



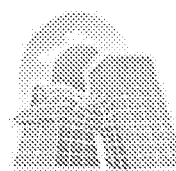
BILSHAM ROAD – YAPTON, WEST SUSSEX



ENERGY STATEMENT

24th March 2022

ARUN DISTRICT COUNCIL Y/47/22/DOC
SUD/2022/LS/3628



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

24th March 2022

Report type:

Planning Condition Discharge: Supporting Document

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Type 3B4P with energy efficiency measures and 2.10 kWp solar PV		
Indicative Solar PV Panel Layout		

1.0 Introduction and Planning Policy Requirements

- 1.1 This Energy Statement has been commissioned by the Bilsham Road Development LLP (hereafter referred to as 'the Applicant') and carried out by Southern Energy Consultants as part of a comprehensive analysis of available opportunities to reduce energy demand and maximise the sustainability credentials of the proposed development at Bilsham Road, Yapton. The proposals for the development relate to the construction of 250 dwellings of mixed type and tenure, as well as provision of public open space, access points and associated infrastructure works.
- 1.2 This Statement will provide the Applicant's response pertaining to the energy requirements of Condition 22 of the outline planning consent (Ref: Y/91/17/OUT). This is worded by Arun District Council as follows:

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

- 1.3 Condition 22 is justified through Policy ECC SP2 (Energy and Climate Change Mitigation) of Arun District Council's Local Plan (2014). This policy requires all major developments of 10 or more dwellings to incorporate decentralised, renewable and low carbon energy supply systems, which must be responsible for producing at least 10% of the total predicted energy requirements from renewable or low carbon energy generation on site.

- 1.4 This Statement will provide the Applicant's response to Condition 22 and the underpinning Policy ECC SP2, paying specific attention to the energy proposals for the site, which will endeavour to utilise best practice energy efficiency techniques to minimise carbon dioxide emissions and energy demand across the lifetime of the new development, then install sufficient renewable energy capacity to deliver at least a 10% contribution to energy demand across the site. Although not required by policy, note that the Applicant will deliver 'A' rated Energy Performance Certificates for all dwellings. This will necessitate the installation of sufficient renewable energy or low carbon technologies to easily comply with the 10% target.
- 1.5 Section 2 of this Statement calculates the baseline emissions and energy demand for the development. These are the carbon dioxide emissions equivalent to the regulatory standard set by Part L1a of 2013 Building Regulations, encompassing the sources of space heating, hot water and fixed electrical items. Section 2 outlines the Applicant's best practice energy efficiency measures that will meet, and for most dwellings, exceed the emissions standard set by Part L1a. In Section 3, the outcome from a brief feasibility study concerning the most suitable renewable energy technology for the site is outlined, before the Applicant's proposals for meeting the 10% energy demand target are outlined.

2.0 Carbon Dioxide Emissions and Energy Demand – Energy Efficiency Proposals

Baseline Carbon Dioxide Emissions

- 2.1 This section models the regulated (Part L1a, 2013 version) carbon dioxide emissions and corresponding energy demand for proposed dwelling types using SAP (2012) methodology. These calculations have been carried out by an Elmhurst Accredited Assessor. SAP calculates the regulated carbon dioxide emissions and energy demand associated with space heating, hot water and fixed electrical items. The baseline regulated annual energy demand for the 250 proposed dwellings at Bilsham Road are calculated to be **1,453,985 kWh/year**. A dwelling type breakdown of this calculation is provided in Table 1 overleaf, with baseline carbon dioxide emissions also referenced for information purposes.

Table 1: Baseline Energy Demand – Bilsham Road, Yapton

Dwelling type	Number of plots	Emissions (kgCO ₂ /year)	Energy Demand (kWh/year)	Total emissions (kgCO ₂ /year)	Total Energy Demand (kWh/year)
Private					
1 bedroom flat	8	1,108	4,277	8,864	34,215
C2H3	4	1,391	5,369	5,564	21,477
C2H4	6	1,401	5,408	8,406	32,447
C3H5	6	1,739	6,713	10,434	40,275
C3H10	4	1,733	6,689	6,932	26,758
C4H2	11	1,800	6,948	19,800	76,428
2B3P Type A	7	1,291	4,983	9,037	34,883
2B4P Type B	25	1,294	4,995	32,350	124,871
2B4P Type C	9	1,367	5,277	12,303	47,490
2B4P Type D (bun)	5	1,689	6,520	8,445	32,598
3B4P Type A	28	1,502	5,798	42,056	162,336
3B5P Type B	19	1,588	6,130	30,172	116,464
3B6P Type C	10	1,812	6,994	18,120	69,943
3B5P Type D	10	1,556	6,006	15,560	60,062
4B7P Type A	12	1,786	6,894	21,432	82,728
4B8P Type B	11	1,958	7,558	21,538	83,137
Sub-total	175			271,013	1,046,110
Affordable					
1 bedroom flat	18	1,108	4,277	19,944	76,984
2 bedroom flat	6	1,267	4,891	7,602	29,344

FOG	1	1,111	4,288	1,111	4,288
C2H3	3	1,391	5,369	4,173	16,108
C3H5	2	1,739	6,713	3,478	13,425
C3H10	1	1,733	6,689	1,733	6,689
C2H4	2	1,401	5,408	2,802	10,816
C2H6	1	1,400	5,404	1,400	5,404
C3H5	2	1,739	6,713	3,478	13,425
C4H2	1	1,800	6,948	1,800	6,948
2B3P Type A	14	1,291	4,983	18,074	69,766
2B4P Type B	3	1,299	5,014	3,897	15,042
2B4P Type C	3	1,367	5,277	4,101	15,830
3B5P Type B	9	1,756	6,778	15,804	61,003
3B5P Type D	3	1,556	6,006	4,668	18,018
3B6P Type C	1	1,812	6,994	1,812	6,994
4B8P Type B	5	1,958	7,558	9,790	37,789
Sub-total	75			105,667	407,875
TOTAL	250			376,680	1,453,985

Measures to comply with and better the baseline scenario

- 2.2 The build specification will incorporate enhanced insulation standards throughout the building envelope (walls, roofs, floors and glazing), for example, by fully filling cavity walls with 140mm of Knauf 38 insulation, fully filling and sealing all party walls, incorporating 100mm Xtratherm (0.022 W/m²K thermal conductivity) or equivalent insulation under screed in the ground floor and using enhanced double glazing to achieve average U-values considerably better than those insisted upon by Part L1A of 2013 Building Regulations.
- 2.3 Table 2 overleaf sets out the fabric performance standards attained by the specification of the Applicant:

Table 2: Fabric Performance Standards – Bilsham Road, Yapton

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	0.23-0.24	20.00-23.33
Roof (joists)	0.20	0.11	45.00
Ground floor	0.25	0.15-0.18	28.00-40.00
Windows	2.00	1.40	30.00

- 2.4 The space heating demand of the development will be reduced by the fabric measures detailed above and the considerable passive gains associated with the appropriate sizing of window openings in cases where an optimal southerly orientation applies for main living areas. All dwellings will also benefit from efficient heating controls, to include single zone controls, programmers, room thermostats (delayed start) and thermostatic radiator valves.
- 2.5 Air tightness standards will be improved by the Applicant adopting an array of details for non-repeating thermal bridges with linear heat transmission considerably lower than Accredited Construction Details. These details will incorporate an improvement over Building Regulations (2013) requirements by reducing air leakage loss and convective bypass of insulation. The Applicant will aim to reduce the design air permeability for all buildings from 10 m³/hm² to 5 m³/hm² to further reduce space heating requirements.
- 2.6 All of the internal lighting throughout the development will be of the dedicated low energy type. Although not assessed within the Building Regulations calculation, external lighting will also be low energy and some will be controlled through PIR sensors or daylight cut-off devices to minimise use and promote the security of the development.
- 2.7 All of the proposed gas boilers for the development will have a SEDBUK (2009) efficiency of at least 88.5%. In addition, boilers will be Class 5 for Nitrous Oxide emissions. This ensures they will not only be highly efficient in terms of energy use, but also have the lowest possible impact

on local air pollution levels. Flue Gas Heat Recovery devices will be installed to boilers in all dwellings with more than one bathroom, reducing the demand for hot water.

- 2.8 Ventilations to the dwellings will be through highly energy efficient decentralised extract fans (Vent Axia 100 Slim Line B).
- 2.9 It is not proposed to provide any mechanical cooling to the proposed dwellings in the form of air conditioning. Instead it is the intention of the Applicant to reduce the need for active cooling as far as possible. This will be achieved through the specification of mainly non-mechanical measures such as good thermal insulation and an air tight build. In addition, and although these aspects are not calculated within a Building Regulations Assessment, the development proposals incorporate extensive areas of landscaped space. These measures facilitate localised cooling through evapotranspiration – energy which would otherwise heat the local atmosphere is instead used evaporating water, thus helping to reduce the urban heat island effect. Deciduous trees provide shading in the summer and facilitate solar gains in the winter. Openable windows will be installed as necessary to facilitate natural ventilation. These will help facilitate cross-ventilation, convective-ventilation and night purging.
- 2.10 All insulating materials specified at the Bilsham Road development will have an Ozone Depleting Potential of Zero and a Global Warming Potential of less than 5. It is intended that the development will utilise low Volatile Organic Compounds. These are usually solvents that have the capacity to rapidly evaporate. Once airborne they cause chemical or photochemical reactions in the atmosphere leading to the formation of smog containing, amongst other things, ground level ozone and can produce a number of physical problems such as eye and skin irritation, lung and breathing problems, headaches, nausea and muscle weakness. Preference will also be given to the specification of inert materials as they are non-toxic and easily re-used or recycled.

Effects of energy efficiency measures

- 2.11 Further SAP calculations have been undertaken to model the impacts of the Applicant's proposed energy efficiency measures set out in paragraphs 2.2 to 2.10. Overall, across the site, energy demand are projected to reduce from **1,453,985 kWh/year** to **1,421,270 kWh/year**, a reduction of **32,715 kWh/year**, or **2.25%** in proportional terms.

- 2.12 In order to deliver 10% of energy demand across the Bilsham Road development from renewable energy or low carbon technologies, the Applicant must deliver a further reduction of at least **142,127 kWh/year** through the incorporation of a feasible technology.

3.0 Renewable Energy Installations

- 3.1 As part of an early feasibility study for the site, it was determined that solar photovoltaic (PV) panels were the most suitable technology for delivering reductions in energy demand beyond those facilitated by best practice energy efficiency measures. Large areas of roof-space, of either optimal or close-to-optimal orientation, is available across the Bilsham Road development, with very limited overshadowing from surrounding trees and tall buildings.
- 3.2 In order to deliver energy demand of at least 142,127 kWh/year and satisfy the Applicant's aspiration to acquire 'A' rated Energy Performance Certificates for all dwellings, further SAP calculations have verified that the Applicant must install at least **462.5 kWp** of solar photovoltaic capacity. This will generate a reduction in energy demand of **455,563 kWh/year**. The Applicant's preference is to maximise opportunities to install solar PV panels to dwellings of optimal orientation, possessing large areas of roof-space. The exact per plot allocations will be determined at the detailed design stage, following tender. Table 2 below summarises the impacts of the Applicant's best practice energy efficiency measures and introduction of 462.5 kWp of solar photovoltaic output, comparing projected energy demand with the regulatory baseline standard.

Table 2: Energy Demand Reduction from Energy Efficiency Measures and Solar PV Installations – Bilsham Road, Yapton

	Energy Demand (kWh/year)
Baseline	1,453,985
Reduction from energy efficiency measures	(32,715)
Reduction from 462.5 kWp solar PV output	(455,563)
Total energy demand reduction	(488,278)
Energy demand after reductions	965,707
Overall percentage reduction after efficiency measures through solar PV	32.05

4.0 Conclusion

- 4.1 This Statement has set out the Applicant's energy strategy to the various sustainability requirements set by Condition 22 and underpinning Policy ECC SP2 (Energy and Climate Change Mitigation) of Arun District Council's Local Plan (2014). These required the Applicant to deliver a 10% contribution to energy demand from renewable energy or low carbon technologies.
- 4.2 The Applicant's first priority has been to minimise energy consumption at the point of demand. This will be achieved through the installation of highly efficient fabric, ventilation and heating systems, together with the benefits of passive solar gains and an air-tight build, all features which will help to lower the fuel bills of future occupants. Further reductions in energy demand will then be secured through the installation of **462.5 kWp** of solar photovoltaic output, with sufficient installations for each dwelling to achieve an 'A' rating on its future Energy Performance Certificate. Overall, the Applicant's strategy of best practice energy efficiency measures and strategically located renewable energy installations will reduce energy demand by **33.58%** across the Bilsham Road development. Excluding the benefits of energy efficiency measures – in other words, after these have been accounted for – the renewable energy installations still deliver a **32.05%** contribution to energy demand.
- 4.3 Example SAP calculations are provided in the Appendix for two common house types (2B3P and 3B4P), with other documents available upon request.

