0467 (87)
Th 2	19.8510	19.8661	19.8718	19.8798	19.8772	19.8849	19.8824	19.8873	19.8824	19.8718	19.8718	19.8632 (88)
util rest of house	0.8975	0.8747	0.8161	0.7052	0.5539	0.3730	0.2450	0.2428	0.4748	0.7090	0.8518	0.9059 (89)
MIT 2	17.3535	17.6286	18.2457	18.9791	19.5176	19.7952	19.8617	19.8688	19.7158	19.1759	18.2282	17.3379 (90)
Living area fraction									fLA = Living area / (4) =			0.2203 (91)
MIT	17.7303	17.9865	18.5640	19.2537	19.7659	20.0349	20.1033	20.1092	19.9545	19.4366	18.5451	17.7143 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.5803	17.8365	18.4140	19.1037	19.6159	19.8849	19.9533	19.9592	19.8045	19.2866	18.3951	17.5643 (93)

8. Space heating requirement

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Utilisation	0.8614	0.8376	0.7791	0.6761	0.5396	0.3730	0.2511	0.2494	0.4687	0.6801	0.8146	0.8710 (94)
Useful gains	467.4085	499.8667	524.6487	521.1043	437.4735	309.7797	198.3292	183.5534	310.5793	392.9681	428.6596	445.9686 (95)
Ext temp.	5.7000	5.9000	7.4000	9.7000	12.7000	15.4000	17.2000	17.4000	15.1000	12.2000	8.7000	5.8000 (96)
Heat loss rate W	906.3826	897.0880	823.0938	697.0949	514.0283	330.7658	203.5780	188.2811	347.8459	529.5948	724.5334	886.7216 (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	326.5967	266.9327	222.0431	126.7132	56.9567	0.0000	0.0000	0.0000	0.0000	101.6503	213.0292	327.9202 (98)
Space heating												1641.8422 (98)
Space heating per m2												(98) / (4) = 27.6964 (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 %)												89.8000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												1828.3320 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	326.5967	266.9327	222.0431	126.7132	56.9567	0.0000	0.0000	0.0000	0.0000	101.6503	213.0292	327.9202 (98)
Space heating efficiency (main heating system 1)	89.8000	89.8000	89.8000	89.8000	89.8000	0.0000	0.0000	0.0000	0.0000	89.8000	89.8000	89.8000 (210)
Space heating fuel (main heating system)	363.6935	297.2524	247.2641	141.1061	63.4262	0.0000	0.0000	0.0000	0.0000	113.1963	237.2263	365.1673 (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	130.7194	100.5126	79.9307	38.1459	17.1369	0.0000	0.0000	18.4430	40.7332	80.6080	111.5717	131.7525 (64)
Efficiency of water heater	89.0709	89.1020	89.1244	89.2089	89.2091	87.3000	87.3000	87.3000	87.3000	88.6769	88.9247	87.3000 (216)
(217)m	89.0709	89.1020	89.1244	89.2089	89.2091	87.3000	87.3000	87.3000	87.3000	88.6769	88.9247	89.0689 (217)
Fuel for water heating, kWh/month	146.7588	112.8062	89.6843	42.7602	19.2098	0.0000	0.0000	21.1260	46.6589	90.9008	125.4676	147.9219 (219)
Water heating fuel used												843.2944 (219)
Annual totals kWh/year												
Space heating fuel - main system												1828.3320 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
pump for solar water heating												50.0000 (230g)
Total electricity for the above, kWh/year												125.0000 (231)
Electricity for lighting (calculated in Appendix L)												279.4265 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 2.50 * 1284 * 0.80) =									-2054.0590			-2054.0590 (233)
Total delivered energy for all uses												1021.9940 (238)

10a. Fuel costs - using BEDF prices (408)

	Fuel	Fuel price	Fuel cost
	kWh/year	p/kWh	£/year
Space heating - main system 1	1828.3320	4.2000	76.7899 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	843.2944	4.2000	35.4184 (247)
Pumps and fans for heating	75.0000	15.5400	11.6550 (249)
Pump for solar water heating	50.0000	15.5400	7.7700 (249)
Energy for lighting	279.4265	15.5400	43.4229 (250)
Additional standing charges			90.0000 (251)
Energy saving/generation technologies			
PV Unit	-2054.0590	15.5400	-319.2008 (252)
Total energy cost			-54.1446 (255)

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

	Energy	Emission factor	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1	1828.3320	0.2160	394.9197 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	843.2944	0.2160	182.1516 (264)
Space and water heating			577.0713 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	279.4265	0.5190	145.0224 (268)
Energy saving/generation technologies			
PV Unit	-2054.0590	0.5190	-1066.0566 (269)
Total kg/year			-279.0879 (272)

Regs Region: England

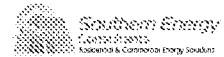
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.03r08

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year	
Space heating - main system 1	1828.3320	1.2200	2230.5651	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	843.2944	1.2200	1028.8191	(264)
Space and water heating			3259.3842	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	279.4265	3.0700	857.8394	(268)
Energy saving/generation technologies				
PV Unit	-2054.0590	3.0700	-6305.9610	(269)
Primary energy kWh/year			-1804.9874	(272)
Primary energy kWh/m ² /year			-30.4485	(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	West
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	189.44	(P1)
Transmission heat loss coefficient	46.28	(37)
Summer heat loss coefficient	235.72	(P2)

Overhangs	Ratio	Z_overhangs	Overhang type
Orientation			
North	0.000	1.000	None
East	0.000	1.000	None
West	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)
East	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	0.4400	86.6589	0.7200	0.7000	0.9000	15.5661
East	5.6900	124.7972	0.7200	0.7000	0.9000	289.8897
West	3.6500	124.7972	0.7200	0.7000	0.9000	185.9574
total:						491.4132

	Jun	Jul	Aug	
Solar gains	522	491	426	(P3)
Internal gains	352	338	345	
Total summer gains	874	829	771	(P5)
Summer gain/loss ratio	3.71	3.52	3.27	(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	20.41	22.22	22.07	(P7)
Likelihood of high internal temperature	Not significant	Medium	Medium	
Assessment of likelihood of high internal temperature:	Medium			

Southern Energy
Services
Residential & Commercial Energy Solutions

SAP2012 - 9.92 input data (DesignData) -

FullRefNo: 001

Regs Region: England
SAF Region: South East England
Postcode: BN17
DwellingOrientation: South
Property Type: House, Semi-Detached
Storeys: 2
Date Built: 2015
Sheltered Sides: 2
Sunlight Shade: Average or unknown
Measurements: Perimeter, Floor Area, Storey Height
 1st Storey: 17.63, 36.41, 2.33
 2nd Storey: 16.73, 34.31, 2.57
Living Area: 14.94 m2, fraction: 21.1%

Thermal Mass: Simple calculation
Thermal Mass Simple: Low
Thermal MassValue: 100

External Walls
External Wall 1: Nett Area, Gross Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
 68.68, 84.07, 0, Other, Cavity, 0, 0.25, Calculate
Party Walls
Party Wall 1: Area, Kappa, Element, Construction, Type, ShelterFactor, UValueFinal
 37.26, 0, Other, FilledWithEdge, 0, 0
External Roofs
 External Roof 1: Nett Area, Gross Area, Kappa, Construction, Element, UValueFinal
 34.32, 34.32, 9, Plasterboard, insulated at ceiling level, 0.11
 External Roof 2: 2.09, 2.09, 9, Plasterboard, insulated at ceiling level, 0.2

Heat Loss Floors
Area, Kappa, Construction, Element, Type, ShelterFactor, UValueFinal
Heat Loss Floor 1: 36.41, 0, Other, Ground Floor - Solid, 0, 0.11

Description: Data Source, Type, Glazing, Glazing Gap, Argon Filled, Solar Trans, Frame Type, Frame Factor, U Value
Opening Type 1: Manufacturer, Solid Door, , , , , ,
Opening Type 2: Manufacturer, Window, Double Low-E Hard 0.15, , , 0.72, , 0.7,

Openings
Opening Type, Location, Orientation, Pitch, Curtain Type, Overhang Ratio, Wide Overhang, Width, Height, Count, Area, Curtain Closed
Opening 1: Solid Door, External Wall 1, South, , , , 0, 0, 0, 1.95,
Opening 2: Window, External Wall 1, South, , None, 0, , 0, 0, 0, 1.03,
Opening 3: Window, External Wall 1, South, , None, 0, , 0, 0, 0, 1.44,
Opening 4: Window, External Wall 1, South, , None, 0, , 0, 0, 0, 2.39,
Opening 5: Window, External Wall 1, North, , None, 0, , 0, 0, 0, 2.88,
Opening 6: Window, External Wall 1, North, , None, 0, , 0, 0, 0, 1.26,
Opening 7: Window, External Wall 1, North, , None, 0, , 0, 0, 0, 3.78,
Opening 8: Window, External Wall 1, East, , None, 0, , 0, 0, 0, 0.66,

Conservatory: None
Draught Proofing: 100
Draught Lobby: No

Thermal Bridges
Bridging: Calculate Bridges
Y: 0.068

List of Bridges
Junction with, Bridge Type, Source Type, Imported, Length, Psi, Adjusted, Result, Reference
0. External wall, E1 Steel lintel with perforated steel base plate, , No, 0, 0, 0, 0.00,
1. External wall, E2 Other lintels (including other steel lintels), Independently assessed, Yes, 10.91, 0.179, 0.179, 1.95, Space4
2. External wall, E3 Sill, Table K1 - Approved, Yes, 9.98, 0.04, 0.04, 0.40, ACD
3. External wall, E4 Jamb, Table K1 - Approved, Yes, 26.7, 0.05, 0.05, 1.34, ACD
4. External wall, E5 Ground floor (normal), Independently assessed, Yes, 17.63, 0.081, 0.081, 1.43, Space4
5. External wall, E19 Ground floor (inverted), , No, 0, 0, 0, 0.00,
6. External wall, E20 Exposed floor (normal), , No, 0, 0, 0, 0.00,
7. External wall, E21 Exposed floor (inverted), , No, 0, 0, 0, 0.00,
8. External wall, E22 Basement floor, , No, 0, 0, 0, 0.00,
9. External wall, E6 Intermediate floor within a dwelling, Table K1 - Approved, Yes, 16.73, 0.07, 0.07, 1.17, ACD
10. External wall, E7 Party floor between dwellings (in blocks of flats), , No, 0, 0, 0, 0.00,
11. External wall, E8 Balcony within a dwelling, wall insulation continuous, , No, 0, 0, 0, 0.00,
12. External wall, E9 Balcony between dwellings, wall insulation continuous, , No, 0, 0, 0, 0.00,
13. External wall, E23 Balcony within or between dwellings, balcony support penetrates wall insulation, , No, 0, 0, 0, 0.00,
14. External wall, E10 Eaves (insulation at ceiling level), Independently assessed, No, 9.47, 0.026, 0.026, 0.25, Space4
15. External wall, E24 Eaves (insulation at ceiling level - inverted), , No, 0, 0, 0, 0.00,
16. External wall, E11 Eaves (insulation at rafter level), , No, 0, 0, 0, 0.00,
17. External wall, E12 Gable (insulation at ceiling level), Independently assessed, No, 7.26, 0.07, 0.07, 0.51, Space4
18. External wall, E13 Gable (insulation at rafter level), , No, 0, 0, 0, 0.00,
19. External wall, E14 Flat roof, , No, 0, 0, 0, 0.00,
20. External wall, E15 Flat roof with parapet, , No, 0, 0, 0, 0.00,
21. External wall, E16 Corner (normal), Independently assessed, Yes, 9.8, 0.055, 0.055, 0.54, Space4
22. External wall, E17 Corner (inverted - internal area greater than external area), , No, 0, 0, 0, 0.00,
23. External wall, E18 Party wall between dwellings, Independently assessed, Yes, 9.8, 0.037, 0.037, 0.36, Space4
24. External wall, E25 Staggered party wall between dwellings, , No, 0, 0, 0, 0.00,
25. Party wall, P1 Party wall - Ground floor, Independently assessed, No, 8.16, 0.113, 0.113, 0.92, Space4
26. Party wall, P6 Party wall - Ground floor (inverted), , No, 0, 0, 0, 0.00,
27. Party wall, P2 Party wall - Intermediate floor within a dwelling, Independently assessed, No, 7.26, 0.001, 0.001, 0.01, Space4
28. Party wall, P3 Party wall - Intermediate floor between dwellings (in blocks of flats), , No, 0, 0, 0, 0.00,
29. Party wall, P7 Party Wall - Exposed floor (normal), , No, 0, 0, 0, 0.00,
30. Party wall, P8 Party Wall - Exposed floor (inverted), , No, 0, 0, 0, 0.00,
31. Party wall, P4 Party wall - Roof (insulation at ceiling level), Table K1 - Default, No, 7.26, 0.24, 0.24, 1.74, Default