APPENDIX

Type 2B3P with energy efficiency measures and 1.70 kWp solar PV
Type 3B4P with energy efficiency measures and 2.10 kWp solar PV
Indicative Solar PV Panel Layout

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	SECBIL011		Issued on Date	20/03/2022	
Assessment Reference	001	Prop Type Ref	2B3P		
Property					

SAP Rating	92 A	BB1	8.97	TG1	20.03
Environmental	94 A	% DER-TED	55.23		
CO ₂ Emissions (t/year)	0.37	DPEE	53.71	TREE	58.55
General Requirements Compliance	Pass	% DPEE-TREE	8.27		

Assessor Details	Mr. Stephen Smith, Southern Energy Consultants Limited, Tel: [REDACTED]	Assessor ID	d168-0001
Client	Thakeham Homes, THA001		

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

DWELLING AS DESIGNED

Semi-Detached House, total floor area 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) 20.03 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 8.97 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)58.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)53.7 kWh/m²/yrOK

2 Fabric U-values

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

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

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

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)
Combi boiler
Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

7 Low energy lights

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

8 Mechanical ventilation

Continuous extract system (decentralised)
Specific fan power: 0.1300 0.1500
Maximum 0.7 OK

9 Summertime temperature

Overheating risk (South East England): Medium OK

Based on:

Overshading: Average
Windows facing East: 8.18 m², No overhang
Windows facing South: 1.08 m², No overhang
Windows facing West: 4.55 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Photovoltaic array 1.70 kW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.6700 (1b)	x 2.4700 (2b)	= 88.1049 (1b) - (3b)
First floor	35.6700 (1c)	x 2.6700 (2c)	= 95.2389 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.3400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.3438 (5)

2. Ventilation rate

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

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.40)			13.8100	1.3258	18.3087		(27)
Opening Type 3			2.2100	1.4000	3.0940		(26)
Heat Loss Floor 1			35.6700	0.1500	5.3505		(28a)
Brick Faced	93.2400	16.0200	77.2200	0.2400	18.5328		(29a)
Main Roof	35.6700		35.6700	0.1100	3.9237		(30)
Total net area of external elements Aum(A, m ²)			164.5800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.2097		(33)
Party Wall 1			44.3700	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)							15.1274 (36)
Total fabric heat loss						(33) + (36) =	64.3371 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	31.5185	31.1971	30.8757	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517 (38)
Heat transfer coeff	95.8556	95.5342	95.2128	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888 (39)
Average = Sum(39)m / 12 =												94.8252 (39)
HLP	Jan 1.3436	Feb 1.3391	Mar 1.3346	Apr 1.3259	May 1.3259	Jun 1.3259	Jul 1.3259	Aug 1.3259	Sep 1.3259	Oct 1.3259	Nov 1.3259	Dec 1.3259 (40)
HLP (average)												1.3292 (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												2.2782 (42)
Average daily hot water use (litres/day)												88.3075 (43)
Daily hot water use	Jan 97.1383	Feb 93.6060	Mar 90.0737	Apr 86.5414	May 83.0091	Jun 79.4768	Jul 79.4768	Aug 83.0091	Sep 86.5414	Oct 90.0737	Nov 93.6060	Dec 97.1383 (44)
Energy conte	144.0533	125.9899	130.0103	113.3461	108.7583	93.8502	86.9660	99.7947	100.9866	117.6901	128.4680	139.5079 (45)
Energy content (annual)										Total = Sum(45)m =		1389.4215 (45)
Distribution loss (46)m = 0.15 x (45)m	21.6080	18.8965	19.5015	17.0019	16.3137	14.0775	13.0449	14.9692	15.1480	17.6535	19.2702	20.9262 (46)

Regs Region: England

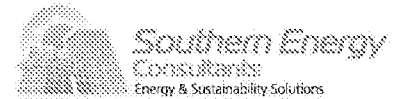
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	0.6297	0.5307	0.5270	0.4414	0.4063	0.3357	0.3110	0.3728	0.3933	0.4770	0.5411	0.6098	(61)
Total heat required for water heating calculated for each month	144.6830	126.5206	130.5373	113.7876	109.1646	94.1858	87.2770	100.1675	101.3799	118.1672	129.0091	140.1177	(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	144.6830	126.5206	130.5373	113.7876	109.1646	94.1858	87.2770	100.1675	101.3799	118.1672	129.0091	140.1177	(64)
Heat gains from water heating, kWh/month	48.0551	42.0243	43.3602	37.7979	36.2637	31.2891	28.9939	33.2749	33.6764	39.2512	42.8509	46.5388	(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	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.0593	16.0401	13.0447	9.8757	7.3822	6.2323	6.7343	8.7535	11.7489	14.9179	17.4114	18.5612	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	200.4041	202.4837	197.2432	186.0869	172.0041	158.7683	149.9259	147.8464	153.0868	164.2431	178.3259	191.5617	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	(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)	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	(71)
Water heating gains (Table 5)	64.5902	62.5362	58.2798	52.4971	48.7415	43.4571	38.9704	44.7244	46.7727	52.7570	59.5151	62.5522	(72)
Total internal gains	343.2268	341.2331	328.7409	308.6329	288.3010	268.6309	255.8037	261.4974	271.7816	292.0912	315.4256	332.8483	(73)

6. Solar gains

[Jan]														
				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d	Gains W		
East				8.1800	19.6403		0.7200		0.7000		0.7700	56.1131 (76)		
South				1.0800	46.7521		0.7200		0.7000		0.7700	17.6355 (78)		
West				4.5500	19.6403		0.7200		0.7000		0.7700	31.2121 (80)		
Solar gains	104.9607	199.7090	318.1181	451.8807	546.1674	556.4428	530.7995	460.5185	365.6276	233.8525	129.7883	87.0507	(83)	
Total gains	448.1875	540.9422	646.8590	760.5136	834.4685	825.0736	786.6033	722.0159	637.4092	525.9437	445.2139	419.8990	(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	20.6735	20.7430	20.8130	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	
alpha	2.3782	2.3829	2.3875	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	
util living area	0.9646	0.9446	0.9058	0.8322	0.7240	0.5908	0.4679	0.5160	0.7139	0.8822	0.9494	0.9694	(86)
MIT	18.2578	18.5860	19.1296	19.7923	20.3496	20.7216	20.8863	20.8523	20.5335	19.7732	18.8942	18.2098	(87)
Th 2	19.8068	19.8103	19.8138	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	(88)
util rest of house	0.9589	0.9358	0.8905	0.8042	0.6758	0.5134	0.3618	0.4095	0.6459	0.8561	0.9398	0.9644	(89)
MIT 2	17.3271	17.6522	18.1860	18.8259	19.3387	19.6549	19.7734	19.7547	19.5152	18.8247	17.9681	17.2888	(90)
Living area fraction	17.5603	17.8863	18.4225	19.0681	19.5921	19.9222	20.0523	20.0298	19.7704	19.0624	18.2002	17.5197	(91)
MIT	17.5603	17.8863	18.4225	19.0681	19.5921	19.9222	20.0523	20.0298	19.7704	19.0624	18.2002	17.5197	(92)
Temperature adjustment	17.4103	17.7363	18.2725	18.9181	19.4421	19.7722	19.9023	19.8798	19.6204	18.9124	18.0502	17.3697	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	422.5687	495.0614	559.6973	592.0881	549.3210	420.7172	290.8401	299.8649	403.2051	436.7576	409.6411	398.8289	(94)
Ext temp.	4.3000	4.0000	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	1256.6994	1226.3031	1120.8912	947.6036	732.3142	489.2341	312.3614	329.1530	522.1708	786.2598	1035.7670	1245.7024	(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	620.5932	491.3944	417.5283	255.9711	136.1469	0.0000	0.0000	0.0000	0.0000	260.0296	450.8107	630.0738	(98)
Space heating												3262.5481	(98)
Space heating per m2												45.7324	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												90.2000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3617.0156 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	620.5932	491.3944	417.5283	255.9711	136.1469	0.0000	0.0000	0.0000	0.0000	260.0296	450.8107	630.0738 (98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000 (210)
Space heating fuel (main heating system)	688.0191	544.7832	462.8916	283.7818	150.9390	0.0000	0.0000	0.0000	0.0000	288.2811	499.7901	698.5298 (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	144.6830	126.5206	130.5373	113.7876	109.1646	94.1858	87.2770	100.1675	101.3799	118.1672	129.0091	140.1177 (64)
Efficiency of water heater (217)m	87.2214	86.9830	86.4795	85.4502	83.4891	76.4000	76.4000	76.4000	76.4000	85.3813	86.7150	76.4000 (216)
Fuel for water heating, kWh/month	165.8801	145.4545	150.9459	133.1624	130.7531	123.2799	114.2369	131.1093	132.6962	138.3993	148.7738	160.4458 (219)
Water heating fuel used												1675.1371 (219)
Annual totals kWh/year												
Space heating fuel - main system												3617.0156 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEV)Decentralised, Database: total watage = 4.7035, total flow = 29.0000, SFP = 0.1622)												
mechanical ventilation fans (SFP = 0.1622)												36.2785 (230a)
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												111.2785 (231)
Electricity for lighting (calculated in Appendix L)												318.9325 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.70 * 1029 * 1.00) =										-1399.6939		-1399.6939 (233)
Total delivered energy for all uses												4322.6698 (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	3617.0156	0.2160	781.2754 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1675.1371	0.2160	361.8296 (264)
Space and water heating			1143.1050 (265)
Pumps and fans	111.2785	0.5190	57.7535 (267)
Energy for lighting	318.9325	0.5190	165.5260 (268)
Energy saving/generation technologies			
PV Unit	-1399.6939	0.5190	-726.4412 (269)
Total CO2, kg/year			639.9434 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			8.9700 (273)

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

DER		8.9700 ZC1
Total Floor Area	TFA	71.3400
Assumed number of occupants	N	2.2782
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		16.6464 ZC2
CO2 emissions from cooking, equation (L16)		2.4345 ZC3
Total CO2 emissions		28.0509 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		28.0509 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	35.6700 (1b)	x 2.4700 (2b)	= 88.1049 (1b) - (3b)
First floor	35.6700 (1c)	x 2.6700 (2c)	= 95.2389 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.3400		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	183.3438 (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) = 0.1636 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4136 (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) =		0.3516 (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	0.4483	0.4395	0.4307	0.3867	0.3780	0.3340	0.3340	0.3252	0.3516	0.3780	0.3955	0.4131 (22b)
Effective ac	0.6005	0.5966	0.5927	0.5748	0.5714	0.5558	0.5558	0.5529	0.5618	0.5714	0.5782	0.5853 (25)

3. Heat losses and heat loss parameter

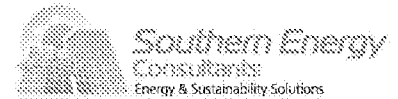
Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			2.2100	1.0000	2.2100		(26)					
TER Opening Type (Uw = 1.40)			13.8100	1.3258	18.3087		(27)					
Heat Loss Floor 1			35.6700	0.1300	4.6371		(28a)					
Brick Faced	93.2400	16.0200	77.2200	0.1800	13.8996		(29a)					
Main Roof	35.6700		35.6700	0.1300	4.6371		(30)					
Total net area of external elements Aum(A, m2)			164.5800				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	43.6925		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.2686 (36)					
Total fabric heat loss						(33) + (36) =	55.9611 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 36.3306	Feb 36.0946	Mar 35.8632	Apr 34.7764	May 34.5731	Jun 33.6266	Jul 33.6266	Aug 33.4513	Sep 33.9912	Oct 34.5731	Nov 34.9844	Dec 35.4145 (38)
Heat transfer coeff	92.2918	92.0557	91.8243	90.7376	90.5342	89.5877	89.5877	89.4124	89.9523	90.5342	90.9456	91.3756 (39)
Average = Sum(39)m / 12 =												90.7366 (39)
HLP	Jan 1.2937	Feb 1.2904	Mar 1.2871	Apr 1.2719	May 1.2691	Jun 1.2558	Jul 1.2558	Aug 1.2533	Sep 1.2609	Oct 1.2691	Nov 1.2748	Dec 1.2808 (40)
HLP (average)												1.2719 (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												2.2782 (42)
Average daily hot water use (litres/day)												88.3075 (43)
Daily hot water use	Jan 97.1383	Feb 93.6060	Mar 90.0737	Apr 86.5414	May 83.0091	Jun 79.4768	Jul 79.4768	Aug 83.0091	Sep 86.5414	Oct 90.0737	Nov 93.6060	Dec 97.1383 (44)
Energy conte	144.0533	125.9899	130.0103	113.3461	108.7583	93.8502	86.9660	99.7947	100.9866	117.6901	128.4680	139.5079 (45)
Energy content (annual)										Total = Sum(45)m =		1389.4215 (45)
Distribution loss (46)m = 0.15 x (45)m												
	21.6080	18.8985	19.5015	17.0019	16.3137	14.0775	13.0449	14.9692	15.1480	17.6535	19.2702	20.9262 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	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	49.5006	43.0844	45.9006	42.6779	42.3005	39.1940	40.5005	42.3005	42.6779	45.9006	46.1619	49.5006 (61)
Total heat required for water heating calculated for each month												
	193.5539	169.0743	175.9109	156.0241	151.0588	133.0442	127.4665	142.0953	143.6645	163.5907	174.6298	189.0085 (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	193.5539	169.0743	175.9109	156.0241	151.0588	133.0442	127.4665	142.0953	143.6645	163.5907	174.6298	189.0085 (64)
	Total per year (kWh/year) = Sum(64)m =											1919.1216 (64)
Heat gains from water heating, kWh/month												
	60.2729	52.6628	54.7036	48.3571	46.7373	41.0037	39.0413	43.7569	44.2475	50.6071	54.2561	58.7615 (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	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	18.0593	16.0401	13.0447	9.8757	7.3822	6.2323	6.7343	8.7535	11.7489	14.9179	17.4114	18.5612 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	200.4041	202.4837	197.2432	186.0869	172.0041	158.7683	149.9259	147.8464	153.0868	164.2431	178.3259	191.5617 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911 (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)												
	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285 (71)
Water heating gains (Table 5)												
	81.0119	78.3672	73.5263	67.1626	62.8189	56.9496	52.4749	58.8130	61.4549	68.0203	75.3557	78.9806 (72)
Total internal gains												
	359.6485	357.0641	343.9874	323.2984	302.3784	282.1234	269.3083	275.5860	286.4638	307.3545	331.2661	349.2767 (73)