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

SAP2012 - 9.92 input data (DesignData) -

32. Party wall, P5 Party wall - Roof (insulation at rafter level), , No, 0, 0, 0, 0.00,
33. External roof, R1 Head of roof window, , No, 0, 0, 0, 0.00,
34. External roof, R2 Sill of roof window, , No, 0, 0, 0, 0.00,
35. External roof, R3 Jamb of roof window, , No, 0, 0, 0, 0.00,
36. External roof, R4 Ridge (vaulted ceiling), , No, 0, 0, 0, 0.00,
37. External roof, R5 Ridge (inverted), , No, 0, 0, 0, 0.00,
38. External roof, R6 Flat ceiling, , No, 0, 0, 0, 0.00,
39. External roof, R7 Flat ceiling (inverted), , No, 0, 0, 0, 0.00,
40. External roof, R8 Roof to wall (rafter), , No, 0, 0, 0, 0.00,
41. External roof, R9 Roof to wall (flat ceiling), , No, 0, 0, 0, 0.00,
Pressure Test: True
Designed q50: 5
AsBuilt q50: 15
Property Tested: False
Mechanical Ventilation: None
Chimneys MHS: 0
Chimneys SHS: 0
Chimneys Other: 0
Chimneys Total: 0
Open Flues MHS: 0
Open Flues SHS: 0
Open Flues Other: 0
Open Flues Total: 0
Intermittent Fans: 4
Passive Vents: 0
Flueless Gas Fires: 0
Cooling System: None
Light Fittings: 20
LEL Fittings: 20
Percentage of LEL Fittings: 100
External Lights Fitted: Yes
External LELs Fitted: Yes
Electricity Tariff: Standard
Main Heating 1
Description
Percentage 100
Sedbuk ID 17045
Fuel Type Mains gas
MHS Mains gas BGW Post 98 Combi condens. with auto ign.
SAP Code 104
Boiler Efficiency Type Split Efficiencies
Efficiency Winter 89.8
Efficiency Summer 87.3
Controls by PCDF 0
MHS Controls CBI Time and temperature zone control
Boiler Interlock Yes
Compensator 0
Delayed Start Stat Yes
Ctrl SAP Code 2110
Flue Type Balanced
Fan Assisted Flue Yes
Pumped Pump in heated space
Heat Pump Age 2013 or later
Heat Emitter Radiators
Flow Temperature Normal (> 45°C)
Combi boiler type Standard Combi
Combi keep hot type None
Main Heating 2 None
Heating Systems Interaction Each system heats separate parts of dwelling
Smoke Control Area Unknown
Community Heating None
Secondary Heating None
Water Heating
Type MainHeating1
WHS HWP From main heating 1
Low Water Usage Yes
SAP Code 901
Showers in Property Non-electric only
Hot Water Cylinder None
Flue Gas Heat Recovery System None
Waste Water Heat Recovery none
PV Unit None
Wind Turbine None
Terrain Type: Urban
Small Scale Hydro None
Special Features None

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

DWELLING AS DESIGNED

Semi-Detached House, total floor area 71 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) 19.17 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.20 kgCO₂/m²OK

1b TFEE and DFEE

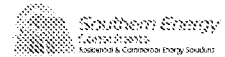
Target Fabric Energy Efficiency (TFEE) 53.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 47.0 kWh/m²/yrOK

2 Fabric U-values

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



SAP2012 - 9.92 input data (DesignData) -

Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.12 (max. 0.20)	0.20 (max. 0.35)	OK
Openings	1.30 (max. 2.00)	1.30 (max. 3.30)	OK

2a Thermal bridging			
Thermal bridging calculated from linear thermal transmittances for each junction			

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

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

Secondary heating system:			
	None		

5 Cylinder insulation			
Hot water storage	No cylinder		

6 Controls			
Space heating controls:	Time and temperature zone control		OK

Hot water controls:			
	No cylinder		

Boiler interlock			
	Yes		OK

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

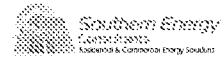
8 Mechanical ventilation			
Not applicable			

9 Summertime temperature			
Overheating risk (South East England):	Slight		OK
Based on:			
Overshading:	Average		
Windows facing North:	7.92 m², No overhang		
Windows facing East:	0.66 m², No overhang		
Windows facing South:	4.86 m², No overhang		
Air change rate:	3.00 ach		
Blinds/curtains:	None		

10 Key features			
Party wall U-value	0.00 W/m²K		
Roof U-value	0.11 W/m²K		
Floor 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	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (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					4 * 10 = 40.0000 (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)					40.0000 / (5) = 0.2312 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4812 (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) =	0.4090 (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	0.5215	0.5113	0.5010	0.4499	0.4397	0.3886	0.3886	0.3783	0.4090	0.4397	0.4601	0.4806 (22b)
Effective ac	0.6360	0.6307	0.6255	0.6012	0.5967	0.5755	0.5755	0.5716	0.5836	0.5967	0.6059	0.6155 (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	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.30)			13.4400	1.2357	16.6084		(27)
Heat Loss Floor 1			36.4100	0.1100	4.0051		(28a)
External Wall 1	84.0700	15.3900	68.6800	0.2500	17.1700		(29a)
External Roof 1	34.3200		34.3200	0.1100	3.7752		(30)
External Roof 2	2.0900		2.0900	0.2000	0.4180		(30)
Total net area of external elements Aum(A, m ²)			156.8900				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		44.5117		(33)
Party Wall 1			37.2600	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)							10.6140 (36)
Total fabric heat loss						(33) + (36) =	55.1256 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	36.3106	36.0092	35.7137	34.3257	34.0660	32.8571	32.8571	32.6333	33.3228	34.0660	34.5913	35.1406 (38)
Heat transfer coeff	91.4363	91.1348	90.8393	89.4513	89.1916	87.9828	87.9828	87.7589	88.4484	89.1916	89.7170	90.2662 (39)
Average = Sum(39)m / 12 =												89.4501 (39)
HLP	1.2929	1.2887	1.2845	1.2649	1.2612	1.2441	1.2441	1.2409	1.2507	1.2612	1.2686	1.2764 (40)
HLP (average)												1.2648 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	96.7533	93.2350	89.7167	86.1984	82.6801	79.1618	79.1618	82.6801	86.1984	89.7167	93.2350	96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)										Total = Sum(45)m =		1383.9153 (45)
Distribution loss (46)m = 0.15 x (45)m												
21.5224	18.8236	19.4243	16.9345	16.2491	14.0217	12.9932	14.9099	15.0880	17.5836	19.1938	20.8433 (46)	
Water storage loss:												
Total storage loss												

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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	(56)
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	26.2480	23.5770	25.8947	24.8236	25.4796	24.4599	25.1521	25.3644	24.6581	25.7230	25.1666	26.1797	(61)
Solar input	169.7304	149.0677	155.3898	137.7206	133.8069	117.9381	111.7734	124.7637	125.2445	142.9467	153.1255	165.1347	(62)
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	Solar input (sum of months) =	Sum (63)m =	0.0000	0.0000	(63)	
Heat gains from water heating, kWh/month	169.7304	149.0677	155.3898	137.7206	133.8069	117.9381	111.7734	124.7637	125.2445	142.9467	153.1255	165.1347	(64)
	54.2699	47.6199	49.5308	43.7441	42.3887	37.1965	35.0896	39.3914	39.6095	45.4076	48.8380	52.7475	(65)
	Total per year (kWh/year) = Sum (64)m = 1686.6419												

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739 (66)
Lighting gains	(calculated in Appendix L, equation L9 or L9a), also see Table 5											
	17.9729	15.9634	12.9823	9.8284	7.3469	6.2025	6.7021	8.7116	11.6927	14.8465	17.3281	18.4724 (67)
Appliances gains	(calculated in Appendix L, equation L13 or L13a), also see Table 5											
	198.9716	201.0363	195.8333	184.7568	170.7747	157.6334	148.8543	146.7896	151.9926	163.0691	177.0512	190.1925 (68)
Cooking gains	(calculated in Appendix L, equation L15 or L15a), also see Table 5											
	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174 (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)											
	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391 (71)
Water heating gains	(Table 5)											
	72.9434	70.8629	66.5737	60.7558	56.9741	51.6618	47.1635	52.9454	55.0132	61.0318	67.8305	70.8971 (72)
Total internal gains												
	349.8401	347.8148	335.3414	315.2931	295.0478	275.4499	262.6719	268.3987	278.6506	298.8996	322.1620	339.5142 (73)

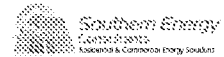
[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	7.9200	10.6334	0.7200	0.7000	0.7700	29.4145 (74)
East	0.6600	19.6403	0.7200	0.7000	0.7700	4.5275 (76)
South	4.8600	46.7521	0.7200	0.7000	0.7700	79.3599 (78)

MIT	18.3959	18.6962	19.1650	19.7740	20.3165	20.7119	20.8826	20.8523	20.5478	19.8490	19.0239	18.3498 (87)	
Th 2	19.8464	19.8497	19.8530	19.8685	19.8714	19.8849	19.8849	19.8874	19.8797	19.8714	19.8655	19.8594 (88)	
util rest of house													
	0.9550	0.9333	0.8973	0.8282	0.7146	0.5522	0.3954	0.4396	0.6643	0.8540	0.9342	0.9605 (89)	
MIT 2	16.3942	16.8284	17.5030	18.3727	19.1150	19.6256	19.8099	19.7865	19.4375	18.4967	17.3164	16.3344 (90)	
Living area fraction									fLA =	Living area / (4) =			0.2113 (91)
MIT	16.8170	17.2230	17.8541	18.6687	19.3688	19.8551	20.0365	20.0117	19.6721	18.7823	17.6771	16.7602 (92)	
Temperature adjustment												-0.1500	
adjusted MIT	16.6670	17.0730	17.7041	18.5187	19.2188	19.7051	19.8865	19.8617	19.5221	18.6323	17.5271	16.6102 (93)	

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 %)												89.8000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3109.1756 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	521.0734	416.4059	365.8096	234.0343	130.8124	0.0000	0.0000	0.0000	0.0000	219.2096	375.4392	529.2553 (98)
Space heating efficiency (main heating system 1)	89.8000	89.8000	89.8000	89.8000	89.8000	0.0000	0.0000	0.0000	0.0000	89.8000	89.8000	89.8000 (210)
Space heating fuel (main heating system)	580.2599	463.7037	407.3603	260.6173	145.6708	0.0000	0.0000	0.0000	0.0000	244.1087	418.0838	589.3711 (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	169.7304	149.0677	155.3898	137.7206	133.8069	117.9381	111.7734	124.7637	125.2445	142.9467	153.1255	165.1347 (64)
Efficiency of water heater (217)m	89.1726	89.1272	89.0398	88.8573	88.5182	87.3000	87.3000	87.3000	87.3000	88.7963	89.0611	87.3000 (216)
Fuel for water heating, kWh/month	190.3393	167.2528	174.5173	154.9907	151.1631	135.0952	128.0337	142.9137	143.4645	160.9827	171.9330	185.1440 (219)
Water heating fuel used												1905.8299 (219)
Annual totals kWh/year												
Space heating fuel - main system												3109.1756 (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)												317.4070 (232)
Total delivered energy for all uses												5407.4125 (238)

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

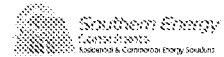
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3109.1756	0.2160	671.5819 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1905.8299	0.2160	411.6593 (264)
Space and water heating			1083.2412 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	317.4070	0.5190	164.7342 (268)
Total CO2, kg/year			1286.9004 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.2000 (273)