6. Solar gains

[Jan]		Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East		8.1800	19.6403	0.6300	0.7000	0.7700	49.0990 (76)
South		1.0800	46.7521	0.6300	0.7000	0.7700	15.4311 (78)
West		4.5500	19.6403	0.6300	0.7000	0.7700	27.3106 (80)
Solar gains							
	91.8406	174.7454	278.3534	395.3956	477.8965	486.8874	464.4496
Total gains							
	451.4891	531.8095	622.3408	718.6940	780.2749	769.0108	733.7579
							402.9537
							319.9242
							204.6210
							113.5648
							76.1694 (83)
							425.4460 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)												
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	53.6794	53.8171	53.9527	54.5989	54.7215	55.2996	55.2996	55.4081	55.0755	54.7215	54.4740	54.2176
alpha	4.5786	4.5878	4.5968	4.6399	4.6481	4.6866	4.6866	4.6939	4.6717	4.6481	4.6316	4.6145
util living area												
	0.9974	0.9942	0.9836	0.9468	0.8527	0.6865	0.5233	0.5820	0.8331	0.9722	0.9948	0.9981 (86)
MIT												
	19.6005	19.7762	20.0761	20.4623	20.7725	20.9414	20.9868	20.9788	20.8510	20.4282	19.9424	19.5721 (87)
Th 2												
	19.8458	19.8484	19.8509	19.8629	19.8652	19.8756	19.8756	19.8776	19.8716	19.8652	19.8606	19.8559 (88)
util rest of house												
	0.9966	0.9921	0.9777	0.9269	0.8000	0.5888	0.3966	0.4518	0.7544	0.9582	0.9927	0.9974 (89)
MIT 2												
	17.9953	18.2532	18.6893	19.2431	19.6481	19.8381	19.8711	19.8693	19.7549	19.2079	18.5052	17.9609 (90)
Living area fraction												
									fLA = Living area / (4) =			0.2506 (91)
MIT												
	18.3976	18.6349	19.0369	19.5487	19.9299	20.1146	20.1507	20.1474	20.0296	19.5137	18.8654	18.3647 (92)
Temperature adjustment												
												0.0000
adjusted MIT												
	18.3976	18.6349	19.0369	19.5487	19.9299	20.1146	20.1507	20.1474	20.0296	19.5137	18.8654	18.3647 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9949	0.9890	0.9719	0.9201	0.8034	0.6110	0.4286	0.4845	0.7671	0.9522	0.9899	0.9960 (94)
Useful gains	449.1657	525.9669	604.8655	661.2361	626.9093	469.8823	314.4827	328.7683	465.1566	487.5281	440.3395	423.7599 (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												
	1301.0954	1264.3778	1151.1932	966.2348	745.0893	494.0399	318.0993	335.0618	533.3833	806.9989	1070.0133	1294.3081 (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												
	633.8357	496.2122	406.4679	219.5991	87.9259	0.0000	0.0000	0.0000	0.0000	237.6863	453.3651	647.6879 (98)
Space heating												
												3182.7800 (98)
Space heating per m2												
										(98) / (4) =		44.6142 (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												3407.6874 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	633.8357	496.2122	406.4679	219.5991	87.9259	0.0000	0.0000	0.0000	0.0000	237.6863	453.3651	647.6879 (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)	678.6250	531.2764	435.1904	235.1168	94.1391	0.0000	0.0000	0.0000	0.0000	254.4821	485.4016	693.4560 (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	193.5539	169.0743	175.9109	156.0241	151.0588	133.0442	127.4665	142.0953	143.6645	163.5907	174.6298	189.0085 (64)
Efficiency of water heater (217)m	87.8161	87.5999	87.0912	85.9115	83.7423	80.3000	80.3000	80.3000	80.3000	85.9907	87.3450	87.9024 (217)
Fuel for water heating, kWh/month	220.4082	193.0075	201.9846	181.6102	180.3854	165.6839	158.7378	176.9555	178.9098	190.2424	199.9311	215.0209 (219)
Water heating fuel used												2262.8772 (219)
Annual totals kWh/year												
Space heating fuel - main system												3407.6874 (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)												318.9325 (232)
Total delivered energy for all uses												6064.4971 (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	3407.6874	0.2160	736.0605 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2262.8772	0.2160	488.7815 (264)
Space and water heating			1224.8419 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	318.9325	0.5190	165.5260 (268)
Total CO2, kg/m2/year			1429.2929 (272)
Emissions per m2 for space and water heating			17.1691 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.3202 (272b)
Emissions per m2 for pumps and fans			0.5456 (272c)
Target Carbon Dioxide Emission Rate (TER) = (17.1691 * 1.00) + 2.3202 + 0.5456, rounded to 2 d.p.			20.0300 (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	35.6700 (1b)	x 2.4700 (2b)	= 88.1049 (1b) - (3b)
First floor	35.6700 (1c)	x 2.6700 (2c)	= 95.2389 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.3400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.3438 (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) = 0.1636 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4136 (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) =	0.3516 (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	0.4483	0.4395	0.4307	0.3867	0.3780	0.3340	0.3340	0.3252	0.3516	0.3780	0.3955	0.4131 (22b)
Effective ac	0.6005	0.5966	0.5927	0.5748	0.5714	0.5558	0.5558	0.5529	0.5618	0.5714	0.5782	0.5853 (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 2 (Uw = 1.40)			13.8100	1.3258	18.3087		(27)
Opening Type 3			2.2100	1.4000	3.0940		(26)
Heat Loss Floor 1			35.6700	0.1500	5.3505		(28a)
Brick Faced	93.2400	16.0200	77.2200	0.2400	18.5328		(29a)
Main Roof	35.6700		35.6700	0.1100	3.9237		(30)
Total net area of external elements Aum(A, m ²)			164.5800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.2097		(33)
Party Wall 1			44.3700	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)							15.1274 (36)
Total fabric heat loss						(33) + (36) =	64.3371 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	36.3306	36.0946	35.8632	34.7764	34.5731	33.6266	33.6266	33.4513	33.9912	34.5731	34.9844	35.4145 (38)
Heat transfer coeff	100.6678	100.4317	100.2003	99.1136	98.9102	97.9637	97.9637	97.7884	98.3283	98.9102	99.3216	99.7516 (39)
Average = Sum(39)m / 12 =												99.1126 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.4111	1.4078	1.4045	1.3893	1.3865	1.3732	1.3732	1.3707	1.3783	1.3865	1.3922	1.3983 (40)
HLP (average)												1.3893 (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	2.2782 (42)
Average daily hot water use (litres/day)	88.3075 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	97.1383	93.6060	90.0737	86.5414	83.0091	79.4768	79.4768	83.0091	86.5414	90.0737	93.6060	97.1383 (44)
Energy conte	144.0533	125.9899	130.0103	113.3461	108.7583	93.8502	86.9660	99.7947	100.9866	117.6901	128.4680	139.5079 (45)
Energy content (annual)										Total = Sum(45)m =		1389.4215 (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

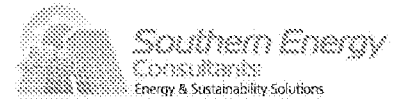
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	30.6113	26.7729	27.6272	24.0861	23.1111	19.9432	18.4803	21.2064	21.4597	25.0092	27.2994	29.6454 (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	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.0593	16.0401	13.0447	9.8757	7.3822	6.2323	6.7343	8.7535	11.7489	14.9179	17.4114	18.5612	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	200.4041	202.4837	197.2432	186.0869	172.0041	158.7683	149.9259	147.8464	153.0868	164.2431	178.3259	191.5617	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	(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)	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	(71)
Water heating gains (Table 5)	41.1443	39.8406	37.1333	33.4529	31.0634	27.6988	24.8391	28.5032	29.8051	33.6145	37.9159	39.8460	(72)
Total internal gains	316.7808	315.5375	304.5944	286.5886	267.6229	249.8727	238.6725	242.2762	251.8139	269.9486	290.8263	307.1421	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East	8.1800	19.6403	0.7200	0.7000	0.7700	56.1131 (76)
South	1.0800	46.7521	0.7200	0.7000	0.7700	17.6355 (78)
West	4.5500	19.6403	0.7200	0.7000	0.7700	31.2121 (80)

Solar gains	104.9607	199.7090	318.1181	451.8807	546.1674	556.4428	530.7995	460.5185	365.6276	233.8525	129.7883	87.0507	(83)
Total gains	421.7415	515.2465	622.7126	738.4693	813.7903	806.3154	769.4720	702.7947	617.4416	503.8012	420.6147	394.1928	(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	19.6852	19.7315	19.7770	19.9939	20.0350	20.2286	20.2286	20.2648	20.1536	20.0350	19.9520	19.8660	
alpha	2.3123	2.3154	2.3185	2.3329	2.3357	2.3486	2.3486	2.3510	2.3436	2.3357	2.3301	2.3244	
util living area	0.9691	0.9507	0.9147	0.8453	0.7418	0.6093	0.4864	0.5360	0.7332	0.8939	0.9556	0.9733	(86)
MIT	18.0778	18.4088	18.9673	19.6702	20.2681	20.6846	20.8681	20.8299	20.4761	19.6614	18.7389	18.0204	(87)
Th 2	19.7548	19.7574	19.7598	19.7715	19.7737	19.7839	19.7839	19.7858	19.7800	19.7737	19.7693	19.7647	(88)
util rest of house	0.9639	0.9425	0.9002	0.8180	0.6936	0.5298	0.3750	0.4249	0.6650	0.8691	0.9468	0.9688	(89)
MIT 2	17.1154	17.4434	17.9923	18.6767	19.2317	19.5965	19.7296	19.7104	19.4368	18.6869	17.7821	17.0651	(90)
Living area fraction									fLA = Living area / (4) =			0.2506	(91)
MIT	17.3566	17.6853	18.2367	18.9257	19.4915	19.8693	20.0149	19.9910	19.6973	18.9311	18.0219	17.3045	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3566	17.6853	18.2367	18.9257	19.4915	19.8693	20.0149	19.9910	19.6973	18.9311	18.0219	17.3045	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9498	0.9240	0.8774	0.7954	0.6809	0.5360	0.3977	0.4454	0.6597	0.8473	0.9297	0.9561	(94)
Useful gains	400.5759	476.1096	546.3671	587.4071	554.1297	432.1599	306.0519	313.0445	407.3195	426.8519	391.0354	376.9014	(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	1314.3810	1284.0528	1176.0177	993.6818	770.6591	516.1961	334.5384	351.1536	550.3714	824.0339	1084.7845	1307.1974	(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	679.8710	542.9379	468.4600	292.5178	161.0979	0.0000	0.0000	0.0000	0.0000	295.5034	499.4993	692.1402	(98)
Space heating												3632.0276	(98)
Space heating per m2											(98) / (4) =	50.9115	(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	920.8586	724.9312	743.1918	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7386	0.7990	0.7674	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	680.1879	579.2020	570.3390	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1027.1467	982.3716	905.8331	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	249.8103	299.9581	249.6077	0.0000	0.0000	0.0000	0.0000	(104)

Regs Region: England

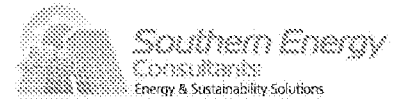
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling											799.3761 (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	62.4526	74.9895	62.4019	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling											199.8440 (107)
Space cooling per m2											2.8013 (108)
Energy for space heating											50.9115 (99)
Energy for space cooling											2.8013 (108)
Total											53.7128 (109)
Dwelling Fabric Energy Efficiency (DFEE)											53.7 (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	35.6700 (1b)	x 2.4700 (2b)	= 88.1049 (1b) - (3b)
First floor	35.6700 (1c)	x 2.6700 (2c)	= 95.2389 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.3400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.3438 (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) = 0.1636 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4136 (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) =	0.3516 (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	0.4483	0.4395	0.4307	0.3867	0.3780	0.3340	0.3340	0.3252	0.3516	0.3780	0.3955	0.4131 (22b)
Effective ac	0.6005	0.5966	0.5927	0.5748	0.5714	0.5558	0.5558	0.5529	0.5618	0.5714	0.5782	0.5853 (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			2.2100	1.0000	2.2100		(26)					
TER Opening Type (Uw = 1.40)			13.8100	1.3258	18.3087		(27)					
Heat Loss Floor 1			35.6700	0.1300	4.6371		(28a)					
Brick Faced	93.2400	16.0200	77.2200	0.1800	13.8996		(29a)					
Main Roof	35.6700		35.6700	0.1300	4.6371		(30)					
Total net area of external elements Aum(A, m2)			164.5800				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	43.6925		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.2686 (36)					
Total fabric heat loss						(33) + (36) =	55.9611 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 36.3306	Feb 36.0946	Mar 35.8632	Apr 34.7764	May 34.5731	Jun 33.6266	Jul 33.6266	Aug 33.4513	Sep 33.9912	Oct 34.5731	Nov 34.9844	Dec 35.4145 (38)
Heat transfer coeff	92.2918	92.0557	91.8243	90.7376	90.5342	89.5877	89.5877	89.4124	89.9523	90.5342	90.9456	91.3756 (39)
Average = Sum(39)m / 12 =												90.7366 (39)
HLP	Jan 1.2937	Feb 1.2904	Mar 1.2871	Apr 1.2719	May 1.2691	Jun 1.2558	Jul 1.2558	Aug 1.2533	Sep 1.2609	Oct 1.2691	Nov 1.2748	Dec 1.2808 (40)
HLP (average)												1.2719 (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												2.2782 (42)
Average daily hot water use (litres/day)												88.3075 (43)
Daily hot water use	Jan 97.1383	Feb 93.6060	Mar 90.0737	Apr 86.5414	May 83.0091	Jun 79.4768	Jul 79.4768	Aug 83.0091	Sep 86.5414	Oct 90.0737	Nov 93.6060	Dec 97.1383 (44)
Energy conte	144.0533	125.9899	130.0103	113.3461	108.7583	93.8502	86.9660	99.7947	100.9866	117.6901	128.4680	139.5079 (45)
Energy content (annual)												Total = Sum(45)m = 1389.4215 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												

Regs Region: England

Elmhurst Energy Systems

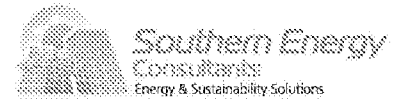
SAP2012 Calculator (Design

System) version 4.14r19



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Heat gains from water heating, kWh/month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
	30.6113	26.7729	27.6272	24.0861	23.1111	19.9432	18.4803	21.2064	21.4597	25.0092	27.2994	29.6454 (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	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	113.9106	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.0593	16.0401	13.0447	9.8757	7.3822	6.2323	6.7343	8.7535	11.7489	14.9179	17.4114	18.5612	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	200.4041	202.4837	197.2432	186.0869	172.0041	158.7683	149.9259	147.8464	153.0868	164.2431	178.3259	191.5617	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	34.3911	(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)	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	(71)
Water heating gains (Table 5)	41.1443	39.8406	37.1333	33.4529	31.0634	27.6988	24.8391	28.5032	29.8051	33.6145	37.9159	39.8460	(72)
Total internal gains	316.7808	315.5375	304.5944	286.5886	267.6229	249.8727	238.6725	242.2762	251.8139	269.9486	290.8263	307.1421	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	8.1800	19.6403	0.6300	0.7000	0.7700	49.0990	(76)
South	1.0800	46.7521	0.6300	0.7000	0.7700	15.4311	(78)
West	4.5500	19.6403	0.6300	0.7000	0.7700	27.3106	(80)

Solar gains	91.8406	174.7454	278.3534	395.3956	477.8965	486.8874	464.4496	402.9537	319.9242	204.6210	113.5648	76.1694	(83)
Total gains	408.6214	490.2829	582.9478	681.9842	745.5194	736.7601	703.1220	645.2299	571.7381	474.5696	404.3911	383.3115	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	53.6794	53.8171	53.9527	54.5989	54.7215	55.2996	55.2996	55.4081	55.0755	54.7215	54.4740	54.2176	
alpha	4.5786	4.5878	4.5968	4.6399	4.6481	4.6866	4.6866	4.6939	4.6717	4.6481	4.6316	4.6145	
util living area	0.9983	0.9958	0.9873	0.9554	0.8691	0.7081	0.5436	0.6072	0.8557	0.9790	0.9965	0.9988	(86)
MIT	19.5461	19.7242	20.0291	20.4251	20.7499	20.9332	20.9846	20.9748	20.8304	20.3855	19.8915	19.5184	(87)
Th 2	19.8458	19.8484	19.8509	19.8629	19.8652	19.8756	19.8756	19.8776	19.8716	19.8652	19.8606	19.8559	(88)
util rest of house	0.9977	0.9943	0.9825	0.9381	0.8194	0.6103	0.4133	0.4737	0.7818	0.9680	0.9951	0.9983	(89)
MIT 2	18.5282	18.7078	19.0120	19.4057	19.6998	19.8459	19.8719	19.8707	19.7784	19.3762	18.8848	18.5085	(90)
Living area fraction									fLA = Living area / (4) =			0.2506	(91)
MIT	18.7833	18.9625	19.2669	19.6612	19.9630	20.1184	20.1508	20.1474	20.0421	19.6292	19.1371	18.7616	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7833	18.9625	19.2669	19.6612	19.9630	20.1184	20.1508	20.1474	20.0421	19.6292	19.1371	18.7616	(93)

8. Space heating requirement

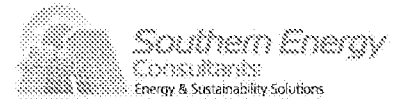
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	407.3718	486.7256	570.8970	637.1677	614.5765	466.4181	313.8269	327.4495	454.4530	457.9011	401.8503	382.4359	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1336.6890	1294.5353	1172.3130	976.4468	748.0854	494.3847	318.1072	335.0657	534.5047	817.4491	1094.7189	1330.5736	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	691.4121	542.8481	447.4535	244.2810	99.3307	0.0000	0.0000	0.0000	0.0000	267.5037	498.8654	705.4144	(98)
Space heating												3497.1088	(98)
Space heating per m2										(98) / (4) =		49.0203	(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	842.1242	662.9488	679.5342	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8684	0.9250	0.8987	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	731.2863	613.2178	610.7240	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	945.8482	904.8197	838.5496	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	154.4846	216.9518	169.5023	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												540.9386	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											FC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	38.6211	54.2379	42.3756	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												135.2346 (107)
Space cooling per m2												1.8956 (108)
Energy for space heating												49.0203 (99)
Energy for space cooling												1.8956 (108)
Total												50.9159 (109)
Target Fabric Energy Efficiency (TFEE)												58.6 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.6700 (1b)	x 2.4700 (2b)	= 88.1049 (1b) - (3b)
First floor	35.6700 (1c)	x 2.6700 (2c)	= 95.2389 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.3400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.3438 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2500 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.8000	4.5000	4.4000	3.9000	3.9000	3.6000	3.7000	3.5000	3.7000	4.0000	4.1000	4.4000 (22)
Wind factor	1.2000	1.1250	1.1000	0.9750	0.9750	0.9000	0.9250	0.8750	0.9250	1.0000	1.0250	1.1000 (22a)
Adj infilt rate	0.2550	0.2391	0.2338	0.2072	0.2072	0.1913	0.1966	0.1859	0.1966	0.2125	0.2178	0.2338 (22b)
Mechanical extract ventilation - decentralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5050	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.40)			13.8100	1.3258	18.3087		(27)
Opening Type 3			2.2100	1.4000	3.0940		(26)
Heat Loss Floor 1			35.6700	0.1500	5.3505		(28a)
Brick Faced	93.2400	16.0200	77.2200	0.2400	18.5328		(29a)
Main Roof	35.6700		35.6700	0.1100	3.9237		(30)
Total net area of external elements Aum(A, m ²)			164.5800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.2097		(33)
Party Wall 1			44.3700	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)							15.1274 (36)
Total fabric heat loss						(33) + (36) =	64.3371 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	30.5542	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517 (38)
Heat transfer coeff	94.8914	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888 (39)
Average = Sum(39)m / 12 =												94.6140 (39)
HLP	1.3301	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259 (40)
HLP (average)												1.3262 (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												2.2782 (42)
Average daily hot water use (litres/day)												88.3075 (43)
Daily hot water use	97.1383	93.6060	90.0737	86.5414	83.0091	79.4768	79.4768	83.0091	86.5414	90.0737	93.6060	97.1383 (44)
Energy conte	144.0533	125.9899	130.0103	113.3461	108.7583	93.8502	86.9660	99.7947	100.9866	117.6901	128.4680	139.5079 (45)
Energy content (annual)										Total = Sum(45)m =		1389.4215 (45)
Distribution loss (46)m = 0.15 x (45)m	21.6080	18.8985	19.5015	17.0019	16.3137	14.0775	13.0449	14.9692	15.1480	17.6535	19.2702	20.9262 (46)

Regs Region: England

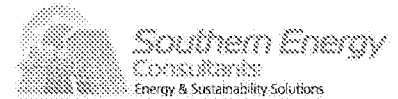
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	0.6297	0.5307	0.5270	0.4414	0.4063	0.3357	0.3110	0.3728	0.3933	0.4770	0.5411	0.6098	(61)
Total heat required for water heating calculated for each month	144.6830	126.5206	130.5373	113.7876	109.1646	94.1858	87.2770	100.1675	101.3799	118.1672	129.0091	140.1177	(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	144.6830	126.5206	130.5373	113.7876	109.1646	94.1858	87.2770	100.1675	101.3799	118.1672	129.0091	140.1177	(64)
RHI water heating demand	48.0551	42.0243	43.3602	37.7979	36.2637	31.2891	28.9939	33.2749	33.6764	39.2512	42.8509	46.5388	(65)
Heat gains from water heating, kWh/month													
	48.0551	42.0243	43.3602	37.7979	36.2637	31.2891	28.9939	33.2749	33.6764	39.2512	42.8509	46.5388	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.1482	40.1002	32.6117	24.6892	18.4554	15.5809	16.8357	21.8836	29.3722	37.2947	43.5284	46.4030	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	299.1106	302.2144	294.3929	277.7417	256.7226	236.9676	223.7700	220.6662	228.4878	245.1389	266.1580	285.9130	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	(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)	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	(71)
Water heating gains (Table 5)	64.5902	62.5362	58.2798	52.4971	48.7415	43.4571	38.9704	44.7244	46.7727	52.7570	59.5151	62.5522	(72)
Total internal gains	508.3608	504.3626	484.7961	454.4397	423.4313	395.5173	379.0878	386.7860	404.1444	434.7024	468.7133	494.3800	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
East				8.1800	23.7288		0.7200		0.7000		0.7700		67.7943 (76)
South				1.0800	53.5774		0.7200		0.7000		0.7700		20.2101 (78)
West				4.5500	23.7288		0.7200		0.7000		0.7700		37.7095 (80)
Solar gains	125.7139	212.7431	337.2671	503.6272	584.1603	635.6970	599.5393	525.8856	414.6074	266.3395	156.9966	100.8085	(83)
Total gains	634.0747	717.1057	822.0633	958.0669	1007.5916	1031.2142	978.6271	912.6715	818.7517	701.0419	625.7100	595.1885	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	20.8835	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	
alpha	2.3922	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	
util living area	0.9239	0.9002	0.8474	0.7489	0.6182	0.4572	0.3294	0.3417	0.5691	0.7807	0.8904	0.9307 (86)	
MIT	18.8021	19.0407	19.5409	20.1260	20.5947	20.8625	20.9571	20.9547	20.7601	20.2154	19.4348	18.7799 (87)	
Th 2	19.8173	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206 (88)	
util rest of house	0.9124	0.8855	0.8248	0.7122	0.5605	0.3764	0.2284	0.2345	0.4866	0.7371	0.8709	0.9199 (89)	
MIT 2	17.8668	18.0998	18.5810	19.1269	19.5416	19.7499	19.8078	19.8076	19.6847	19.2272	18.4900	17.8486 (90)	
Living area fraction	18.1012	18.3357	18.8216	19.3773	19.8056	20.0287	20.0958	20.0951	19.9543	19.4749	18.7268	18.0820 (92)	
Temperature adjustment												-0.1500	
adjusted MIT	17.9512	18.1857	18.6716	19.2273	19.6556	19.8787	19.9458	19.9451	19.8043	19.3249	18.5768	17.9320 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	563.5807	616.6769	656.3464	662.2145	555.9191	392.5235	234.4496	224.7844	397.3915	501.6266	528.7586	534.0099	(95)
Ext temp.	5.0000	5.4000	7.1000	9.5000	12.6000	15.4000	17.4000	17.5000	15.0000	11.7000	8.1000	5.2000	(96)
Heat loss rate W	1228.9558	1209.3800	1094.5437	920.0950	667.3771	423.6384	240.8069	231.2779	454.4305	721.2311	990.9898	1204.3079	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	495.0391	398.2965	326.0188	185.6739	82.9247	0.0000	0.0000	0.0000	0.0000	163.3857	332.8065	498.7017	(98)
Space heating												2482.8469	(98)
RHI space heating demand												2483	(98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.6700 (1b)	x 2.4700 (2b)	= 88.1049 (1b) - (3b)
First floor	35.6700 (1c)	x 2.6700 (2c)	= 95.2389 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.3400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.3438 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2500 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497 (22b)
Mechanical extract ventilation - decentralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.40)			13.8100	1.3258	18.3087		(27)
Opening Type 3			2.2100	1.4000	3.0940		(26)
Heat Loss Floor 1			35.6700	0.1500	5.3505		(28a)
Brick Faced	93.2400	16.0200	77.2200	0.2400	18.5328		(29a)
Main Roof	35.6700		35.6700	0.1100	3.9237		(30)
Total net area of external elements Aum(A, m ²)			164.5800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.2097		(33)
Party Wall 1			44.3700	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)							15.1274 (36)
Total fabric heat loss						(33) + (36) =	64.3371 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	31.5185	31.1971	30.8757	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517 (38)
Heat transfer coeff	95.8556	95.5342	95.2128	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888 (39)
Average = Sum(39)m / 12 =												94.8252 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3436	1.3391	1.3346	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259 (40)
HLP (average)												1.3292 (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												2.2782 (42)
Average daily hot water use (litres/day)												88.3075 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	97.1383	93.6060	90.0737	86.5414	83.0091	79.4768	79.4768	83.0091	86.5414	90.0737	93.6060	97.1383 (44)
Energy conte	144.0533	125.9899	130.0103	113.3461	108.7583	93.8502	86.9660	99.7947	100.9866	117.6901	128.4680	139.5079 (45)
Energy content (annual)										Total = Sum(45)m =		1389.4215 (45)
Distribution loss (46)m = 0.15 x (45)m	21.6080	18.8985	19.5015	17.0019	16.3137	14.0775	13.0449	14.9692	15.1480	17.6535	19.2702	20.9262 (46)