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

DER		18.2000 ZC1
Total Floor Area	TFA	70.7200
Assumed number of occupants	N	2.2635
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		16.6723 ZC2
CO2 emissions from cooking, equation (L16)		2.4508 ZC3
Total CO2 emissions		37.3231 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		37.3231 ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.2312 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4812 (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) =	0.4090 (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	0.5215	0.5113	0.5010	0.4499	0.4397	0.3886	0.3886	0.3783	0.4090	0.4397	0.4601	0.4806 (22b)
Effective ac	0.6360	0.6307	0.6255	0.6012	0.5967	0.5755	0.5755	0.5716	0.5836	0.5967	0.6059	0.6155 (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	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.30)			13.4400	1.2357	16.6084		(27)
Heat Loss Floor 1			36.4100	0.1100	4.0051		(28a)
External Wall 1	84.0700	15.3900	68.6800	0.2500	17.1700		(29a)
External Roof 1	34.3200		34.3200	0.1100	3.7752		(30)
External Roof 2	2.0900		2.0900	0.2000	0.4180		(30)
Total net area of external elements Aum(A, m ²)			156.8900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.5117		(33)
Party Wall 1			37.2600	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)							10.6140 (36)
Total fabric heat loss						(33) + (36) =	55.1256 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	36.3106	36.0092	35.7137	34.3257	34.0660	32.8571	32.8571	32.6333	33.3228	34.0660	34.5913	35.1406 (38)
Heat transfer coeff	91.4363	91.1348	90.8393	89.4513	89.1916	87.9828	87.9828	87.7589	88.4484	89.1916	89.7170	90.2662 (39)
Average = Sum(39)m / 12 =												89.4501 (39)
HLP	1.2929	1.2887	1.2845	1.2649	1.2612	1.2441	1.2441	1.2409	1.2507	1.2612	1.2686	1.2764 (40)
HLP (average)												1.2648 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.7533	93.2350	89.7167	86.1984	82.6801	79.1618	79.1618	82.6801	86.1984	89.7167	93.2350	96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)											Total = Sum(45)m =	1383.9153 (45)
Distribution loss (46)m = 0.15 x (45)m												
	21.5224	18.8236	19.4243	16.9345	16.2491	14.0217	12.9932	14.9099	15.0880	17.5836	19.1938	20.8433 (46)
Water storage loss:												
Store volume												150.0000 (47)

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 Gas and Electricity
 Gas and Electricity

b) If manufacturer declared loss factor is not known :													
Hot water storage loss factor from Table 2 (kWh/litre/day)											0.0191	(51)	
Volume factor from Table 2a											0.9283	(52)	
Temperature factor from Table 2b											0.5400	(53)	
Enter (49) or (54) in (55)											1.4364	(55)	
Total storage loss													
	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(56)
If cylinder contains dedicated solar storage													
	44.5282	40.2190	44.5282	43.0918	44.5282	43.0918	44.5282	44.5282	43.0918	44.5282	43.0918	44.5282	(57)
Primary loss													
	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	211.2730	186.7208	197.2857	178.5008	176.1179	159.0820	154.4119	167.1898	166.1902	185.0143	193.5627	206.7456	(62)
Solar input													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	211.2730	186.7208	197.2857	178.5008	176.1179	159.0820	154.4119	167.1898	166.1902	185.0143	193.5627	206.7456	(64)
Total per year (kWh/year) = Sum(64)m =												2182.0948	(64)
Heat gains from water heating, kWh/month													
	101.9404	90.7098	97.2896	90.0213	90.2513	83.5646	83.0341	87.2827	85.9280	93.2094	95.0294	100.4350	(65)

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.9729	15.9634	12.9823	9.8284	7.3469	6.2025	6.7021	8.7116	11.6927	14.8465	17.3281	18.4724 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.9716	201.0363	195.8333	184.7658	170.7747	157.6334	148.8543	146.7896	151.9926	163.0691	177.0512	190.1925 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174 (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)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391 (71)
Water heating gains (Table 5)	137.0166	134.9848	130.7656	125.0296	121.3055	116.0619	111.6049	117.3155	119.3445	125.2814	131.9852	134.9933 (72)
Total internal gains	413.9133	411.9367	399.5334	379.5669	359.3792	339.8500	327.1134	332.7688	342.9818	363.1492	386.3167	403.6104 (73)

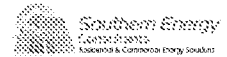
[Jan]				Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				7.9200	10.6334	0.7200	0.7000	0.7700	29.4145 (74)			
East				0.6600	19.6403	0.7200	0.7000	0.7700	4.5275 (76)			
South				4.8600	46.7521	0.7200	0.7000	0.7700	79.3599 (78)			
Solar gains	113.3018	195.0402	275.6645	361.8188	427.7405	435.5963	415.3265	363.7684	304.7553	217.6088	136.0002	96.8187 (83)
Total gains	527.2151	606.9769	675.1979	741.3857	787.1197	775.4463	742.4399	696.5372	647.7371	580.7580	522.3169	500.4291 (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	21.4843	21.5554	21.6255	21.9610	22.0250	22.3276	22.3276	22.3846	22.2101	22.0250	21.8960	21.7628
alpha	2.4323	2.4370	2.4417	2.4641	2.4683	2.4885	2.4885	2.4923	2.4807	2.4683	2.4597	2.4509
util living area	0.9494	0.9283	0.8940	0.8302	0.7301	0.5928	0.4664	0.5061	0.6912	0.8534	0.9281	0.9548 (86)
MIT	18.5293	18.8214	19.2777	19.8658	20.3801	20.7470	20.9000	20.8746	20.6031	19.9492	19.1503	18.4861 (87)
Th 2	19.8464	19.8497	19.8530	19.8685	19.8714	19.8849	19.8849	19.8874	19.8797	19.8714	19.8655	19.8594 (88)
util rest of house	0.9417	0.9176	0.8777	0.8028	0.6838	0.5188	0.3657	0.4058	0.6245	0.8239	0.9156	0.9479 (89)
MIT 2	17.6198	17.9081	18.3555	18.9307	19.4078	19.7316	19.8420	19.8300	19.6192	19.0237	18.2468	17.5863 (90)
Living area fraction	17.8119	18.1011	18.5503	19.1282	19.6132	19.9461	20.0655	20.0507	19.8270	19.2192	18.4377	0.2113 (91)
MIT	17.8119	18.1011	18.5503	19.1282	19.6132	19.9461	20.0655	20.0507	19.8270	19.2192	18.4377	17.7764 (92)
Temperature adjustment	17.8119	18.1011	18.5503	19.1282	19.6132	19.9461	20.0655	20.0507	19.8270	19.2192	18.4377	0.0000
adjusted MIT	17.8119	18.1011	18.5503	19.1282	19.6132	19.9461	20.0655	20.0507	19.8270	19.2192	18.4377	17.7764 (93)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9237	0.8966	0.8547	0.7817	0.6719	0.5232	0.3830	0.4216	0.6209	0.8032	0.8951	0.9310 (94)
Useful gains	486.9640	544.2334	577.0791	579.5191	528.8904	405.7320	284.3644	293.6310	402.2106	466.4722	467.5385	465.8895 (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	1235.4800	1203.0778	1094.6446	914.9276	705.7905	470.3646	304.9067	320.3814	506.5470	768.7617	1017.1835	1225.4892 (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	556.8958	442.7434	385.0687	241.4941	131.6136	0.0000	0.0000	0.0000	0.0000	224.9034	395.7444	565.1422 (98)
Space heating												2943.6057 (98)
Space heating per m2												(98) / (4) = 41.6234 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF STANDARD ENE7 CO2 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

DER

Total Floor Area

Assumed number of occupants

CO2 emission factor in Table 12 for electricity displaced from grid

CO2 emissions from appliances, equation (L14)

CO2 emissions from cooking, equation (L16)

Total CO2 emissions

Residual CO2 emissions offset from biofuel CHP

Additional allowable electricity generation, kWh/m²/year

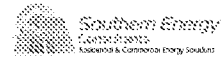
Resulting CO2 emissions offset from additional allowable electricity generation

Net CO2 emissions

TFA	21.0200	ZC1
N	70.7200	
EF	2.2635	
	0.5190	
	16.6723	ZC2
	2.4508	ZC3
	40.1431	ZC4
	0.0000	ZC5
	0.0000	ZC6
	0.0000	ZC7
	40.1431	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	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (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) = 0.1734 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4234 (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) =	0.3599 (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	0.4589	0.4499	0.4409	0.3959	0.3869	0.3419	0.3419	0.3329	0.3599	0.3869	0.4049	0.4229 (22b)
Effective ac	0.6053	0.6012	0.5972	0.5784	0.5748	0.5584	0.5584	0.5554	0.5648	0.5748	0.5820	0.5894 (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)			13.4400	1.3258	17.8182			(27)					
Heat Loss Floor 1			36.4100	0.1300	4.7333			(28a)					
External Wall 1	84.0700	15.3900	68.6800	0.1800	12.3624			(29a)					
External Roof 1	34.3200		34.3200	0.1300	4.4616			(30)					
External Roof 2	2.0900		2.0900	0.1300	0.2717			(30)					
Total net area of external elements Aum(A, m2)			156.8900					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	41.5972			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								9.1981 (36)					
Total fabric heat loss						(33) + (36) =		50.7953 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 34.5576	Feb 34.3242	Mar 34.0954	Apr 33.0208	May 32.8198	Jun 31.8839	Jul 31.8839	Aug 31.7106	Sep 32.2444	Oct 32.8198	Nov 33.2265	Dec 33.6517	(38)
Heat transfer coeff	85.3528	85.1194	84.8907	83.8161	83.6151	82.6792	82.6792	82.5058	83.0397	83.6151	84.0218	84.4470	(39)
Average = Sum(39)m / 12 =												83.8152	(39)
HLP	Jan 1.2069	Feb 1.2036	Mar 1.2004	Apr 1.1852	May 1.1823	Jun 1.1691	Jul 1.1691	Aug 1.1667	Sep 1.1742	Oct 1.1823	Nov 1.1881	Dec 1.1941	(40)
HLP (average)												1.1852	(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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	Jan 96.7533	Feb 93.2350	Mar 89.7167	Apr 86.1984	May 82.6801	Jun 79.1618	Jul 79.1618	Aug 82.6801	Sep 86.1984	Oct 89.7167	Nov 93.2350	Dec 96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)												Total = Sum(45)m = 1383.9153 (45)
Distribution loss (46)m = 0.15 x (45)m	21.5224	18.8236	19.4243	16.9345	16.2491	14.0217	12.9932	14.9099	15.0880	17.5836	19.1938	20.8433 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.03r08

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 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)
Combi loss	49.3044	42.9137	45.7187	42.5088	42.1329	39.0387	40.3400	42.1329	42.5088	45.7187	45.9789	49.3044 (61)
Total heat required for water heating calculated for each month	192.7869	168.4043	175.2138	155.4058	150.4602	132.5169	126.9613	141.5321	143.0952	162.9424	173.9378	188.2595 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	192.7869	168.4043	175.2138	155.4058	150.4602	132.5169	126.9613	141.5321	143.0952	162.9424	173.9378	188.2595 (64)
Heat gains from water heating, kWh/month	60.0340	52.4541	54.4868	48.1654	46.5521	40.8412	38.8866	43.5835	44.0722	50.4066	54.0411	58.5287 (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	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.9729	15.9634	12.9823	9.8284	7.3469	6.2025	6.7021	8.7116	11.6927	14.8465	17.3281	18.4724 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.9716	201.0363	195.8333	184.7568	170.7747	157.6334	148.8543	146.7896	151.9926	163.0691	177.0512	190.1925 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174 (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)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391 (71)
Water heating gains (Table 5)	80.6909	78.0566	73.2349	66.8964	62.5700	56.7239	52.2669	58.5799	61.2114	67.7508	75.0570	78.6676 (72)
Total internal gains	357.5876	355.0085	342.0027	321.4338	300.6437	280.5120	267.7754	274.0332	284.8487	305.6185	329.3885	347.2846 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W
North				7.9200	10.6334	0.6300	0.7000			0.7700			25.7376 (74)
East				0.6600	19.6403	0.6300	0.7000			0.7700			3.9615 (76)
South				4.8600	46.7521	0.6300	0.7000			0.7700			69.4399 (78)
Solar gains	99.1390	170.6602	241.2064	316.5914	374.2730	381.1468	363.4107	318.2973	266.6609	190.4077	119.0002	84.7164	(83)
Total gains	456.7266	525.6686	583.2091	638.0253	674.9166	661.6588	631.1861	592.3306	551.5096	496.0262	448.3887	432.0010	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	57.5389	57.6967	57.8522	58.5939	58.7348	59.3996	59.3996	59.5244	59.1418	58.7348	58.4505	58.1561
alpha	4.8359	4.8464	4.8568	4.9063	4.9157	4.9600	4.9600	4.9683	4.9428	4.9157	4.8967	4.8771
util living area	0.9972	0.9940	0.9858	0.9592	0.8840	0.7279	0.5599	0.6136	0.8472	0.9718	0.9943	0.9979 (86)
MIT	19.7251	19.8849	20.1368	20.4693	20.7610	20.9371	20.9862	20.9787	20.8602	20.4883	20.0477	19.6989 (87)
Th 2	19.9145	19.9171	19.9197	19.9319	19.9342	19.9448	19.9448	19.9468	19.9407	19.9342	19.9295	19.9247 (88)
util rest of house	0.9963	0.9920	0.9807	0.9435	0.8391	0.6349	0.4340	0.4864	0.7742	0.9579	0.9920	0.9972 (89)
MIT 2	18.2248	18.4594	18.8264	19.3082	19.6979	19.9026	19.9397	19.9380	19.8283	19.3437	18.7065	18.1937 (90)
Living area fraction	18.5418	18.7605	19.1033	19.5535	19.9225	20.1211	20.1608	20.1579	20.0463	19.5855	18.9898	18.5117 (92)
Temperature adjustment												0.0000
adjusted MIT	18.5418	18.7605	19.1033	19.5535	19.9225	20.1211	20.1608	20.1579	20.0463	19.5855	18.9898	18.5117 (93)

8. Space heating requirement

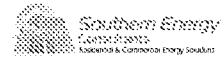
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9945	0.9889	0.9754	0.9364	0.8386	0.6518	0.4607	0.5132	0.7827	0.9517	0.9890	0.9957 (94)
Ext temp.	454.2113	519.8226	568.8713	597.4429	565.9542	431.2669	290.7909	303.9922	431.6493	472.0787	443.4548	430.1585 (95)
Heat loss rate W	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	1215.5749	1179.8008	1069.8984	892.9359	687.5269	456.4817	294.4047	310.0454	493.7795	751.3239	999.0048	1208.5766 (97)
Space heating kWh	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 per m ²	566.4545	443.5053	372.7642	212.7550	90.4501	0.0000	0.0000	0.0000	0.0000	207.7584	399.9960	579.1430 (98)
												2872.8266 (98)
												40.6225 (99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

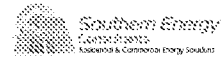
Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)											
Fraction of space heat from main system(s)	1.0000 (202)											
Efficiency of main space heating system 1 (in %)	93.4000 (206)											
Efficiency of secondary/supplementary heating system, %	0.0000 (208)											
Space heating requirement	3075.8315 (211)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	566.4545	443.5053	372.7642	212.7550	90.4501	0.0000	0.0000	0.0000	0.0000	207.7584	399.9960	579.1430 (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)	606.4823	474.8451	399.1051	227.7890	96.8417	0.0000	0.0000	0.0000	0.0000	222.4394	428.2612	620.0675 (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	192.7869	168.4043	175.2138	155.4058	150.4602	132.5169	126.9613	141.5321	143.0952	162.9424	173.9378	188.2595 (64)
Efficiency of water heater (217)m	87.6022	87.3754	86.9049	85.8424	83.8159	80.3000	80.3000	80.3000	80.3000	85.6640	87.0806	87.6941 (217)
Fuel for water heating, kWh/month	220.0708	192.7364	201.6154	181.0362	179.5128	165.0273	158.1088	176.2542	178.2007	190.2111	199.7434	214.6775 (219)
Water heating fuel used												2257.1947 (219)
Annual totals kWh/year												
Space heating fuel - main system												3075.8315 (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)												317.4070 (232)
Total delivered energy for all uses												5725.4332 (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	3075.8315	0.2160	664.3796 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2257.1947	0.2160	487.5541 (264)
Space and water heating			1151.9337 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	317.4070	0.5190	164.7342 (268)
Total CO2, kg/m2/year			1355.5929 (272)
Emissions per m2 for space and water heating			16.2887 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.3294 (272b)
Emissions per m2 for pumps and fans			0.5504 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.2887 * 1.00) + 2.3294 + 0.5504, rounded to 2 d.p.			19.1700 (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	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (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)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1734 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4234 (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) =	0.3599 (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	0.4589	0.4499	0.4409	0.3959	0.3869	0.3419	0.3419	0.3329	0.3599	0.3869	0.4049	0.4229 (22b)
Effective ac	0.6053	0.6012	0.5972	0.5784	0.5748	0.5584	0.5584	0.5554	0.5648	0.5748	0.5820	0.5894 (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	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.30)			13.4400	1.2357	16.6084		(27)
Heat Loss Floor 1			36.4100	0.1100	4.0051		(28a)
External Wall 1	84.0700	15.3900	68.6800	0.2500	17.1700		(29a)
External Roof 1	34.3200		34.3200	0.1100	3.7752		(30)
External Roof 2	2.0900		2.0900	0.2000	0.4180		(30)
Total net area of external elements Aum(A, m ²)			156.8900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.5117		(33)
Party Wall 1			37.2600	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)							10.6140 (36)
Total fabric heat loss						(33) + (36) =	55.1256 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	34.5576	34.3242	34.0954	33.0208	32.8198	31.8839	31.8839	31.7106	32.2444	32.8198	33.2265	33.6517 (38)
Heat transfer coeff	89.6832	89.4498	89.2210	88.1465	87.9454	87.0095	87.0095	86.8362	87.3700	87.9454	88.3521	88.7773 (39)
Average = Sum(39)m / 12 =												88.1455 (39)
HLP	1.2681	1.2648	1.2616	1.2464	1.2436	1.2303	1.2303	1.2279	1.2354	1.2436	1.2493	1.2553 (40)
HLP (average)												1.2464 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	96.7533	93.2350	89.7167	86.1984	82.6801	79.1618	79.1618	82.6801	86.1984	89.7167	93.2350	96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)										Total = Sum(45)m =		1383.9153 (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												

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.03r08

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	30.4900	26.6668	27.5177	23.9906	23.0196	19.8641	18.4070	21.1223	21.3746	24.9100	27.1913	29.5279 (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	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.9729	15.9634	12.9823	9.8284	7.3469	6.2025	6.7021	8.7116	11.6927	14.8465	17.3281	18.4724	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.9716	201.0363	195.8333	184.7568	170.7747	157.6334	148.8543	146.7896	151.9926	163.0691	177.0512	190.1925	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	(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)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	(71)
Water heating gains (Table 5)	40.9812	39.6827	36.9862	33.3203	30.9403	27.5891	24.7406	28.3902	29.6870	33.4812	37.7656	39.6881	(72)
Total internal gains	314.8779	313.6345	302.7540	284.8577	266.0140	248.3772	237.2491	240.8436	250.3243	268.3490	289.0971	305.3052	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.9200	10.6334	0.7200	0.7000	0.7700	29.4145	(74)
East	0.6600	19.6403	0.7200	0.7000	0.7700	4.5275	(76)
South	4.8600	46.7521	0.7200	0.7000	0.7700	79.3599	(78)

Solar gains	113.3018	195.0402	275.6645	361.8188	427.7405	435.5963	415.3265	363.7684	304.7553	217.6088	136.0002	96.8187	(83)
Total gains	428.1797	508.6747	578.4184	646.6765	693.7545	683.9735	652.5756	604.6119	555.0796	485.9578	425.0973	402.1239	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.9043	21.9614	22.0177	22.2861	22.3371	22.5773	22.5773	22.6224	22.4842	22.3371	22.2343	22.1278	
alpha	2.4603	2.4641	2.4678	2.4857	2.4891	2.5052	2.5052	2.5082	2.4989	2.4891	2.4823	2.4752	
util living area	0.9668	0.9488	0.9192	0.8625	0.7694	0.6381	0.5113	0.5572	0.7430	0.8909	0.9518	0.9712	(86)
MIT	18.3698	18.6737	19.1466	19.7561	20.3048	20.7041	20.8791	20.8462	20.5328	19.8213	18.9889	18.3167	(87)
Th 2	19.8659	19.8685	19.8710	19.8830	19.8853	19.8958	19.8958	19.8978	19.8918	19.8853	19.8807	19.8760	(88)
util rest of house	0.9615	0.9408	0.9061	0.8387	0.7264	0.5647	0.4062	0.4535	0.6805	0.8670	0.9429	0.9666	(89)
MIT 2	17.4770	17.7782	18.2441	18.8423	19.3570	19.7125	19.8425	19.8251	19.5769	18.9181	18.1019	17.4315	(90)
Living area fraction									fLA = Living area / (4) =			0.2113	(91)
MIT	17.6656	17.9673	18.4348	19.0353	19.5573	19.9220	20.0615	20.0408	19.7788	19.1089	18.2893	17.6185	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6656	17.9673	18.4348	19.0353	19.5573	19.9220	20.0615	20.0408	19.7788	19.1089	18.2893	17.6185	(93)

8. Space heating requirement

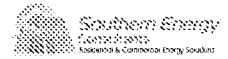
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9474	0.9230	0.8848	0.8170	0.7120	0.5666	0.4232	0.4682	0.6731	0.8462	0.9259	0.9539	(94)
Ext temp.	405.6753	469.4969	511.7931	528.3423	493.9403	387.5224	276.1390	283.0887	373.6325	411.2103	393.6095	383.5808	(95)
Heat loss rate 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	1198.6743	1168.8713	1064.8341	893.3928	691.0107	463.0637	301.1794	316.1562	496.1611	748.3203	988.5982	1191.2571	(97)
Space heating kWh	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	589.9912	469.9796	411.4625	262.8364	146.6204	0.0000	0.0000	0.0000	0.0000	250.8098	428.3918	600.9111	(98)
Space heating per m ²												3161.0028	(98)
												44.6974	(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	817.8896	643.8705	659.9552	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7418	0.8040	0.7762	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	606.6786	517.6678	512.2331	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	883.6216	845.2268	790.5558	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													

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

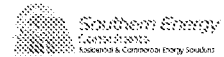


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	199.3990	243.7039	207.0721	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												650.1749 (104)
Cooled fraction									FC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	49.8498	60.9260	51.7680	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												162.5437 (107)
Space cooling per m2												2.2984 (108)
Energy for space heating												44.6974 (99)
Energy for space cooling												2.2984 (108)
Total												46.9958 (109)
Dwelling Fabric Energy Efficiency (DFEE)												47.0 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (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) = 0.1734 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4234 (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) =	0.3599 (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	0.4589	0.4499	0.4409	0.3959	0.3869	0.3419	0.3419	0.3329	0.3599	0.3869	0.4049	0.4229 (22b)
Effective ac	0.6053	0.6012	0.5972	0.5784	0.5748	0.5584	0.5584	0.5554	0.5648	0.5748	0.5820	0.5894 (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)			13.4400	1.3258	17.8182			(27)					
Heat Loss Floor 1			36.4100	0.1300	4.7333			(28a)					
External Wall 1	84.0700	15.3900	68.6800	0.1800	12.3624			(29a)					
External Roof 1	34.3200		34.3200	0.1300	4.4616			(30)					
External Roof 2	2.0900		2.0900	0.1300	0.2717			(30)					
Total net area of external elements Aum(A, m2)			156.8900					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	41.5972			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)								9.1981 (36)					
Total fabric heat loss						(33) + (36) =		50.7953 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 34.5576	Feb 34.3242	Mar 34.0954	Apr 33.0208	May 32.8198	Jun 31.8839	Jul 31.8839	Aug 31.7106	Sep 32.2444	Oct 32.8198	Nov 33.2265	Dec 33.6517	(38)
Heat transfer coeff	85.3528	85.1194	84.8907	83.8161	83.6151	82.6792	82.6792	82.5058	83.0397	83.6151	84.0218	84.4470	(39)
Average = Sum(39)m / 12 =												83.8152	(39)
HLP	Jan 1.2069	Feb 1.2036	Mar 1.2004	Apr 1.1852	May 1.1823	Jun 1.1691	Jul 1.1691	Aug 1.1667	Sep 1.1742	Oct 1.1823	Nov 1.1881	Dec 1.1941	(40)
HLP (average)												1.1852	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

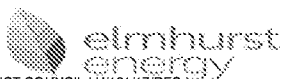
Assumed occupancy												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	Jan 96.7533	Feb 93.2350	Mar 89.7167	Apr 86.1984	May 82.6801	Jun 79.1618	Jul 79.1618	Aug 82.6801	Sep 86.1984	Oct 89.7167	Nov 93.2350	Dec 96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)												Total = Sum(45)m = 1383.9153 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