Regs Region: England

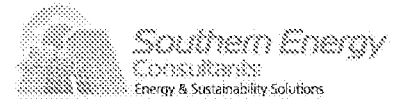
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	0.6297	0.5307	0.5270	0.4414	0.4063	0.3357	0.3110	0.3728	0.3933	0.4770	0.5411	0.6098	(61)
Total heat required for water heating calculated for each month	144.6830	126.5206	130.5373	113.7876	109.1646	94.1858	87.2770	100.1675	101.3799	118.1672	129.0091	140.1177	(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	144.6830	126.5206	130.5373	113.7876	109.1646	94.1858	87.2770	100.1675	101.3799	118.1672	129.0091	140.1177	(64)
Heat gains from water heating, kWh/month	48.0551	42.0243	43.3602	37.7979	36.2637	31.2891	28.9939	33.2749	33.6764	39.2512	42.8509	46.5388	(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	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.1482	40.1002	32.6117	24.6892	18.4554	15.5809	16.8357	21.8836	29.3722	37.2947	43.5284	46.4030	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	299.1106	302.2144	294.3929	277.7417	256.7226	236.9676	223.7700	220.6662	228.4878	245.1389	266.1580	285.9130	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	(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)	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	(71)
Water heating gains (Table 5)	64.5902	62.5362	58.2798	52.4971	48.7415	43.4571	38.9704	44.7244	46.7727	52.7570	59.5151	62.5522	(72)
Total internal gains	508.3608	504.3626	484.7961	454.4397	423.4313	395.5173	379.0878	386.7860	404.1444	434.7024	468.7133	494.3800	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c	Access factor Table 6d	Gains W		
East				8.1800	19.6403	0.7200		0.7000	0.7700	56.1131 (76)		
South				1.0800	46.7521	0.7200		0.7000	0.7700	17.6355 (78)		
West				4.5500	19.6403	0.7200		0.7000	0.7700	31.2121 (80)		
Solar gains	104.9607	199.7090	318.1181	451.8807	546.1674	556.4428	530.7995	460.5185	365.6276	233.8525	129.7883	87.0507 (83)
Total gains	613.3215	704.0716	802.9143	906.3204	969.5987	951.9600	909.8873	847.3044	769.7720	668.5550	598.5017	581.4307 (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	20.6735	20.7430	20.8130	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	
alpha	2.3782	2.3829	2.3875	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	
util living area	0.9344	0.9093	0.8635	0.7826	0.6705	0.5363	0.4165	0.4571	0.6455	0.8262	0.9113	0.9411	(86)
MIT	18.5882	18.8897	19.3824	19.9727	20.4582	20.7761	20.9121	20.8871	20.6322	19.9819	19.1839	18.5406	(87)
Th 2	19.8068	19.8103	19.8138	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	(88)
util rest of house	0.9247	0.8961	0.8435	0.7502	0.6199	0.4607	0.3182	0.3574	0.5744	0.7924	0.8960	0.9323	(89)
MIT 2	17.6494	17.9453	18.4241	18.9872	19.4263	19.6902	19.7850	19.7718	19.5871	19.0124	18.2463	17.6124	(90)
Living area fraction									fLA = Living area / (4) =			0.2506	(91)
MIT	17.8847	18.1820	18.6643	19.2342	19.6849	19.9624	20.0675	20.0513	19.8490	19.2554	18.4813	17.8451	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.7347	18.0320	18.5143	19.0842	19.5349	19.8124	19.9175	19.9013	19.6990	19.1054	18.3313	17.6951	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9023	0.8709	0.8167	0.7268	0.6063	0.4601	0.3268	0.3647	0.5662	0.7677	0.8713	0.9112	(94)
Ext temp.	553.3962	613.1995	655.7415	658.7051	587.8885	438.0389	297.3253	309.0409	435.8511	513.2349	521.4770	529.7743	(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	1287.7875	1254.5524	1143.9131	963.3142	741.0967	493.0333	313.7966	331.1846	529.6040	804.5138	1062.3551	1276.4834	(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	546.3872	430.9891	363.1997	219.3186	113.9869	0.0000	0.0000	0.0000	0.0000	216.7115	389.4322	555.5516	(98)
Space heating per m2												2835.5768	(98)
												(98) / (4) =	39.7474 (99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												90.2000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3143.6550 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	546.3872	430.9891	363.1997	219.3186	113.9869	0.0000	0.0000	0.0000	0.0000	216.7115	389.4322	555.5516 (98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000 (210)
Space heating fuel (main heating system)	605.7507	477.8150	402.6604	243.1470	126.3713	0.0000	0.0000	0.0000	0.0000	240.2567	431.7431	615.9109 (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	144.6830	126.5206	130.5373	113.7876	109.1646	94.1858	87.2770	100.1675	101.3799	118.1672	129.0091	140.1177 (64)
Efficiency of water heater	86.9132	86.6482	86.0888	84.9579	82.8768	76.4000	76.4000	76.4000	76.4000	84.7954	86.3201	76.4000 (216)
(217)m	166.4683	146.0165	151.6310	133.9340	131.7191	123.2799	114.2369	131.1093	132.6962	139.3557	149.4543	87.0336 (217)
Fuel for water heating, kWh/month	166.4683	146.0165	151.6310	133.9340	131.7191	123.2799	114.2369	131.1093	132.6962	139.3557	149.4543	160.9927 (219)
Water heating fuel used												1680.8938 (219)
Annual totals kWh/year												
Space heating fuel - main system												3143.6550 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEV)Decentralised, Database: total watage = 4.7035, total flow = 29.0000, SFP = 0.1622)												
mechanical ventilation fans (SFP = 0.1622)												36.2785 (230a)
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												111.2785 (231)
Electricity for lighting (calculated in Appendix L)												318.9325 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 1.70 * 1029 * 1.00) =												-1399.6939 (233)
Total delivered energy for all uses												3855.0659 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3143.6550	3.4800	109.3992 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1680.8938	3.4800	58.4951 (247)
Mechanical ventilation fans	36.2785	13.1900	4.7851 (249)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	318.9325	13.1900	42.0672 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-1399.6939	13.1900	-184.6196 (252)
Total energy cost			160.0195 (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] = 0.5777 (257)
SAP value	91.9413
SAP rating (Section 12)	92 (258)
SAP band	A

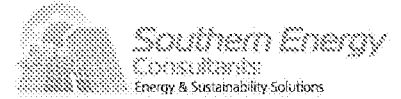
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3143.6550	0.2160	679.0295 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1680.8938	0.2160	363.0731 (264)
Space and water heating			1042.1026 (265)
Pumps and fans	111.2785	0.5190	57.7535 (267)
Energy for lighting	318.9325	0.5190	165.5260 (268)
Energy saving/generation technologies			
PV Unit	-1399.6939	0.5190	-726.4412 (269)
Total kg/year			538.9409 (272)
CO2 emissions per m2			7.5500 (273)
EI value			93.7925
EI rating			94 (274)
EI band			A

Calculation of stars for heating and DHW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9020 = 3.858$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9020 = 0.2395$, stars = 4
Water heating energy efficiency	$3.48 / 0.8260 = 4.213$, stars = 4
Water heating environmental impact	$0.216 / 0.8260 = 0.2615$, 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	35.6700 (1b)	x 2.4700 (2b)	= 88.1049 (1b) - (3b)
First floor	35.6700 (1c)	x 2.6700 (2c)	= 95.2389 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.3400		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	183.3438 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2500 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.8000	4.5000	4.4000	3.9000	3.9000	3.6000	3.7000	3.5000	3.7000	4.0000	4.1000	4.4000 (22)
Wind factor	1.2000	1.1250	1.1000	0.9750	0.9750	0.9000	0.9250	0.8750	0.9250	1.0000	1.0250	1.1000 (22a)
Adj infilt rate	0.2550	0.2391	0.2338	0.2072	0.2072	0.1913	0.1966	0.1859	0.1966	0.2125	0.2178	0.2338 (22b)
Mechanical extract ventilation - decentralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5050	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.40)			13.8100	1.3258	18.3087		(27)
Opening Type 3			2.2100	1.4000	3.0940		(26)
Heat Loss Floor 1			35.6700	0.1500	5.3505		(28a)
Brick Faced	93.2400	16.0200	77.2200	0.2400	18.5328		(29a)
Main Roof	35.6700		35.6700	0.1100	3.9237		(30)
Total net area of external elements Aum(A, m ²)			164.5800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.2097		(33)
Party Wall 1			44.3700	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)							15.1274 (36)
Total fabric heat loss						(33) + (36) =	64.3371 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	30.5542	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517 (38)
Heat transfer coeff	94.8914	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888 (39)
Average = Sum(39)m / 12 =												94.6140 (39)
HLP	1.3301	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259 (40)
HLP (average)												1.3262 (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												2.2782 (42)
Average daily hot water use (litres/day)												88.3075 (43)
Daily hot water use	97.1383	93.6060	90.0737	86.5414	83.0091	79.4768	79.4768	83.0091	86.5414	90.0737	93.6060	97.1383 (44)
Energy conte	144.0533	125.9899	130.0103	113.3461	108.7583	93.8502	86.9660	99.7947	100.9866	117.6901	128.4680	139.5079 (45)
Energy content (annual)										Total = Sum(45)m =		1389.4215 (45)
Distribution loss (46)m = 0.15 x (45)m	21.6080	18.8985	19.5015	17.0019	16.3137	14.0775	13.0449	14.9692	15.1480	17.6535	19.2702	20.9262 (46)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	(57)
Combi loss	0.6297	0.5307	0.5270	0.4414	0.4063	0.3357	0.3110	0.3728	0.3933	0.4770	0.5411	(61)
Total heat required for water heating calculated for each month	144.6830	126.5206	130.5373	113.7876	109.1646	94.1858	87.2770	100.1675	101.3799	118.1672	129.0091	(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	(63)
Output from w/h	144.6830	126.5206	130.5373	113.7876	109.1646	94.1858	87.2770	100.1675	101.3799	118.1672	129.0091	(64)
Heat gains from water heating, kWh/month	48.0551	42.0243	43.3602	37.7979	36.2637	31.2891	28.9939	33.2749	33.6764	39.2512	42.8509	(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	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927	136.6927
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	45.1482	40.1002	32.6117	24.6892	18.4554	15.5809	16.8357	21.8836	29.3722	37.2947	43.5284	46.4030
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	299.1106	302.2144	294.3929	277.7417	256.7226	236.9676	223.7700	220.6662	228.4878	245.1389	266.1580	285.9130
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475	50.9475
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
Losses e.g. evaporation (negative values) (Table 5)	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285	-91.1285
Water heating gains (Table 5)	64.5902	62.5362	58.2798	52.4971	48.7415	43.4571	38.9704	44.7244	46.7727	52.7570	59.5151	62.5522
Total internal gains	508.3608	504.3626	484.7961	454.4397	423.4313	395.5173	379.0878	386.7860	404.1444	434.7024	468.7133	494.3800

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g Specific data or Table 6c	FF Access factor Table 6d	Gains W
East	8.1800	23.7288	0.7200	0.7000	0.7700	67.7943
South	1.0800	53.5774	0.7200	0.7000	0.7700	20.2101
West	4.5500	23.7288	0.7200	0.7000	0.7700	37.7095
Solar gains	125.7139	212.7431	337.2671	503.6272	584.1603	635.6970
Total gains	634.0747	717.1057	822.0633	958.0669	1007.5916	1031.2142

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000
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	20.8835	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503	20.9503
alpha	2.3922	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967	2.3967
util living area	0.9239	0.9002	0.8474	0.7489	0.6182	0.4572	0.3294	0.3417	0.5691	0.7807	0.8904	0.9307
MIT	18.8021	19.0407	19.5409	20.1260	20.5947	20.8625	20.9571	20.9547	20.7601	20.2154	19.4348	18.7799
Th 2	19.8173	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206	19.8206
util rest of house	0.9124	0.8855	0.8248	0.7122	0.5605	0.3764	0.2284	0.2345	0.4866	0.7371	0.8709	0.9199
MIT 2	17.8668	18.0998	18.5810	19.1269	19.5416	19.7499	19.8078	19.8076	19.6847	19.2272	18.4900	17.8486
Living area fraction									fLA = Living area / (4) =			0.2506
MIT	18.1012	18.3357	18.8216	19.3773	19.8056	20.0287	20.0958	20.0951	19.9543	19.4749	18.7268	18.0820
Temperature adjustment												-0.1500
adjusted MIT	17.9512	18.1857	18.6716	19.2273	19.6556	19.8787	19.9458	19.9451	19.8043	19.3249	18.5768	17.9320

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	563.5807	616.6769	656.3464	662.2145	555.9191	392.5235	234.4496	224.7844	397.3915	501.6266	528.7586	534.0099
Ext temp.	5.0000	5.4000	7.1000	9.5000	12.6000	15.4000	17.4000	17.5000	15.0000	11.7000	8.1000	5.2000
Heat loss rate W	1228.9558	1209.3800	1094.5437	920.0950	667.3771	423.6384	240.8069	231.2779	454.4305	721.2311	990.9898	1204.3079
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
Space heating kWh	495.0391	398.2965	326.0188	185.6739	82.9247	0.0000	0.0000	0.0000	0.0000	163.3857	332.8065	498.7017
Space heating												2482.8469
Space heating per m2										(98) / (4) =		34.8030

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.2000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													2752.6019 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	495.0391	398.2965	326.0188	185.6739	82.9247	0.0000	0.0000	0.0000	0.0000	163.3857	332.8065	498.7017	(98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)	548.8238	441.5703	361.4399	205.8469	91.9343	0.0000	0.0000	0.0000	0.0000	181.1372	368.9650	552.8844	(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	144.6830	126.5206	130.5373	113.7876	109.1646	94.1858	87.2770	100.1675	101.3799	118.1672	129.0091	140.1177	(64)
Efficiency of water heater	86.6598	86.4361	85.7704	84.4068	81.8028	76.4000	76.4000	76.4000	76.4000	83.8439	85.8672	76.4000	(216)
(217)m												86.7626	(217)
Fuel for water heating, kWh/month	166.9552	146.3747	152.1939	134.8085	133.4484	123.2799	114.2369	131.1093	132.6962	140.9372	150.2426	161.4956	(219)
Water heating fuel used												1687.7782	(219)
Annual totals kWh/year													
Space heating fuel - main system												2752.6019	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEV)Decentralised, Database: total watage = 4.7035, total flow = 29.0000, SFP = 0.1622)													
mechanical ventilation fans (SFP = 0.1622)												36.2785	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												111.2785	(231)
Electricity for lighting (calculated in Appendix L)												318.9325	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.70 * 1154 * 1.00) =										-1568.8956		-1568.8956	(233)
Total delivered energy for all uses												3301.6955	(238)

10a. Fuel costs - using BEDF prices (491)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2752.6019	3.6300	99.9194 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1687.7782	3.6300	61.2663 (247)
Mechanical ventilation fans	36.2785	19.4400	7.0525 (249)
Pumps and fans for heating	75.0000	19.4400	14.5800 (249)
Energy for lighting	318.9325	19.4400	62.0005 (250)
Additional standing charges			95.0000 (251)
Energy saving/generation technologies			
PV Unit	-1568.8956	19.4400	-304.9933 (252)
Total energy cost			34.8255 (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	2752.6019	0.2160	594.5620 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1687.7782	0.2160	364.5601 (264)
Space and water heating			959.1221 (265)
Pumps and fans	111.2785	0.5190	57.7535 (267)
Energy for lighting	318.9325	0.5190	165.5260 (268)
Energy saving/generation technologies			
PV Unit	-1568.8956	0.5190	-814.2568 (269)
Total kg/year			368.1448 (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	2752.6019	1.2200	3358.1743 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1687.7782	1.2200	2059.0894 (264)
Space and water heating			5417.2637 (265)
Pumps and fans	111.2785	3.0700	341.6250 (267)
Energy for lighting	318.9325	3.0700	979.1229 (268)
Energy saving/generation technologies			
PV Unit	-1568.8956	3.0700	-4816.5094 (269)
Primary energy kWh/year			1921.5021 (272)
Primary energy kWh/m2/year			26.9344 (273)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92
Current environmental impact rating: A 94