Regs Region: England

Elmhurst Energy Systems

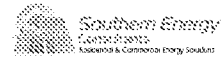
SAP2012 Calculator (Design

System) version 4.03r08



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET 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	30.4900	26.6668	27.5177	23.9906	23.0196	19.8641	18.4070	21.1223	21.3746	24.9100	27.1913	29.5279 (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	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	113.1739	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.9729	15.9634	12.9823	9.8284	7.3469	6.2025	6.7021	8.7116	11.6927	14.8465	17.3281	18.4724	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	198.9716	201.0363	195.8333	184.7568	170.7747	157.6334	148.8543	146.7896	151.9926	163.0691	177.0512	190.1925	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	34.3174	(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)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	(71)
Water heating gains (Table 5)	40.9812	39.6827	36.9862	33.3203	30.9403	27.5891	24.7406	28.3902	29.6870	33.4812	37.7656	39.6881	(72)
Total internal gains	314.8779	313.6345	302.7540	284.8577	266.0140	248.3772	237.2491	240.8436	250.3243	268.3490	289.0971	305.3052	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	7.9200	10.6334	0.6300	0.7000	0.7700	25.7376 (74)
East	0.6600	19.6403	0.6300	0.7000	0.7700	3.9615 (76)
South	4.8600	46.7521	0.6300	0.7000	0.7700	69.4399 (78)

Solar gains	99.1390	170.6602	241.2064	316.5914	374.2730	381.1468	363.4107	318.2973	266.6609	190.4077	119.0002	84.7164	(83)
Total gains	414.0169	484.2947	543.9604	601.4491	640.2869	629.5240	600.6598	559.1409	516.9852	458.7567	408.0973	390.0215	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	57.5389	57.6967	57.8522	58.5939	58.7348	59.3996	59.3996	59.5244	59.1418	58.7348	58.4505	58.1561	
alpha	4.8359	4.8464	4.8568	4.9063	4.9157	4.9600	4.9600	4.9683	4.9428	4.9157	4.8967	4.8771	
util living area	0.9982	0.9958	0.9893	0.9671	0.9006	0.7527	0.5847	0.6435	0.8714	0.9792	0.9962	0.9987	(86)
MIT	19.6697	19.8319	20.0884	20.4293	20.7346	20.9268	20.9834	20.9739	20.8381	20.4450	19.9959	19.6441	(87)
Th 2	19.9145	19.9171	19.9197	19.9319	19.9342	19.9448	19.9448	19.9468	19.9407	19.9342	19.9295	19.9247	(88)
util rest of house	0.9976	0.9944	0.9854	0.9540	0.8596	0.6608	0.4550	0.5131	0.8041	0.9684	0.9946	0.9982	(89)
MIT 2	18.7056	18.8693	19.1259	19.4689	19.7518	19.9105	19.9405	19.9392	19.8491	19.4903	19.0432	18.6882	(90)
Living area fraction													(91)
MIT	18.9093	19.0727	19.3293	19.6718	19.9595	20.1252	20.1608	20.1578	20.0580	19.6920	19.2445	18.8902	(92)
Temperature adjustment													(93)
adjusted MIT	18.9093	19.0727	19.3293	19.6718	19.9595	20.1252	20.1608	20.1578	20.0580	19.6920	19.2445	18.8902	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	412.6776	480.8008	534.4497	571.3524	551.1439	426.8432	289.9753	302.4374	420.2753	442.7596	405.3304	389.0735	(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	(95)
Heat loss rate W	1246.9438	1206.3720	1089.0848	902.8491	690.6157	456.8198	294.4077	310.0394	494.7511	760.2244	1020.3998	1240.5391	(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	620.6940	487.5839	412.6485	238.6776	103.7670	0.0000	0.0000	0.0000	0.0000	236.1938	442.8500	633.4904	(98)
Space heating													(98)
Space heating per m2													(98) / (4) = 44.9082 (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	777.1842	611.8258	627.0445	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8537	0.9170	0.8921	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	663.4856	561.0513	559.4043	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	819.9793	784.5459	737.4078	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	112.6754	166.2800	132.4346	0.0000	0.0000	0.0000	0.0000	(104)

Regs Region: England

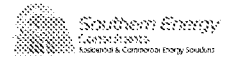
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.03r08

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

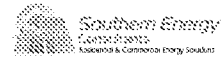


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												411.3901 (104)
Cooled fraction												1.0000 (105)
Intermittency factor (Table 10b)												
	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	28.1689	41.5700	33.1087	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												102.8475 (107)
Space cooling per m2												1.4543 (108)
Energy for space heating												44.9082 (99)
Energy for space cooling												1.4543 (108)
Total												46.3625 (109)
Target Fabric Energy Efficiency (TFEE)												53.3 (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	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (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					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.2312 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4812 (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) =	0.4090 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.3000	4.8000	4.6000	4.3000	4.4000	4.1000	4.2000	4.0000	4.2000	4.6000	4.6000	4.9000 (22)
Wind factor	1.3250	1.2000	1.1500	1.0750	1.1000	1.0250	1.0500	1.0000	1.0500	1.1500	1.1500	1.2250 (22a)
Adj infilt rate	0.5419	0.4908	0.4704	0.4397	0.4499	0.4192	0.4295	0.4090	0.4295	0.4704	0.4704	0.5010 (22b)
Effective ac	0.6469	0.6205	0.6106	0.5967	0.6012	0.5879	0.5922	0.5836	0.5922	0.6106	0.6106	0.6255 (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	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.30)			13.4400	1.2357	16.6084		(27)
Heat Loss Floor 1			36.4100	0.1100	4.0051		(28a)
External Wall 1	84.0700	15.3900	68.6800	0.2500	17.1700		(29a)
External Roof 1	34.3200		34.3200	0.1100	3.7752		(30)
External Roof 2	2.0900		2.0900	0.2000	0.4180		(30)
Total net area of external elements Aum(A, m ²)			156.8900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.5117		(33)
Party Wall 1			37.2600	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)							10.6140 (36)
Total fabric heat loss						(33) + (36) =	55.1256 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	36.9315	35.4241	34.8630	34.0660	34.3257	33.5645	33.8123	33.3228	33.8123	34.8630	34.8630	35.7137 (38)
Heat transfer coeff	92.0571	90.5498	89.9886	89.1916	89.4513	88.6902	88.9379	88.4484	88.9379	89.9886	89.9886	90.8393 (39)
Average = Sum(39)m / 12 =												89.7558 (39)
HLP	1.3017	1.2804	1.2725	1.2612	1.2649	1.2541	1.2576	1.2507	1.2576	1.2725	1.2725	1.2845 (40)
HLP (average)												1.2692 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	96.7533	93.2350	89.7167	86.1984	82.6801	79.1618	79.1618	82.6801	86.1984	89.7167	93.2350	96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)										Total = Sum(45)m =		1383.9153 (45)
Distribution loss (46)m = 0.15 x (45)m												
21.5224	18.8236	19.4243	16.9345	16.2491	14.0217	12.9932	14.9099	15.0880	17.5836	19.1938	20.8433 (46)	
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	26.2480	23.5770	25.8947	24.8236	25.4796	24.4599	25.1521	25.3644	24.6581	25.7230	25.1666	26.1797 (61)
Total heat required for water heating calculated for each month	169.7304	149.0677	155.3898	137.7206	133.8069	117.9381	111.7734	124.7637	125.2445	142.9467	153.1255	165.1347 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	169.7304	149.0677	155.3898	137.7206	133.8069	117.9381	111.7734	124.7637	125.2445	142.9467	153.1255	165.1347 (64)
RHI water heating demand												
Heat gains from water heating, kWh/month	54.2699	47.6199	49.5308	43.7441	42.3887	37.1965	35.0896	39.3914	39.6095	45.4076	48.8380	52.7475 (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	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.9322	39.9084	32.4557	24.5711	18.3672	15.5063	16.7551	21.7790	29.2317	37.1163	43.3202	46.1811	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	296.9726	300.0542	292.2886	275.7564	254.8876	235.2738	222.1706	219.0889	226.8546	243.3867	264.2556	283.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	(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)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	(71)
Water heating gains (Table 5)	72.9434	70.8629	66.5737	60.7558	56.9741	51.6618	47.1635	52.9454	55.0132	61.0318	67.8305	70.8971	(72)
Total internal gains	513.9621	509.9395	490.4318	460.1971	429.3427	401.5558	385.2030	392.9271	410.2133	440.6487	474.5202	500.0614	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W	
North					7.9200	14.2444	0.7200	0.7000			0.7700	39.4033 (74)	
East					0.6600	26.6336	0.7200	0.7000			0.7700	6.1396 (76)	
South					4.8600	59.7356	0.7200	0.7000			0.7700	101.3990 (78)	
Solar gains	146.9419	214.1494	303.9117	419.4980	482.7159	530.4273	501.4645	439.4611	361.4481	258.5886	170.0141	120.8331	(83)
Total gains	660.9040	724.0888	794.3435	879.6951	912.0586	931.9831	886.6675	832.3882	771.6614	699.2373	644.5343	620.8945	(84)

7. Mean internal temperature (heating season)

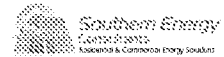
Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
alpha	21.3394	21.6946	21.8299	22.0250	21.9610	22.1495	22.0878	22.2101	22.0878	21.8299	21.8299	21.6255	
util living area	2.4226	2.4463	2.4553	2.4683	2.4641	2.4766	2.4725	2.4807	2.4725	2.4553	2.4553	2.4417	
	0.9082	0.8881	0.8434	0.7583	0.6351	0.4739	0.3586	0.3600	0.5664	0.7533	0.8691	0.9165	(86)
MIT	19.0602	19.2496	19.6577	20.1710	20.6036	20.8660	20.9514	20.9541	20.7864	20.3575	19.6751	19.0407	(87)
Th 2	19.8395	19.8562	19.8625	19.8714	19.8685	19.8770	19.8742	19.8797	19.8742	19.8625	19.8625	19.8530	(88)
util rest of house	0.8943	0.8719	0.8204	0.7225	0.5787	0.3949	0.2606	0.2563	0.4856	0.7056	0.8463	0.9036	(89)
MIT 2	17.3416	17.6173	18.1948	18.9038	19.4650	19.7733	19.8500	19.8583	19.6963	19.1663	18.2331	17.3233	(90)
Living area fraction	17.7046	17.9622	18.5039	19.1715	19.7055	20.0041	20.0826	20.0898	19.9266	19.4179	18.5377	17.6861	(92)
Temperature adjustment	17.5546	17.8122	18.3539	19.0215	19.5555	19.8541	19.9326	19.9398	19.7766	19.2679	18.3877	17.5361	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.8573	0.8340	0.7826	0.6913	0.5615	0.3932	0.2659	0.2622	0.4780	0.6762	0.8083	0.8679	(94)
Ext temp.	566.6237	603.8677	621.6597	608.1506	512.1255	366.4270	235.7632	218.2117	368.8221	472.8385	520.9819	538.8667	(95)
Heat loss rate W	5.7000	5.9000	7.4000	9.7000	12.7000	15.4000	17.2000	17.4000	15.1000	12.2000	8.7000	5.8000	(96)
Month fracti	1091.3043	1078.6429	985.7237	831.3981	613.2374	395.0346	243.0350	224.6443	415.9284	636.0307	871.7847	1066.0983	(97)
Space heating kWh	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	390.3624	319.0489	270.8636	160.7382	75.2272	0.0000	0.0000	0.0000	0.0000	121.4150	252.5780	392.2603	(98)
RHI space heating demand												1982.4937	(98)

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	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (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					4 * 10 = 40.0000 (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)					40.0000 / (5) = 0.2312 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4812 (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) =	0.4090 (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	0.5215	0.5113	0.5010	0.4499	0.4397	0.3886	0.3886	0.3783	0.4090	0.4397	0.4601	0.4806 (22b)
Effective ac	0.6360	0.6307	0.6255	0.6012	0.5967	0.5755	0.5755	0.5716	0.5836	0.5967	0.6059	0.6155 (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	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.30)			13.4400	1.2357	16.6084		(27)
Heat Loss Floor 1			36.4100	0.1100	4.0051		(28a)
External Wall 1	84.0700	15.3900	68.6800	0.2500	17.1700		(29a)
External Roof 1	34.3200		34.3200	0.1100	3.7752		(30)
External Roof 2	2.0900		2.0900	0.2000	0.4180		(30)
Total net area of external elements Aum(A, m ²)			156.8900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.5117		(33)
Party Wall 1			37.2600	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)							10.6140 (36)
Total fabric heat loss						(33) + (36) =	55.1256 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	36.3106	36.0092	35.7137	34.3257	34.0660	32.8571	32.8571	32.6333	33.3228	34.0660	34.5913	35.1406 (38)
Heat transfer coeff	91.4363	91.1348	90.8393	89.4513	89.1916	87.9828	87.9828	87.7589	88.4484	89.1916	89.7170	90.2662 (39)
Average = Sum(39)m / 12 =												89.4501 (39)
HLP	1.2929	1.2887	1.2845	1.2649	1.2612	1.2441	1.2441	1.2409	1.2507	1.2612	1.2686	1.2764 (40)
HLP (average)												1.2648 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	96.7533	93.2350	89.7167	86.1984	82.6801	79.1618	79.1618	82.6801	86.1984	89.7167	93.2350	96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)										Total = Sum(45)m =		1383.9153 (45)
Distribution loss (46)m = 0.15 x (45)m												
21.5224	18.8236	19.4243	16.9345	16.2491	14.0217	12.9932	14.9099	15.0880	17.5836	19.1938	20.8433 (46)	
Water storage loss:												
Total storage loss												

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)	
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)	
Combi loss	26.2480	23.5770	25.8947	24.8236	25.4796	24.4599	25.1521	25.3644	24.6581	25.7230	25.1666	26.1797 (61)	
Total heat required for water heating calculated for each month													
	169.7304	149.0677	155.3898	137.7206	133.8069	117.9381	111.7734	124.7637	125.2445	142.9467	153.1255	165.1347 (62)	
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)	
								Solar input (sum of months) = Sum(63)m =					0.0000 (63)
Output from w/h													
	169.7304	149.0677	155.3898	137.7206	133.8069	117.9381	111.7734	124.7637	125.2445	142.9467	153.1255	165.1347 (64)	
								Total per year (kWh/year) = Sum(64)m =					1686.6419 (64)
Heat gains from water heating, kWh/month													
	54.2699	47.6199	49.5308	43.7441	42.3887	37.1965	35.0896	39.3914	39.6095	45.4076	48.8380	52.7475 (65)	

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
((66)m	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.9322	39.9084	32.4557	24.5711	18.3672	15.5063	16.7551	21.7790	29.2317	37.1163	43.3202	46.1811	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	296.9726	300.0542	292.2886	275.7564	254.8876	235.2738	222.1706	219.0889	226.8546	243.3867	264.2556	283.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	(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)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	(71)
Water heating gains (Table 5)	72.9434	70.8629	66.5737	60.7558	56.9741	51.6618	47.1635	52.9454	55.0132	61.0318	67.8305	70.8971	(72)
Total internal gains	513.9621	509.9395	490.4318	460.1971	429.3427	401.5558	385.2030	392.9271	410.2133	440.6487	474.5202	500.0614	(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	7.9200	10.6334	0.7200	0.7000	0.7700	29.4145 (74)
East	0.6600	19.6403	0.7200	0.7000	0.7700	4.5275 (76)
South	4.8600	46.7521	0.7200	0.7000	0.7700	79.3599 (78)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, t_{in} (°C)	21.0000 (65)
Utilisation factor for gains for living area, $u_{l,m}$ (see Table 9a)	

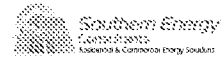
8. Space heating requirement

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 %)												89.8000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												2697.4938 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	458.4970	365.2447	318.2373	199.7210	108.3551	0.0000	0.0000	0.0000	0.0000	182.1249	323.9402	466.2292 (98)
Space heating efficiency (main heating system 1)	89.8000	89.8000	89.8000	89.8000	89.8000	0.0000	0.0000	0.0000	0.0000	89.8000	89.8000	89.8000 (210)
Space heating fuel (main heating system)	510.5757	406.7313	354.3845	222.4065	120.6627	0.0000	0.0000	0.0000	0.0000	202.8116	360.7352	519.1862 (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	169.7304	149.0677	155.3898	137.7206	133.8069	117.9381	111.7734	124.7637	125.2445	142.9467	153.1255	165.1347 (64)
Efficiency of water heater (217)m	89.1106	89.0608	88.9642	88.7626	88.4012	87.3000	87.3000	87.3000	87.3000	88.6832	88.9821	87.3000 (216)
Fuel for water heating, kWh/month	190.4717	167.3774	174.6657	155.1561	151.3632	135.0952	128.0337	142.9137	143.4645	161.1880	172.0857	89.1324 (217)
Water heating fuel used												185.2690 (219)
Annual totals kWh/year												1907.0839 (219)
Space heating fuel - main system												2697.4938 (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)												317.4070 (232)
Total delivered energy for all uses												4996.9847 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2697.4938	3.4800	93.8728 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1907.0839	3.4800	66.3665 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	317.4070	13.1900	41.8660 (250)
Additional standing charges			120.0000 (251)
Total energy cost			331.9978 (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] =		1.2050 (257)
SAP value			83.1907
SAP rating (Section 12)			83 (258)
SAP band			B

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

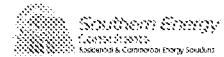
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2697.4938	0.2160	582.6587 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1907.0839	0.2160	411.9301 (264)
Space and water heating			994.5888 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	317.4070	0.5190	164.7342 (268)
Total kg/year			1198.2480 (272)
CO2 emissions per m2			16.9400 (273)
EI value			86.1247
EI rating			86 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.8980 = 3.875$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.8980 = 0.2405$, stars = 4
Water heating energy efficiency	$3.48 / 0.8836 = 3.939$, stars = 4
Water heating environmental impact	$0.216 / 0.8836 = 0.2445$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (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					4 * 10 = 40.0000 (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) =					40.0000 / (5) = 0.2312 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4812 (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) =	0.4090 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.3000	4.8000	4.6000	4.3000	4.4000	4.1000	4.2000	4.0000	4.2000	4.6000	4.6000	4.9000 (22)
Wind factor	1.3250	1.2000	1.1500	1.0750	1.1000	1.0250	1.0500	1.0000	1.0500	1.1500	1.1500	1.2250 (22a)
Adj infilt rate	0.5419	0.4908	0.4704	0.4397	0.4499	0.4192	0.4295	0.4090	0.4295	0.4704	0.4704	0.5010 (22b)
Effective ac	0.6469	0.6205	0.6106	0.5967	0.6012	0.5879	0.5922	0.5836	0.5922	0.6106	0.6106	0.6255 (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	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.30)			13.4400	1.2357	16.6084		(27)
Heat Loss Floor 1			36.4100	0.1100	4.0051		(28a)
External Wall 1	84.0700	15.3900	68.6800	0.2500	17.1700		(29a)
External Roof 1	34.3200		34.3200	0.1100	3.7752		(30)
External Roof 2	2.0900		2.0900	0.2000	0.4180		(30)
Total net area of external elements Aum(A, m ²)			156.8900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.5117		(33)
Party Wall 1			37.2600	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)							10.6140 (36)
Total fabric heat loss						(33) + (36) =	55.1256 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	36.9315	35.4241	34.8630	34.0660	34.3257	33.5645	33.8123	33.3228	33.8123	34.8630	34.8630	35.7137 (38)
Heat transfer coeff	92.0571	90.5498	89.9886	89.1916	89.4513	88.6902	88.9379	88.4484	88.9379	89.9886	89.9886	90.8393 (39)
Average = Sum(39)m / 12 =												89.7558 (39)
HLP	1.3017	1.2804	1.2725	1.2612	1.2649	1.2541	1.2576	1.2507	1.2576	1.2725	1.2725	1.2845 (40)
HLP (average)												1.2692 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	96.7533	93.2350	89.7167	86.1984	82.6801	79.1618	79.1618	82.6801	86.1984	89.7167	93.2350	96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)										Total = Sum(45)m =		1383.9153 (45)
Distribution loss (46)m = 0.15 x (45)m												
21.5224	18.8236	19.4243	16.9345	16.2491	14.0217	12.9932	14.9099	15.0880	17.5836	19.1938	20.8433 (46)	
Water storage loss:												
Total storage loss												

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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	(56)	
Combi loss	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	26.2480	23.5770	25.8947	24.8236	25.4796	24.4599	25.1521	25.3644	24.6581	25.7230	25.1666	26.1797	(61)
Solar input	169.7304	149.0677	155.3898	137.7206	133.8069	117.9381	111.7734	124.7637	125.2445	142.9467	153.1255	165.1347	(62)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Output from w/h								Solar input (sum of months) =	Sum(63)m =			0.0000	(63)
	169.7304	149.0677	155.3898	137.7206	133.8069	117.9381	111.7734	124.7637	125.2445	142.9467	153.1255	165.1347	(64)
Heat gains from water heating, kWh/month								Total per year (kWh/year) =	Sum(64)m =			1686.6419	(64)
	54.2699	47.6199	49.5308	43.7441	42.3887	37.1965	35.0896	39.3914	39.6095	45.4076	48.8380	52.7475	(65)

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.9322	39.9084	32.4557	24.5711	18.3672	15.5063	16.7551	21.7790	29.2317	37.1163	43.3202	46.1811 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	296.9726	300.0542	292.2886	275.7564	254.8876	235.2738	222.1706	219.0889	226.8546	243.3867	264.2556	283.8694 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443 (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)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391 (71)
Water heating gains (Table 5)	72.9434	70.8629	66.5737	60.7558	56.9741	51.6618	47.1635	52.9454	55.0132	61.0318	67.8305	70.8971 (72)
Total internal gains	513.9621	509.9395	490.4318	460.1971	429.3427	401.5558	385.2030	392.9271	410.2133	440.6487	474.5202	500.0614 (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	7.9200	14.2444	0.7200	0.7000	0.7700	39.4033 (74)
East	0.6600	26.6336	0.7200	0.7000	0.7700	6.1396 (76)
South	4.8600	59.7356	0.7200	0.7000	0.7700	101.3990 (78)

MIT	19.0602	19.2496	19.6577	20.1710	20.6036	20.8660	20.9514	20.9541	20.7864	20.3575	19.6751	19.0407 (87)
Th 2	19.8395	19.8562	19.8625	19.8714	19.8685	19.8770	19.8742	19.8797	19.8742	19.8625	19.8625	19.8530 (88)
util rest of house												
	0.8943	0.8719	0.8204	0.7225	0.5787	0.3949	0.2606	0.2563	0.4856	0.7056	0.8463	0.9036 (89)
MIT 2	17.3416	17.6173	18.1948	18.9038	19.4650	19.7733	19.8500	19.8593	19.6963	19.1663	18.2331	17.3233 (90)
Living area fraction									fLA = Living area / (4) =			0.2113 (91)
MIT	17.7046	17.9622	18.5039	19.1715	19.7055	20.0041	20.0826	20.0898	19.9266	19.4179	18.5377	17.6861 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.5546	17.8122	18.3539	19.0215	19.5555	19.8541	19.9326	19.9398	19.7766	19.2679	18.3877	17.5361 (93)

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 %)													89.8000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2207.6767 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	390.3624	319.0489	270.8636	160.7382	75.2272	0.0000	0.0000	0.0000	0.0000	121.4150	252.5780	392.2603	(98)
Space heating efficiency (main heating system 1)	89.8000	89.8000	89.8000	89.8000	89.8000	0.0000	0.0000	0.0000	0.0000	89.8000	89.8000	89.8000	(210)
Space heating fuel (main heating system)	434.7020	355.2883	301.6299	178.9958	83.7720	0.0000	0.0000	0.0000	0.0000	135.2061	281.2672	436.8155	(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	169.7304	149.0677	155.3898	137.7206	133.8069	117.9381	111.7734	124.7637	125.2445	142.9467	153.1255	165.1347	(64)
Efficiency of water heater (217)m	89.0274	88.9885	88.8722	88.6288	88.1835	87.3000	87.3000	87.3000	87.3000	88.4307	88.6398	87.3000	(216)
Fuel for water heating, kWh/month	190.6496	167.5134	174.8464	155.3902	151.7369	135.0952	128.0337	142.9137	143.4645	161.6483	172.3614	185.4518	(219)
Water heating fuel used													1909.1051 (219)
Annual totals kWh/year													
Space heating fuel - main system													2207.6767 (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)													317.4070 (232)
Total delivered energy for all uses													4509.1888 (238)