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	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	-£ 27	-191 kg (51.8%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£27 2.67 kg/m²	A 93	A 96
Total Savings	£27 2.67 kg/m²		
Potential energy efficiency rating:		A 93	
Potential environmental impact rating:			A 96

Fuel prices for cost data on this page from database revision number 491 TEST (28 Feb 2022)
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	£84	£93	-£10
Mains gas	£256	£220	£36
Space heating	£217	£217	£0
Water heating	£61	£35	£27
Lighting	£62	£62	£0
Generated (PV)	-£305	-£305	£0
Total cost of fuels	£35	£8	£26
Total cost of uses	£35	£9	£27
Delivered energy	46 kWh/m²	33 kWh/m²	13 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.2 tonnes	0.2 tonnes
CO2 emissions per m²	5 kg/m²	2 kg/m²	3 kg/m²
Primary energy	27 kWh/m²	12 kWh/m²	15 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	35.6700 (1b)	x 2.4700 (2b)	= 88.1049 (1b) - (3b)
First floor	35.6700 (1c)	x 2.6700 (2c)	= 95.2389 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.3400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.3438 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2500 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497 (22b)
Mechanical extract ventilation - decentralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.40)			13.8100	1.3258	18.3087		(27)
Opening Type 3			2.2100	1.4000	3.0940		(26)
Heat Loss Floor 1			35.6700	0.1500	5.3505		(28a)
Brick Faced	93.2400	16.0200	77.2200	0.2400	18.5328		(29a)
Main Roof	35.6700		35.6700	0.1100	3.9237		(30)
Total net area of external elements Aum(A, m ²)			164.5800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.2097		(33)
Party Wall 1			44.3700	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)							15.1274 (36)
Total fabric heat loss						(33) + (36) =	64.3371 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	31.5185	31.1971	30.8757	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517	30.2517 (38)
Heat transfer coeff	95.8556	95.5342	95.2128	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888 (39)
Average = Sum(39)m / 12 =												94.8252 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3436	1.3391	1.3346	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259	1.3259 (40)
HLP (average)												1.3292 (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												2.2782 (42)
Average daily hot water use (litres/day)												88.3075 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	97.1383	93.6060	90.0737	86.5414	83.0091	79.4768	79.4768	83.0091	86.5414	90.0737	93.6060	97.1383 (44)
Energy conte	144.0533	125.9899	130.0103	113.3461	108.7583	93.8502	86.9660	99.7947	100.9866	117.6901	128.4680	139.5079 (45)
Energy content (annual)										Total = Sum(45)m =		1389.4215 (45)
Distribution loss (46)m = 0.15 x (45)m	21.6080	18.8965	19.5015	17.0019	16.3137	14.0775	13.0449	14.9692	15.1480	17.6535	19.2702	20.9262 (46)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

Southern Energy
Consultants
Energy & Sustainability Solutions

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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9023	0.8709	0.8167	0.7268	0.6063	0.4601	0.3268	0.3647	0.5662	0.7677	0.8713	0.9112	(94)
Useful gains	553.3962	613.1995	655.7415	658.7051	587.8885	438.0389	297.3253	309.0409	435.8511	513.2349	521.4770	529.7743	(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	1287.7875	1254.5524	1143.9131	963.3142	741.0967	493.0333	313.7966	331.1846	529.6040	804.5138	1062.3551	1276.4834	(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	546.3872	430.9891	363.1997	219.3186	113.9869	0.0000	0.0000	0.0000	0.0000	216.7115	389.4322	555.5516	(98)
Space heating												2835.5768	(98)
Space heating per m2											(98) / (4) =	39.7474	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3143.6550	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	546.3872	430.9891	363.1997	219.3186	113.9869	0.0000	0.0000	0.0000	0.0000	216.7115	389.4322	555.5516	(98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)	605.7507	477.8150	402.6604	243.1470	126.3713	0.0000	0.0000	0.0000	0.0000	240.2567	431.7431	615.9109	(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	120.7431	86.5718	62.4999	22.6041	0.0000	0.0000	0.0000	4.6814	26.5951	67.0980	100.6130	120.0841	(64)
Efficiency of water heater	87.3446	87.5547	87.8698	88.7030	90.2000	76.4000	76.4000	76.4000	76.4000	86.5059	86.9745	87.3943	(216)
Fuel for water heating, kWh/month	136.2377	98.8775	71.1279	25.4829	0.0000	0.0000	0.0000	6.1274	34.8103	77.5646	115.6810	137.4050	(219)
Water heating fuel used												705.3144	(219)
Annual totals kWh/year													
Space heating fuel - main system												3143.6550	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:

(MEV)Decentralised, Database: total watage = 4.7035, total flow = 29.0000, SFP = 0.1622)		
mechanical ventilation fans (SFP = 0.1622)		36.2785 (230a)
central heating pump		30.0000 (230c)
main heating flue fan		45.0000 (230e)
pump for solar water heating		50.0000 (230g)
Total electricity for the above, kWh/year		161.2785 (231)
Electricity for lighting (calculated in Appendix L)		318.9325 (232)

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

PV Unit 0 (0.80 * 1.70 * 1029 * 1.00) =	-1399.6939	-1399.6939 (233)
Total delivered energy for all uses		2929.4865 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3143.6550	3.4800	109.3992	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	705.3144	3.4800	24.5449	(247)
Mechanical ventilation fans	36.2785	13.1900	4.7851	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	318.9325	13.1900	42.0672	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1399.6939	13.1900	-184.6196	(252)
Total energy cost			132.6643	(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] =	0.4789 (257)
SAP value		93.3189
SAP rating (Section 12)		93 (258)
SAP band		A

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

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3143.6550	0.2160	679.0295 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	705.3144	0.2160	152.3479 (264)
Space and water heating			831.3774 (265)
Pumps and fans	161.2785	0.5190	83.7035 (267)
Energy for lighting	318.9325	0.5190	165.5260 (268)
Energy saving/generation technologies			
PV Unit	-1399.6939	0.5190	-726.4412 (269)
Total kg/year			354.1658 (272)
CO2 emissions per m2			4.9600 (273)
EI value			95.9207
EI rating			96 (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	35.6700 (1b)	x 2.4700 (2b)	= 88.1049 (1b) - (3b)
First floor	35.6700 (1c)	x 2.6700 (2c)	= 95.2389 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.3400		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	183.3438 (5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour				
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000 (6a)				
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000 (6b)				
Number of intermittent fans							0 * 10 =	0.0000 (7a)				
Number of passive vents							0 * 10 =	0.0000 (7b)				
Number of flueless gas fires							0 * 40 =	0.0000 (7c)				
								Air changes per hour				
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(7a)+(7b)+(7c) =						0.0000 / (5) =	0.0000 (8)				
Pressure test							Yes					
Measured/design AP50							5.0000					
Infiltration rate							0.2500	(18)				
Number of sides sheltered							2	(19)				
Shelter factor							(20) = 1 - [0.075 x (19)] =	0.8500 (20)				
Infiltration rate adjusted to include shelter factor							(21) = (18) x (20) =	0.2125 (21)				
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	4.8000	4.5000	4.4000	3.9000	3.9000	3.6000	3.7000	3.5000	3.7000	4.0000	4.1000	4.4000 (22)
Wind factor	1.2000	1.1250	1.1000	0.9750	0.9750	0.9000	0.9250	0.8750	0.9250	1.0000	1.0250	1.1000 (22a)
Adj infilt rate												
	0.2550	0.2391	0.2338	0.2072	0.2072	0.1913	0.1966	0.1859	0.1966	0.2125	0.2178	0.2338 (22b)
Mechanical extract ventilation - decentralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5050	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Opening Type 2 (Uw = 1.40)			13.8100	1.3258	18.3087		(27)					
Opening Type 3			2.2100	1.4000	3.0940		(26)					
Heat Loss Floor 1			35.6700	0.1500	5.3505		(28a)					
Brick Faced	93.2400	16.0200	77.2200	0.2400	18.5328		(29a)					
Main Roof	35.6700		35.6700	0.1100	3.9237		(30)					
Total net area of external elements Aum(A, m2)			164.5800				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.2097		(33)					
Party Wall 1			44.3700	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)							15.1274 (36)					
Total fabric heat loss						(33) + (36) =	64.3371 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 30.5542	Feb 30.2517	Mar 30.2517	Apr 30.2517	May 30.2517	Jun 30.2517	Jul 30.2517	Aug 30.2517	Sep 30.2517	Oct 30.2517	Nov 30.2517	Dec 30.2517 (38)
Heat transfer coeff	94.8914	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888	94.5888 (39)
Average = Sum(39)m / 12 =												94.6140 (39)
HLP	Jan 1.3301	Feb 1.3259	Mar 1.3259	Apr 1.3259	May 1.3259	Jun 1.3259	Jul 1.3259	Aug 1.3259	Sep 1.3259	Oct 1.3259	Nov 1.3259	Dec 1.3259 (40)
HLP (average)												1.3262 (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												2.2782 (42)
Average daily hot water use (litres/day)												88.3075 (43)
Daily hot water use	Jan 97.1383	Feb 93.6060	Mar 90.0737	Apr 86.5414	May 83.0091	Jun 79.4768	Jul 79.4768	Aug 83.0091	Sep 86.5414	Oct 90.0737	Nov 93.6060	Dec 97.1383 (44)
Energy conte	144.0533	125.9899	130.0103	113.3461	108.7583	93.8502	86.9660	99.7947	100.9866	117.6901	128.4680	139.5079 (45)
Energy content (annual)										Total = Sum(45)m =		1389.4215 (45)
Distribution loss (46)m = 0.15 x (45)m	21.6080	18.8985	19.5015	17.0019	16.3137	14.0775	13.0449	14.9692	15.1480	17.6535	19.2702	20.9262 (46)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

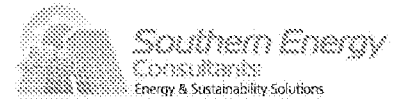
System) version 4.14r19

Southern Energy
Consultants
Energy & Sustainability Solutions

ARUN DISTRICT COUNCIL Y/47/22/DOC

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8888	0.8600	0.7984	0.6912	0.5517	0.3806	0.2396	0.2463	0.4854	0.7155	0.8451	0.8972	(94)
Useful gains	563.5807	616.6769	656.3464	662.2145	555.9191	392.5235	234.4496	224.7844	397.3915	501.6266	528.7586	534.0099	(95)
Ext temp.	5.0000	5.4000	7.1000	9.5000	12.6000	15.4000	17.4000	17.5000	15.0000	11.7000	8.1000	5.2000	(96)
Heat loss rate W	1228.9558	1209.3800	1094.5437	920.0950	667.3771	423.6384	240.8069	231.2779	454.4305	721.2311	990.9898	1204.3079	(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	495.0391	398.2965	326.0188	185.6739	82.9247	0.0000	0.0000	0.0000	0.0000	163.3857	332.8065	498.7017	(98)
Space heating												2482.8469	(98)
Space heating per m2											(98) / (4) =	34.8030	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)
Fraction of space heat from main system(s)													1.0000	(202)
Efficiency of main space heating system 1 (in %)													90.2000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													2752.6019	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	495.0391	398.2965	326.0188	185.6739	82.9247	0.0000	0.0000	0.0000	0.0000	163.3857	332.8065	498.7017	(98)	
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)	
Space heating fuel (main heating system)	548.8238	441.5703	361.4399	205.8469	91.9343	0.0000	0.0000	0.0000	0.0000	181.1372	368.9650	552.8844	(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	118.3176	87.3564	64.0183	19.8201	0.0000	0.0000	0.0000	0.0000	23.0933	64.6039	97.4189	118.7885	(64)	
Efficiency of water heater	87.1629	87.3616	87.6028	88.6555	90.2000	76.4000	76.4000	76.4000	76.4000	85.8081	86.6557	87.1710	(216)	
Fuel for water heating, kWh/month	135.7431	99.9940	73.0779	22.3563	0.0000	0.0000	0.0000	0.0000	30.2269	75.2888	112.4206	136.2707	(219)	
Water heating fuel used												685.3784	(219)	
Annual totals kWh/year														
Space heating fuel - main system												2752.6019	(211)	
Space heating fuel - secondary												0.0000	(215)	
Electricity for pumps and fans:														
(MEV)Decentralised, Database: total watage = 4.7035, total flow = 29.0000, SFP = 0.1622)														
mechanical ventilation fans (SFP = 0.1622)													36.2785	(230a)
central heating pump													30.0000	(230c)
main heating flue fan													45.0000	(230e)
pump for solar water heating													50.0000	(230g)
Total electricity for the above, kWh/year													161.2785	(231)
Electricity for lighting (calculated in Appendix L)													318.9325	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV Unit 0 (0.80 * 1.70 * 1154 * 1.00) =									-1568.8956			-1568.8956	(233)	
Total delivered energy for all uses												2349.2957	(238)	