10a. Fuel costs - using BEDF prices (408)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2207.6767	4.2000	92.7224 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1909.1051	4.2000	80.1824 (247)
Pumps and fans for heating	75.0000	15.5400	11.6550 (249)
Energy for lighting	317.4070	15.5400	49.3251 (250)
Additional standing charges			90.0000 (251)
Total energy cost			323.8849 (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	2207.6767	0.2160	476.8582 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1909.1051	0.2160	412.3667 (264)
Space and water heating			889.2249 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	317.4070	0.5190	164.7342 (268)
Total kg/year			1092.8841 (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	2207.6767	1.2200	2693.3656 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1909.1051	1.2200	2329.1082 (264)
Space and water heating			5022.4738 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	317.4070	3.0700	974.4396 (268)
Primary energy kWh/year			6227.1633 (272)
Primary energy kWh/m2/year			88.0538 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 83
Current environmental impact rating: B 86

(For testing purposes):

A Not considered
B Not considered

Regs Region: England

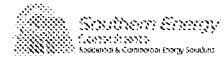
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.03r08

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.3	-£ 34	-186 kg (17.1%)
U Solar photovoltaic panels	+ 11.5	-£ 319	-1066 kg (117.6%)

Recommended measures	Typical annual savings		Energy efficiency	Environmental impact
Solar water heating	£34	2.64 kg/m²	B 85	B 88
Solar photovoltaic panels	£319	15.07 kg/m²	A 96	A 99
Total Savings	£353	17.71 kg/m²		

Potential energy efficiency rating: A 96
 Potential environmental impact rating: A 99

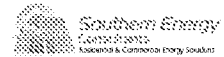
Fuel prices for cost data on this page from database revision number 408 TEST (23 Feb 2017)
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£61	£69	-£8
Mains gas	£263	£222	£41
Space heating	£194	£194	£0
Water heating	£80	£47	£34
Lighting	£49	£49	£0
Generated (PV)	-£0	-£319	£319
Total cost of fuels	£324	-£28	£352
Total cost of uses	£323	-£29	£353
Delivered energy	64 kWh/m²	22 kWh/m²	42 kWh/m²
Carbon dioxide emissions	1.1 tonnes	-0.2 tonnes	1.3 tonnes
CO2 emissions per m²	15 kg/m²	-2 kg/m²	18 kg/m²
Primary energy	88 kWh/m²	-16 kWh/m²	104 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	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (5)

2. Ventilation rate

	main heating	+	secondary heating	+	other	=	total	m3 per hour				
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000 (6a)				
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)				
Number of intermittent fans							4 * 10 =	40.0000 (7a)				
Number of passive vents							0 * 10 =	0.0000 (7b)				
Number of flueless gas fires							0 * 40 =	0.0000 (7c)				
Air changes per hour												
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =						40.0000 / (5) =	0.2312 (8)				
Pressure test							Yes					
Measured/design q50							5.0000					
Infiltration rate							0.4812 (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) =	0.4090 (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	0.5215	0.5113	0.5010	0.4499	0.4397	0.3886	0.3886	0.3783	0.4090	0.4397	0.4601	0.4806 (22b)
Effective ac	0.6360	0.6307	0.6255	0.6012	0.5967	0.5755	0.5755	0.5716	0.5836	0.5967	0.6059	0.6155 (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	1.3000	2.5350			(26)		
Opening Type 2 (Uw = 1.30)					13.4400	1.2357	16.6084			(27)		
Heat Loss Floor 1					36.4100	0.1100	4.0051			(28a)		
External Wall 1			84.0700	15.3900	68.6800	0.2500	17.1700			(29a)		
External Roof 1			34.3200		34.3200	0.1100	3.7752			(30)		
External Roof 2			2.0900		2.0900	0.2000	0.4180			(30)		
Total net area of external elements Aum(A, m2)					156.8900					(31)		
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	44.5117				(33)		
Party Wall 1					37.2600	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)											10.6140 (36)	
Total fabric heat loss								(33) + (36) =	55.1256	(37)		
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	36.3106	36.0092	35.7137	34.3257	34.0660	32.8571	32.8571	32.6333	33.3228	34.0660	34.5913	35.1406 (38)
Heat transfer coeff	91.4363	91.1348	90.8393	89.4513	89.1916	87.9828	87.9828	87.7589	88.4484	89.1916	89.7170	90.2662 (39)
Average = Sum(39)m / 12 =												89.4501 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1.2929	1.2887	1.2845	1.2649	1.2612	1.2441	1.2441	1.2409	1.2507	1.2612	1.2686	1.2764 (40)
HLP (average)												1.2648 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	96.7533	93.2350	89.7167	86.1984	82.6801	79.1618	79.1618	82.6801	86.1984	89.7167	93.2350	96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)											Total = Sum(45)m =	1383.9153 (45)
Distribution loss (46)m = 0.15 x (45)m												
	21.5224	18.8236	19.4243	16.9345	16.2491	14.0217	12.9932	14.9099	15.0880	17.5836	19.1938	20.8433 (46)
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	26.2480	23.5770	25.8947	24.8236	25.4796	24.4599	25.1521	25.3644	24.6581	25.7230	25.1666	26.1797 (61)
Total heat required for water heating calculated for each month	169.7304	149.0677	155.3898	137.7206	133.8069	117.9381	111.7734	124.7637	125.2445	142.9467	153.1255	165.1347 (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												1.3105 (H8)
Utilisation factor												0.5338 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												87.9576 (H14)
Volume ratio Veff/V												0.8527 (H15)
Solar storage volume factor												0.9681 (H16)
Solar input												-824.0657 (H17)
Solar input	-23.8963	-39.8760	-67.9134	-91.0173	-112.4442	-110.5506	-109.0896	-95.3121	-74.6485	-50.9762	-28.3444	-19.9971 (63)
Solar input (sum of months) = Sum(63)m =												-824.0657 (63)
Output from w/h	145.8341	109.1917	87.4764	46.7033	21.3627	7.3875	2.6838	29.4515	50.5959	91.9706	124.7811	145.1376 (64)
Total per year (kWh/year) = Sum(64)m =												862.5762 (64)
Heat gains from water heating, kWh/month	54.2699	47.6199	49.5308	43.7441	42.3887	37.1965	35.0896	39.3914	39.6095	45.4076	48.8380	52.7475 (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	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.9322	39.9084	32.4557	24.5711	18.3672	15.5063	16.7551	21.7790	29.2317	37.1163	43.3202	46.1811	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	296.9726	300.0542	292.2886	275.7564	254.8876	235.2738	222.1706	219.0889	226.8546	243.3867	264.2556	283.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	(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)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	(71)
Water heating gains (Table 5)	72.9434	70.8629	66.5737	60.7558	56.9741	51.6618	47.1635	52.9454	55.0132	61.0318	67.8305	70.8971	(72)
Total internal gains	513.9621	509.9395	490.4318	460.1971	429.3427	401.5558	385.2030	392.9271	410.2133	440.6487	474.5202	500.0614	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				7.9200	10.6334	0.7200	0.7000	0.7700	29.4145 (74)			
East				0.6600	19.6403	0.7200	0.7000	0.7700	4.5275 (76)			
South				4.8600	46.7521	0.7200	0.7000	0.7700	79.3599 (78)			
Solar gains	113.3018	195.0402	275.6645	361.8188	427.7405	435.5963	415.3265	363.7684	304.7553	217.6088	136.0002	96.8187 (83)
Total gains	627.2639	704.9797	766.0963	822.0159	857.0832	837.1521	800.5295	756.6955	714.9686	658.2575	610.5204	596.8802 (84)

7. Mean internal temperature (heating season)

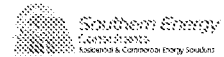
Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.4843	21.5554	21.6255	21.9610	22.0250	22.3276	22.3276	22.3846	22.2101	22.0250	21.8960	21.7628	
alpha	2.4323	2.4370	2.4417	2.4641	2.4683	2.4885	2.4885	2.4923	2.4807	2.4683	2.4597	2.4509	
util living area	0.9290	0.9053	0.8682	0.8013	0.6999	0.5631	0.4391	0.4750	0.6544	0.8210	0.9038	0.9357	(86)
MIT	18.7271	19.0016	19.4261	19.9706	20.4415	20.7756	20.9129	20.8916	20.6523	20.0582	19.3128	18.6815	(87)
Th 2	19.8464	19.8497	19.8530	19.8685	19.8714	19.8849	19.8849	19.8874	19.8797	19.8714	19.8655	19.8594	(88)
util rest of house	0.9187	0.8919	0.8490	0.7712	0.6520	0.4898	0.3422	0.3781	0.5863	0.7875	0.8879	0.9264	(89)
MIT 2	16.8665	17.2595	17.8641	18.6329	19.2658	19.6881	19.8309	19.8159	19.5507	18.7721	17.7218	16.8088	(90)
Living area fraction													0.2113 (91)
MIT	17.2596	17.6276	18.1941	18.9155	19.5142	19.9179	20.0595	20.0431	19.7834	19.0438	18.0579	17.2044	(92)
Temperature adjustment													-0.1500
adjusted MIT	17.1096	17.4776	18.0441	18.7655	19.3642	19.7679	19.9095	19.8931	19.6334	18.8938	17.9079	17.0544	(93)

8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Utilisation	0.8848	0.8550	0.8105	0.7361	0.6276	0.4815	0.3445	0.3786	0.5694	0.7519	0.8513	0.8941 (94)
Useful gains	555.0008	602.7338	620.9171	605.0880	537.9410	403.0671	275.7694	286.5154	407.1206	494.9489	519.7346	533.6686 (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	1171.2601	1146.2527	1048.6554	882.4783	683.5796	454.6837	291.1771	306.5521	489.4215	739.7403	969.6515	1160.3207 (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	458.4970	365.2447	318.2373	199.7210	108.3551	0.0000	0.0000	0.0000	0.0000	182.1249	323.9402	466.2292 (98)
Space heating												2422.3494 (98)
Space heating per m2												(98) / (4) = 34.2527 (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 %)												89.8000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												2697.4938 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	458.4970	365.2447	318.2373	199.7210	108.3551	0.0000	0.0000	0.0000	0.0000	182.1249	323.9402	466.2292 (98)
Space heating efficiency (main heating system 1)	89.8000	89.8000	89.8000	89.8000	89.8000	0.0000	0.0000	0.0000	0.0000	89.8000	89.8000	89.8000 (210)
Space heating fuel (main heating system)	510.5757	406.7313	354.3845	222.4065	120.6627	0.0000	0.0000	0.0000	0.0000	202.8116	360.7352	519.1862 (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	145.8341	109.1917	87.4764	46.7033	21.3627	7.3875	2.6838	29.4515	50.5959	91.9706	124.7811	145.1376 (64)
Efficiency of water heater	89.1837	89.2120	89.2489	89.3153	89.3785	87.3000	87.3000	87.3000	87.3000	88.9453	89.0905	87.3000 (216)
(217)m	89.1837	89.2120	89.2489	89.3153	89.3785	87.3000	87.3000	87.3000	87.3000	88.9453	89.0905	89.1936 (217)
Fuel for water heating, kWh/month	163.5211	122.3957	98.0140	52.2904	23.9013	8.4622	3.0742	33.7360	57.9564	103.4012	140.0610	162.7220 (219)
Water heating fuel used												969.5354 (219)
Annual totals kWh/year												
Space heating fuel - main system												2697.4938 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
pump for solar water heating												50.0000 (230g)
Total electricity for the above, kWh/year												125.0000 (231)
Electricity for lighting (calculated in Appendix L)												317.4070 (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)
Total delivered energy for all uses												2382.1968 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2697.4938	3.4800	93.8728 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	969.5354	3.4800	33.7398 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Pump for solar water heating	50.0000	13.1900	6.5950 (249)
Energy for lighting	317.4070	13.1900	41.8660 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-1727.2394	13.1900	-227.8229 (252)
Total energy cost			78.1432 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		
Energy cost factor (ECF)	[[255] x (256)] / [(4) + 45.0] =	0.4200 (256)
SAP value		0.2836 (257)
SAP rating (Section 12)		96.0435
SAP band		96 (258)
		A

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	2697.4938	0.2160	582.6587 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	969.5354	0.2160	209.4197 (264)

Regs Region: England

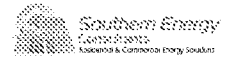
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.03r08

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

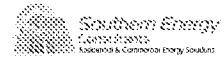


CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Space and water heating			792.0783 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	317.4070	0.5190	164.7342 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			125.2503 (272)
CO2 emissions per m2			1.7700 (273)
EI value			98.5496
EI rating			99 (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	36.4100 (1b)	x 2.3300 (2b)	= 84.8353 (1b) - (3b)
First floor	34.3100 (1c)	x 2.5700 (2c)	= 88.1767 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 173.0120 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.2312 (8)
Pressure test					Yes
Measured/design q50					5.0000
Infiltration rate					0.4812 (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) =	0.4090 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.3000	4.8000	4.6000	4.3000	4.4000	4.1000	4.2000	4.0000	4.2000	4.6000	4.6000	4.9000 (22)
Wind factor	1.3250	1.2000	1.1500	1.0750	1.1000	1.0250	1.0500	1.0000	1.0500	1.1500	1.1500	1.2250 (22a)
Adj infilt rate	0.5419	0.4908	0.4704	0.4397	0.4499	0.4192	0.4295	0.4090	0.4295	0.4704	0.4704	0.5010 (22b)
Effective ac	0.6469	0.6205	0.6106	0.5967	0.6012	0.5879	0.5922	0.5836	0.5922	0.6106	0.6106	0.6255 (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	1.3000	2.5350		(26)
Opening Type 2 (Uw = 1.30)			13.4400	1.2357	16.6084		(27)
Heat Loss Floor 1			36.4100	0.1100	4.0051		(28a)
External Wall 1	84.0700	15.3900	68.6800	0.2500	17.1700		(29a)
External Roof 1	34.3200		34.3200	0.1100	3.7752		(30)
External Roof 2	2.0900		2.0900	0.2000	0.4180		(30)
Total net area of external elements Aum(A, m ²)			156.8900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.5117		(33)
Party Wall 1			37.2600	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)							10.6140 (36)
Total fabric heat loss						(33) + (36) =	55.1256 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	36.9315	35.4241	34.8630	34.0660	34.3257	33.5645	33.8123	33.3228	33.8123	34.8630	34.8630	35.7137 (38)
Heat transfer coeff	92.0571	90.5498	89.9886	89.1916	89.4513	88.6902	88.9379	88.4484	88.9379	89.9886	89.9886	90.8393 (39)
Average = Sum(39)m / 12 =												89.7558 (39)
HLP	1.3017	1.2804	1.2725	1.2612	1.2649	1.2541	1.2576	1.2507	1.2576	1.2725	1.2725	1.2845 (40)
HLP (average)												1.2692 (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												2.2635 (42)
Average daily hot water use (litres/day)												87.9576 (43)
Daily hot water use	96.7533	93.2350	89.7167	86.1984	82.6801	79.1618	79.1618	82.6801	86.1984	89.7167	93.2350	96.7533 (44)
Energy conte	143.4824	125.4906	129.4951	112.8970	108.3273	93.4782	86.6213	99.3992	100.5864	117.2237	127.9589	138.9551 (45)
Energy content (annual)										Total = Sum(45)m =		1383.9153 (45)
Distribution loss (46)m = 0.15 x (45)m												
21.5224	18.8236	19.4243	16.9345	16.2491	14.0217	12.9932	14.9099	15.0880	17.5836	19.1938	20.8433 (46)	
Water storage loss:												
Total storage loss												

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	26.2480	23.5770	25.8947	24.8236	25.4796	24.4599	25.1521	25.3644	24.6581	25.7230	25.1666	26.1797 (61)
Total heat required for water heating calculated for each month	169.7304	149.0677	155.3898	137.7206	133.8069	117.9381	111.7734	124.7637	125.2445	142.9467	153.1255	165.1347 (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												1283.7868 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2156.7619 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.5584 (H8)
Utilisation factor												0.4736 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												87.9576 (H14)
Volume ratio Veff/V												0.8527 (H15)
Solar storage volume factor												0.9681 (H16)
Solar input												-869.4913 (H17)
Solar input	-28.1792	-39.7450	-67.5252	-94.1943	-112.4716	-119.0413	-116.5805	-102.4352	-79.5276	-54.8869	-32.2110	-22.6936 (63)
Solar input (sum of months) = Sum(63)m =												-869.4913 (63)
Output from w/h	141.5512	109.3226	87.8647	43.5263	21.3353	0.0000	0.0000	22.3285	45.7169	88.0599	120.9145	142.4411 (64)
Total per year (kWh/year) = Sum(64)m =												823.0609 (64)
Heat gains from water heating, kWh/month	54.2699	47.6199	49.5308	43.7441	42.3887	37.1965	35.0896	39.3914	39.6095	45.4076	48.8380	52.7475 (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	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	135.8086	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	44.9322	39.9084	32.4557	24.5711	18.3672	15.5063	16.7551	21.7790	29.2317	37.1163	43.3202	46.1811	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	296.9726	300.0542	292.2886	275.7564	254.8876	235.2738	222.1706	219.0889	226.8546	243.3867	264.2556	283.8694	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	50.8443	(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)	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	-90.5391	(71)
Water heating gains (Table 5)	72.9434	70.8629	66.5737	60.7558	56.9741	51.6618	47.1635	52.9454	55.0132	61.0318	67.8305	70.8971	(72)
Total internal gains	513.9621	509.9395	490.4318	460.1971	429.3427	401.5558	385.2030	392.9271	410.2133	440.6487	474.5202	500.0614	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a		g	FF		Access		Gains	
					W/m2	Specific data or Table 6b		Specific data or Table 6c		factor Table 6d		W	
North				7.9200		14.2444	0.7200		0.7000		0.7700	39.4033	(74)
East				0.6600		26.6336	0.7200		0.7000		0.7700	6.1396	(76)
South				4.8600		59.7356	0.7200		0.7000		0.7700	101.3990	(78)
Solar gains	146.9419	214.1494	303.9117	419.4980	482.7159	530.4273	501.4645	439.4611	361.4481	258.5886	170.0141	120.8331	(83)
Total gains	660.9040	724.0888	794.3435	879.6951	912.0586	931.9831	886.6675	832.3882	771.6614	699.2373	644.5343	620.8945	(84)

7. Mean internal temperature (heating season)

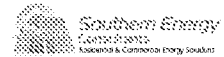
Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	21.3394	21.6946	21.8299	22.0250	21.9610	22.1495	22.0878	22.2101	22.0878	21.8299	21.8299	21.6255	
alpha	2.4226	2.4463	2.4553	2.4683	2.4641	2.4766	2.4725	2.4807	2.4725	2.4553	2.4553	2.4417	
util living area	0.9082	0.8881	0.8434	0.7583	0.6351	0.4739	0.3586	0.3600	0.5664	0.7533	0.8691	0.9165	(86)
MIT	19.0602	19.2496	19.6577	20.1710	20.6036	20.8660	20.9514	20.9541	20.7864	20.3575	19.6751	19.0407	(87)
Th 2	19.8395	19.8562	19.8625	19.8714	19.8685	19.8770	19.8742	19.8797	19.8742	19.8625	19.8625	19.8530	(88)
util rest of house	0.8943	0.8719	0.8204	0.7225	0.5787	0.3949	0.2606	0.2563	0.4856	0.7056	0.8463	0.9036	(89)
MIT 2	17.3416	17.6173	18.1948	18.9038	19.4650	19.7733	19.8500	19.8583	19.6963	19.1663	18.2331	17.3233	(90)
Living area fraction									fLA = Living area / (4) =			0.2113	(91)
MIT	17.7046	17.9622	18.5039	19.1715	19.7055	20.0041	20.0826	20.0898	19.9266	19.4179	18.5377	17.6861	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5546	17.8122	18.3539	19.0215	19.5555	19.8541	19.9326	19.9398	19.7766	19.2679	18.3877	17.5361	(93)

8. Space heating requirement

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

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Utilisation	0.8573	0.8340	0.7826	0.6913	0.5615	0.3932	0.2659	0.2622	0.4780	0.6762	0.8083	0.8679 (94)
Useful gains	566.6237	603.8677	621.6597	608.1506	512.1255	366.4270	235.7632	218.2117	368.8221	472.8385	520.9819	538.8667 (95)
Ext temp.	5.7000	5.9000	7.4000	9.7000	12.7000	15.4000	17.2000	17.4000	15.1000	12.2000	8.7000	5.8000 (96)
Heat loss rate W	1091.3043	1078.6429	985.7237	831.3981	613.2374	395.0346	243.0350	224.6443	415.9284	636.0307	871.7847	1066.0983 (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	390.3624	319.0489	270.8636	160.7382	75.2272	0.0000	0.0000	0.0000	0.0000	121.4150	252.5780	392.2603 (98)
Space heating												1982.4937 (98)
Space heating per m2												(98) / (4) = 28.0330 (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 %)												89.8000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												2207.6767 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	390.3624	319.0489	270.8636	160.7382	75.2272	0.0000	0.0000	0.0000	0.0000	121.4150	252.5780	392.2603 (98)
Space heating efficiency (main heating system 1)	89.8000	89.8000	89.8000	89.8000	89.8000	0.0000	0.0000	0.0000	0.0000	89.8000	89.8000	89.8000 (210)
Space heating fuel (main heating system)	434.7020	355.2883	301.6299	178.9958	83.7720	0.0000	0.0000	0.0000	0.0000	135.2061	281.2672	436.8155 (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	141.5512	109.3226	87.8647	43.5263	21.3353	0.0000	0.0000	22.3285	45.7169	88.0599	120.9145	142.4411 (64)
Efficiency of water heater	89.1208	89.1485	89.1745	89.2553	89.2354	87.3000	87.3000	87.3000	87.3000	88.7318	88.9751	87.3000 (216)
(217)m	89.1208	89.1485	89.1745	89.2553	89.2354	87.3000	87.3000	87.3000	87.3000	88.7318	88.9751	89.1201 (217)
Fuel for water heating, kWh/month	158.8306	122.6298	98.5311	48.7660	23.9090	0.0000	0.0000	25.5767	52.3676	99.2427	135.8970	159.8305 (219)
Water heating fuel used												925.5811 (219)
Annual totals kWh/year												
Space heating fuel - main system												2207.6767 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
pump for solar water heating												50.0000 (230g)
Total electricity for the above, kWh/year												125.0000 (231)
Electricity for lighting (calculated in Appendix L)												317.4070 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 2.50 * 1284 * 0.80) =									-2054.0590			-2054.0590 (233)
Total delivered energy for all uses												1521.6059 (238)

10a. Fuel costs - using BEDF prices (408)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2207.6767	4.2000	92.7224 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	925.5811	4.2000	38.8744 (247)
Pumps and fans for heating	75.0000	15.5400	11.6550 (249)
Pump for solar water heating	50.0000	15.5400	7.7700 (249)
Energy for lighting	317.4070	15.5400	49.3251 (250)
Additional standing charges			90.0000 (251)
Energy saving/generation technologies			
PV Unit	-2054.0590	15.5400	-319.2008 (252)
Total energy cost			-28.8539 (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	2207.6767	0.2160	476.8582 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	925.5811	0.2160	199.9255 (264)
Space and water heating			676.7837 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	317.4070	0.5190	164.7342 (268)
Energy saving/generation technologies			
PV Unit	-2054.0590	0.5190	-1066.0566 (269)
Total kg/year			-159.6637 (272)

Regs Region: England

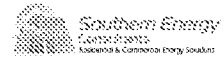
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.03r08

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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	2207.6767	1.2200	2693.3656 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	925.5811	1.2200	1129.2090 (264)
Space and water heating			3822.5746 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	317.4070	3.0700	974.4396 (268)
Energy saving/generation technologies			
PV Unit	-2054.0590	3.0700	-6305.9610 (269)
Primary energy kWh/year			-1125.1969 (272)
Primary energy kWh/m2/year			-15.9106 (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	South
Overshading	Average or unknown
Thermal mass parameter	100.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	228.38 (P1)
Transmission heat loss coefficient	55.13 (37)
Summer heat loss coefficient	283.50 (P2)

Overhangs	Ratio	Z_overhangs	Overhang type
Orientation			
North	0.000	1.000	None
East	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)
East	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	Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	7.9200	86.6589	0.7200	0.7000	0.9000	280.1907
East	0.6600	124.7972	0.7200	0.7000	0.9000	33.6252
South	4.8600	118.3991	0.7200	0.7000	0.9000	234.9092
total:						548.7251

Solar gains	Jun 583	Jul 549	Aug 483	(P3)
Internal gains	399	382	390	
Total summer gains	981	931	873	(P5)
Summer gain/loss ratio	3.46	3.28	3.08	(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	20.16	21.98	21.88	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			

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