10a. Fuel costs - using BEDF prices (491)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2752.6019	3.6300	99.9194	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	685.3784	3.6300	24.8792	(247)
Mechanical ventilation fans	36.2785	19.4400	7.0525	(249)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Pump for solar water heating	50.0000	19.4400	9.7200	(249)
Energy for lighting	318.9325	19.4400	62.0005	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-1568.8956	19.4400	-304.9933	(252)
Total energy cost			8.1584	(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	2752.6019	0.2160	594.5620	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	685.3784	0.2160	148.0417	(264)
Space and water heating			742.6037	(265)
Pumps and fans	161.2785	0.5190	83.7035	(267)
Energy for lighting	318.9325	0.5190	165.5260	(268)
Energy saving/generation technologies				
PV Unit	-1568.8956	0.5190	-814.2568	(269)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Total kg/year 177.5764 (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	2752.6019	1.2200	3358.1743 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	685.3784	1.2200	836.1616 (264)
Space and water heating			4194.3359 (265)
Pumps and fans	161.2785	3.0700	495.1250 (267)
Energy for lighting	318.9325	3.0700	979.1229 (268)
Energy saving/generation technologies			
PV Unit	-1568.8956	3.0700	-4816.5094 (269)
Primary energy kWh/year			852.0743 (272)
Primary energy kWh/m2/year			11.9439 (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	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	242.01 (P1)
Transmission heat loss coefficient	64.34 (37)
Summer heat loss coefficient	306.35 (P2)

Overhangs	Ratio	Z_overhangs	Overhang type
Orientation			
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

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

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific g or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	8.1800	124.7972	0.7200	0.7000	0.9000	416.7483
South	1.0800	118.3991	0.7200	0.7000	0.9000	52.2021
West	4.5500	124.7972	0.7200	0.7000	0.9000	231.8099

total: 700.7602

	Jun	Jul	Aug	
Solar gains	743	701	615	(P3)
Internal gains	393	376	384	
Total summer gains	1136	1077	999	(P5)
Summer gain/loss ratio	3.71	3.52	3.26	(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	22.06	(P7)
Likelihood of high internal temperature	Not significant	Medium	Medium	

Assessment of likelihood of high internal temperature: Medium

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	SECBIL012		Issued on Date	20/03/2022	
Assessment Reference	001 Test GAS & PV	Prop Type Ref	3B4P		
Property					

SAP Rating	92 A	BB1	9.12	TG1	18.31
Environmental	93 A	% DER-TERR	50.18		
CO ₂ Emissions (t/year)	0.49	DERE	48.98	TERR	53.90
General Requirements Compliance	Pass	% DERE-TERR	9.12		

Assessor Details	Mr. Stephen Smith, Southern Energy Consultants Limited, Tel: [REDACTED]	Assessor ID	d168-0001
Client	Thakeham Homes, THA001		

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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

DWELLING AS DESIGNED

Semi-Detached House, total floor area 88 m²

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

1a TER and DER

Fuel for main heating:Mains gas

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 18.31 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 9.12 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)53.9 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)49.0 kWh/m²/yrOK

2 Fabric U-values

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

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

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

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas

Data from database

Vaillant ecoFIT sustain 835 VUW 356/6-3 (H-GB)

Combi boiler

Efficiency: 89.3% SEDBUK2009

Minimum: 88.0% OK

Secondary heating system:

None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls:

No cylinder

Boiler interlock

Yes

OK

7 Low energy lights

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

Minimum 75% OK

8 Mechanical ventilation

Continuous extract system (decentralised)

Specific fan power: 0.1300 0.1500

Maximum 0.7 OK

9 Summertime temperature

Overheating risk (South East England): Slight OK

Based on:

Overshading: Average

Windows facing East: 8.18 m², No overhang

Windows facing South: 1.08 m², No overhang

Windows facing West: 4.55 m², No overhang

Air change rate: 4.00 ach

Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K

Roof U-value 0.11 W/m²K

Photovoltaic array 2.10 kW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.1700 (1b)	x 2.4700 (2b)	= 109.0999 (1b) - (3b)
First floor	44.1700 (1c)	x 2.6700 (2c)	= 117.9339 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.3400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	227.0338 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2500 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497 (22b)
Mechanical extract ventilation - decentralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.40)			13.8100	1.3258	18.3087		(27)
Opening Type 3			2.2100	1.4000	3.0940		(26)
Heat Loss Floor 1			44.1700	0.1500	6.6255		(28a)
Brick Faced	99.3000	16.0200	83.2800	0.2400	19.9872		(29a)
Main Roof	44.1700		44.1700	0.1100	4.8587		(30)
Total net area of external elements Aum(A, m ²)			187.6400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.8741		(33)
Party Wall 1			44.3700	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)							15.1274 (36)
Total fabric heat loss						(33) + (36) =	68.0015 (37)

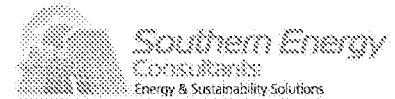
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	39.0292	38.6312	38.2332	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606 (38)
Heat transfer coeff	107.0308	106.6327	106.2347	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621 (39)
Average = Sum(39)m / 12 =												105.7547 (39)
HLP	1.2116	1.2071	1.2026	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938 (40)
HLP (average)												1.1971 (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												2.6023 (42)
Average daily hot water use (litres/day)												96.0049 (43)
Daily hot water use	105.6054	101.7652	97.9250	94.0848	90.2446	86.4044	86.4044	90.2446	94.0848	97.9250	101.7652	105.6054 (44)
Energy conte	156.6097	136.9718	141.3427	123.2260	118.2382	102.0306	94.5464	108.4933	109.7891	127.9486	139.6659	151.6681 (45)
Energy content (annual)										Total = Sum(45)m =		1510.5304 (45)
Distribution loss (46)m = 0.15 x (45)m	23.4915	20.5458	21.2014	18.4839	17.7357	15.3046	14.1820	16.2740	16.4684	19.1923	20.9499	22.7502 (46)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	0.6709	0.6078	0.6228	0.5217	0.4802	0.3967	0.3676	0.4406	0.4648	0.5638	0.6198	0.6497	(61)
Total heat required for water heating calculated for each month	157.2806	137.5796	141.9655	123.7477	118.7184	102.4273	94.9140	108.9339	110.2539	128.5124	140.2857	152.3178	(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	157.2806	137.5796	141.9655	123.7477	118.7184	102.4273	94.9140	108.9339	110.2539	128.5124	140.2857	152.3178	(64)
Heat gains from water heating, kWh/month	52.2404	45.6951	47.1521	41.1031	39.4343	34.0244	31.5286	36.1842	36.6211	42.6839	46.5938	50.5921	(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	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.0514	19.5858	15.9283	12.0587	9.0140	7.6100	8.2229	10.6884	14.3460	18.2155	21.2602	22.6642	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	235.9904	238.4392	232.2682	219.1309	202.5474	186.9612	176.5487	174.0998	180.2708	193.4082	209.9917	225.5779	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	(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)	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	(71)
Water heating gains (Table 5)	70.2156	67.9986	63.3765	57.0876	53.0030	47.2561	42.3771	48.6347	50.8626	57.3708	64.7137	68.0001	(72)
Total internal gains	393.2921	391.0584	376.6077	353.3119	329.5991	306.8619	292.1833	298.4576	310.5141	334.0292	361.0003	381.2769	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W				
East				8.1800	19.6403	0.7200	0.7000	0.7700	56.1131 (76)				
South				1.0800	46.7521	0.7200	0.7000	0.7700	17.6355 (78)				
West				4.5500	19.6403	0.7200	0.7000	0.7700	31.2121 (80)				
Solar gains	104.9607	199.7090	318.1181	451.8807	546.1674	556.4428	530.7995	460.5185	365.6276	233.8525	129.7883	87.0507	(83)
Total gains	498.2528	590.7674	694.7258	805.1925	875.7665	863.3047	822.9829	758.9761	676.1418	567.8817	490.7886	468.3276	(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	22.9270	23.0125	23.0987	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	
alpha	2.5285	2.5342	2.5399	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	
util living area	0.9711	0.9550	0.9227	0.8584	0.7578	0.6256	0.4983	0.5467	0.7443	0.9004	0.9584	0.9751	(86)
MIT	18.4188	18.7142	19.2137	19.8348	20.3682	20.7313	20.8925	20.8601	20.5528	19.8337	19.0167	18.3801	(87)
Th 2	19.9107	19.9143	19.9179	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	(88)
util rest of house	0.9666	0.9480	0.9104	0.8348	0.7150	0.5535	0.3969	0.4459	0.6832	0.8786	0.9507	0.9712	(89)
MIT 2	17.5559	17.8500	18.3429	18.9477	19.4443	19.7582	19.8772	19.8585	19.6214	18.9598	18.1600	17.5273	(90)
Living area fraction	17.7433	18.0376	18.5319	19.1403	19.6449	19.9695	20.0976	20.0760	19.8236	19.1495	18.3460	17.7125	(91)
MIT	17.7433	18.0376	18.5319	19.1403	19.6449	19.9695	20.0976	20.0760	19.8236	19.1495	18.3460	17.7125	(92)
Temperature adjustment	17.5933	17.8876	18.3819	18.9903	19.4949	19.8195	19.9476	19.9260	19.6736	18.9995	18.1960	17.5625	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9531	0.9304	0.8878	0.8099	0.6953	0.5457	0.3992	0.4460	0.6665	0.8546	0.9337	0.9590	(94)
Ext temp.	474.8708	549.6361	616.7686	652.1345	608.9396	471.1277	328.5648	338.4832	450.6574	485.2907	458.2542	449.1272	(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	1422.7903	1384.9034	1262.2754	1064.1405	822.0636	550.4569	353.0449	371.8578	587.8040	885.8340	1170.2057	1409.2328	(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	705.2521	561.2997	480.2571	296.6444	158.5642	0.0000	0.0000	0.0000	0.0000	298.0042	512.6051	714.3185	(98)
Space heating per m2													(98) / (4) =

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												90.2000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												4131.8684 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	705.2521	561.2997	480.2571	296.6444	158.5642	0.0000	0.0000	0.0000	0.0000	298.0042	512.6051	714.3185 (98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000 (210)
Space heating fuel (main heating system)	781.8760	622.2835	532.4358	328.8740	175.7918	0.0000	0.0000	0.0000	0.0000	330.3816	568.2983	791.9274 (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	157.2806	137.5796	141.9655	123.7477	118.7184	102.4273	94.9140	108.9339	110.2539	128.5124	140.2857	152.3178 (64)
Efficiency of water heater	87.3238	87.1028	86.6298	85.6462	83.7250	76.4000	76.4000	76.4000	76.4000	85.5443	86.8300	76.4000 (216)
(217)m	87.3238	87.1028	86.6298	85.6462	83.7250	76.4000	76.4000	76.4000	76.4000	85.5443	86.8300	87.4246 (217)
Fuel for water heating, kWh/month	180.1119	157.9509	163.8760	144.4871	141.7956	134.0672	124.2330	142.5837	144.3114	150.2291	161.5636	174.2278 (219)
Water heating fuel used												1819.4371 (219)
Annual totals kWh/year												
Space heating fuel - main system												4131.8684 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEV)Decentralised, Database: total watage = 4.7035, total flow = 29.0000, SFP = 0.1622)												
mechanical ventilation fans (SFP = 0.1622)												44.9235 (230a)
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												119.9235 (231)
Electricity for lighting (calculated in Appendix L)												389.4339 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 2.10 * 853 * 1.00) =												-1433.0903 (233)
Total delivered energv for all uses												5027.5727 (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	4131.8684	0.2160	892.4836 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1819.4371	0.2160	392.9984 (264)
Space and water heating			1285.4820 (265)
Pumps and fans	119.9235	0.5190	62.2403 (267)
Energy for lighting	389.4339	0.5190	202.1162 (268)
Energy saving/generation technologies			
PV Unit	-1433.0903	0.5190	-743.7738 (269)
Total CO2, kg/year			806.0646 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.1200 (273)

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

DER	9.1200 ZC1
Total Floor Area	88.3400
Assumed number of occupants	2.6023
CO2 emission factor in Table 12 for electricity displaced from grid	0.5190
CO2 emissions from appliances, equation (L14)	15.8301 ZC2
CO2 emissions from cooking, equation (L16)	2.0541 ZC3
Total CO2 emissions	27.0041 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	27.0041 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	44.1700 (1b)	x 2.4700 (2b)	= 109.0999 (1b) - (3b)
First floor	44.1700 (1c)	x 2.6700 (2c)	= 117.9339 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.3400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 227.0338 (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) = 0.1321 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3821 (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)	=	0.3248 (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	0.4141	0.4060	0.3979	0.3573	0.3492	0.3086	0.3086	0.3005	0.3248	0.3492	0.3654	0.3817 (22b)
Effective ac	0.5858	0.5824	0.5792	0.5638	0.5610	0.5476	0.5476	0.5451	0.5528	0.5610	0.5668	0.5728 (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
TER Opaque door			2.2100	1.0000	2.2100		(26)
TER Opening Type (Uw = 1.40)			13.8100	1.3258	18.3087		(27)
Heat Loss Floor 1			44.1700	0.1300	5.7421		(28a)
Brick Faced	99.3000	16.0200	83.2800	0.1800	14.9904		(29a)
Main Roof	44.1700		44.1700	0.1300	5.7421		(30)
Total net area of external elements Aum(A, m ²)			187.6400				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.9933		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.2686 (36)
Total fabric heat loss						(33) + (36) =	59.2619 (37)

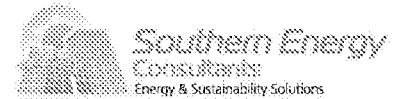
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	43.8856	43.6361	43.3916	42.2429	42.0280	41.0276	41.0276	40.8423	41.4129	42.0280	42.4628	42.9173 (38)
Average = Sum(39)m / 12 =	103.1475	102.8980	102.6535	101.5048	101.2899	100.2895	100.2895	100.1042	100.6748	101.2899	101.7247	102.1792 (39)
												101.5038 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1676	1.1648	1.1620	1.1490	1.1466	1.1353	1.1353	1.1332	1.1396	1.1466	1.1515	1.1567 (40)
Days in month												1.1490 (40)
	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6023 (42)
Average daily hot water use (litres/day)												96.0049 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	105.6054	101.7652	97.9250	94.0848	90.2446	86.4044	86.4044	90.2446	94.0848	97.9250	101.7652	105.6054 (44)
Energy content (annual)	156.6097	136.9718	141.3427	123.2260	118.2382	102.0306	94.5464	108.4933	109.7891	127.9486	139.6659	151.6681 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1510.5304 (45)
Water storage loss:	23.4915	20.5458	21.2014	18.4839	17.7357	15.3046	14.1820	16.2740	16.4684	19.1923	20.9499	22.7502 (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)
If cylinder contains dedicated solar storage												

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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 (57)
Combi loss	50.9589	46.0274	49.9015	46.3980	45.9876	42.6104	44.0307	45.9876	46.3980	49.9015	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
Solar input	207.5686	182.9992	191.2442	169.6239	164.2259	144.6410	138.5771	154.4810	156.1871	177.8501	188.9810	202.6270 (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)
Solar input (sum of months) = Sum (63)m =												0.0000 (63)
Output from w/h												
	207.5686	182.9992	191.2442	169.6239	164.2259	144.6410	138.5771	154.4810	156.1871	177.8501	188.9810	202.6270 (64)
Total per year (kWh/year) = Sum (64)m =												2079.0060 (64)
Heat gains from water heating, kWh/month												
	64.8124	57.0500	59.4718	52.5721	50.8111	44.5778	42.4443	47.5709	48.1044	55.0183	58.7677	63.1694 (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	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	22.0514	19.5858	15.9283	12.0587	9.0140	7.6100	8.2229	10.6884	14.3460	18.2155	21.2602	22.6642 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	235.9904	238.4392	232.2682	219.1309	202.5474	186.9612	176.5487	174.0998	180.2708	193.4082	209.9917	225.5779 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116 (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)												
	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924 (71)
Water heating gains (Table 5)												
	87.1135	84.8958	79.9352	73.0168	68.2945	61.9136	57.0489	63.9394	66.8116	73.9493	81.6218	84.9051 (72)
Total internal gains												
	410.1899	407.9555	393.1664	369.2411	344.8906	321.5195	306.8551	313.7624	326.4631	350.6077	377.9084	398.1818 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W
East	8.1800	19.6403	0.6300	0.7000	0.7700	49.0990 (76)
South	1.0800	46.7521	0.6300	0.7000	0.7700	15.4311 (78)
West	4.5500	19.6403	0.6300	0.7000	0.7700	27.3106 (80)
Solar gains						
	91.8406	174.7454	278.3534	395.3956	477.8965	486.8874
Total gains						
	502.0305	582.7009	671.5198	764.6367	822.7871	808.4069

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	59.4752	59.6194	59.7615	60.4377	60.5660	61.1701	61.1701	61.2834	60.9360	60.5660	60.3071	60.0389
alpha	4.9650	4.9746	4.9841	5.0292	5.0377	5.0780	5.0780	5.0856	5.0624	5.0377	5.0205	5.0026
util living area												
	0.9984	0.9964	0.9895	0.9631	0.8853	0.7267	0.5572	0.6165	0.8636	0.9808	0.9968	0.9988 (86)
MIT												
	19.7057	19.8591	20.1259	20.4771	20.7728	20.9421	20.9878	20.9802	20.8547	20.4587	20.0178	19.6803 (87)
Th 2												
	19.9460	19.9483	19.9505	19.9610	19.9630	19.9721	19.9721	19.9738	19.9686	19.9630	19.9590	19.9548 (88)
util rest of house												
	0.9979	0.9952	0.9857	0.9487	0.8414	0.6355	0.4347	0.4918	0.7954	0.9709	0.9954	0.9984 (89)
MIT 2												
	18.2187	18.4442	18.8336	19.3422	19.7376	19.9331	19.9676	19.9655	19.8489	19.3253	18.6843	18.1878 (90)
Living area fraction												
									fLA = Living area / (4) =			0.2171 (91)
MIT												
	18.5416	18.7514	19.1142	19.5886	19.9624	20.1521	20.1891	20.1858	20.0673	19.5713	18.9738	18.5118 (92)
Temperature adjustment												
												0.0000
adjusted MIT												
	18.5416	18.7514	19.1142	19.5886	19.9624	20.1521	20.1891	20.1858	20.0673	19.5713	18.9738	18.5118 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9968	0.9931	0.9814	0.9422	0.8414	0.6528	0.4614	0.5188	0.8030	0.9657	0.9935	0.9976 (94)
Useful gains	500.4283	578.6569	659.0214	720.4213	692.2805	527.7059	355.9054	371.8395	519.0773	536.2027	488.2670	473.2024 (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												
	1468.9816	1425.2805	1294.8926	1084.9469	836.8934	556.8218	359.9486	378.9776	600.7576	908.7068	1207.8613	1462.3732 (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												
	720.6037	568.9311	473.0882	262.4584	107.5920	0.0000	0.0000	0.0000	0.0000	277.1431	518.1079	735.9431 (98)
Space heating												
												3663.8675 (98)
Space heating per m2												(98) / (4) =
												41.4746 (99)

8c. Space cooling requirement

Not applicable

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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												3922.7704 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	720.6037	568.9311	473.0882	262.4584	107.5920	0.0000	0.0000	0.0000	0.0000	277.1431	518.1079	735.9431 (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)	771.5243	609.1339	506.5184	281.0048	115.1948	0.0000	0.0000	0.0000	0.0000	296.7271	554.7194	787.9476 (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	207.5686	182.9992	191.2442	169.6239	164.2259	144.6410	138.5771	154.4810	156.1871	177.8501	188.9810	202.6270 (64)
Efficiency of water heater (217)m	87.9268	87.7150	87.2411	86.1463	84.0155	80.3000	80.3000	80.3000	80.3000	86.1638	87.4599	88.0102 (217)
Fuel for water heating, kWh/month	236.0698	208.6294	219.2133	196.9021	195.4710	180.1258	172.5742	192.3798	194.5044	206.4094	216.0772	230.2314 (219)
Water heating fuel used												2448.5878 (219)
Annual totals kWh/year												
Space heating fuel - main system												3922.7704 (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)												389.4339 (232)
Total delivered energy for all uses												6835.7920 (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	3922.7704	0.2160	847.3184 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2448.5878	0.2160	528.8950 (264)
Space and water heating			1376.2134 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	389.4339	0.5190	202.1162 (268)
Total CO2, kg/m2/year			1617.2546 (272)
Emissions per m2 for space and water heating			15.5786 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.2879 (272b)
Emissions per m2 for pumps and fans			0.4406 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.5786 * 1.00) + 2.2879 + 0.4406, rounded to 2 d.p.			18.3100 (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	44.1700 (1b)	x 2.4700 (2b)	= 109.0999 (1b) - (3b)
First floor	44.1700 (1c)	x 2.6700 (2c)	= 117.9339 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.3400		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) = 227.0338 (5)
Dwelling volume			

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) = 0.1321 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3821 (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) =	0.3248 (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	0.4141	0.4060	0.3979	0.3573	0.3492	0.3086	0.3086	0.3005	0.3248	0.3492	0.3654	0.3817 (22b)
Effective ac	0.5858	0.5824	0.5792	0.5638	0.5610	0.5476	0.5476	0.5451	0.5528	0.5610	0.5668	0.5728 (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 2 (Uw = 1.40)			13.8100	1.3258	18.3087		(27)
Opening Type 3			2.2100	1.4000	3.0940		(26)
Heat Loss Floor 1			44.1700	0.1500	6.6255		(28a)
Brick Faced	99.3000	16.0200	83.2800	0.2400	19.9872		(29a)
Main Roof	44.1700		44.1700	0.1100	4.8587		(30)
Total net area of external elements Aum(A, m ²)			187.6400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.8741		(33)
Party Wall 1			44.3700	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)							15.1274 (36)
Total fabric heat loss						(33) + (36) =	68.0015 (37)

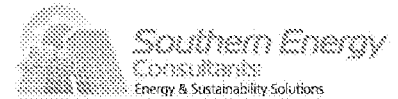
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	43.8856	43.6361	43.3916	42.2429	42.0280	41.0276	41.0276	40.8423	41.4129	42.0280	42.4628	42.9173 (38)
Heat transfer coeff	111.8871	111.6376	111.3931	110.2444	110.0295	109.0291	109.0291	108.8438	109.4144	110.0295	110.4643	110.9188 (39)
Average = Sum(39)m / 12 =												110.2434 (39)
HLP	1.2666	1.2637	1.2610	1.2480	1.2455	1.2342	1.2342	1.2321	1.2386	1.2455	1.2504	1.2556 (40)
HLP (average)												1.2479 (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												2.6023 (42)
Average daily hot water use (litres/day)												96.0049 (43)
Daily hot water use	105.6054	101.7652	97.9250	94.0848	90.2446	86.4044	86.4044	90.2446	94.0848	97.9250	101.7652	105.6054 (44)
Energy conte	156.6097	136.9718	141.3427	123.2260	118.2382	102.0306	94.5464	108.4933	109.7891	127.9486	139.6659	151.6681 (45)
Energy content (annual)												Total = Sum(45)m = 1510.5304 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	33.2796	29.1065	30.0353	26.1855	25.1256	21.6815	20.0911	23.0548	23.3302	27.1891	29.6790	32.2295 (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	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.0514	19.5858	15.9283	12.0587	9.0140	7.6100	8.2229	10.6884	14.3460	18.2155	21.2602	22.6642	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	235.9904	238.4392	232.2682	219.1309	202.5474	186.9612	176.5487	174.0998	180.2708	193.4082	209.9917	225.5779	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	(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)	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	(71)
Water heating gains (Table 5)	44.7306	43.3133	40.3700	36.3688	33.7710	30.1132	27.0042	30.9877	32.4030	36.5445	41.2208	43.3192	(72)
Total internal gains	364.8070	363.3730	350.6012	329.5930	307.3671	286.7191	273.8104	277.8106	289.0545	310.2028	334.5074	353.5960	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East	8.1800	19.6403	0.7200	0.7000	0.7700	56.1131 (76)
South	1.0800	46.7521	0.7200	0.7000	0.7700	17.6355 (78)
West	4.5500	19.6403	0.7200	0.7000	0.7700	31.2121 (80)

Solar gains	104.9607	199.7090	318.1181	451.8807	546.1674	556.4428	530.7995	460.5185	365.6276	233.8525	129.7883	87.0507	(83)
Total gains	469.7677	563.0820	668.7194	781.4737	853.5345	843.1618	804.6099	738.3291	654.6822	544.0554	464.2958	440.6466	(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	21.9318	21.9808	22.0291	22.2586	22.3021	22.5067	22.5067	22.5450	22.4275	22.3021	22.2143	22.1233	
alpha	2.4621	2.4654	2.4686	2.4839	2.4868	2.5004	2.5004	2.5030	2.4952	2.4868	2.4810	2.4749	
util living area	0.9748	0.9600	0.9303	0.8701	0.7746	0.6441	0.5172	0.5671	0.7628	0.9108	0.9635	0.9783	(86)
MIT	18.2580	18.5546	19.0659	19.7208	20.2911	20.6959	20.8751	20.8388	20.4985	19.7299	18.8735	18.2055	(87)
Th 2	19.8671	19.8694	19.8715	19.8818	19.8838	19.8927	19.8927	19.8944	19.8893	19.8838	19.8799	19.8758	(88)
util rest of house	0.9707	0.9536	0.9186	0.8473	0.7320	0.5705	0.4113	0.4625	0.7020	0.8902	0.9566	0.9748	(89)
MIT 2	17.3678	17.6625	18.1671	18.8088	19.3441	19.7040	19.8375	19.8180	19.5482	18.8322	17.9888	17.3215	(90)
Living area fraction									fLA = Living area / (4) =			0.2171	(91)
MIT	17.5610	17.8562	18.3622	19.0068	19.5497	19.9194	20.0628	20.0396	19.7545	19.0271	18.1809	17.5135	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.5610	17.8562	18.3622	19.0068	19.5497	19.9194	20.0628	20.0396	19.7545	19.0271	18.1809	17.5135	(93)

8. Space heating requirement

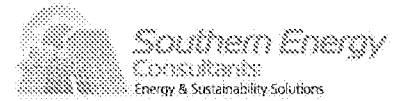
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	450.4941	528.1575	600.8457	645.1732	612.3387	482.6881	345.0333	352.5869	453.9782	473.3237	437.3613	424.9103	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(95)
Heat loss rate W	1483.7396	1446.3992	1321.3716	1114.2197	863.7028	579.9699	377.5463	396.1500	618.6848	927.2324	1224.0450	1476.7128	(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	768.7346	617.0584	536.0713	337.7134	187.0149	0.0000	0.0000	0.0000	0.0000	337.7081	566.4123	782.5411	(98)
Space heating												4133.2542	(98)
Space heating per m2												(98) / (4) =	46.7880 (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	1024.8734	806.8152	827.2130	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7340	0.7972	0.7659	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	752.2658	643.2132	633.5407	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1083.8349	1036.7443	961.0900	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	238.7297	292.7872	243.6967	0.0000	0.0000	0.0000	0.0000	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling											775.2136 (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	59.6824	73.1968	60.9242	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling											193.8034 (107)
Space cooling per m2											2.1938 (108)
Energy for space heating											46.7880 (99)
Energy for space cooling											2.1938 (108)
Total											48.9819 (109)
Dwelling Fabric Energy Efficiency (DFEE)											49.0 (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	44.1700 (1b)	x 2.4700 (2b)	= 109.0999 (1b) - (3b)
First floor	44.1700 (1c)	x 2.6700 (2c)	= 117.9339 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.3400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 227.0338 (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) = 0.1321 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3821 (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) =				0.3248 (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	0.4141	0.4060	0.3979	0.3573	0.3492	0.3086	0.3086	0.3005	0.3248	0.3492	0.3654	0.3817 (22b)
Effective ac	0.5858	0.5824	0.5792	0.5638	0.5610	0.5476	0.5476	0.5451	0.5528	0.5610	0.5668	0.5728 (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
TER Opaque door			2.2100	1.0000	2.2100		(26)
TER Opening Type (Uw = 1.40)			13.8100	1.3258	18.3087		(27)
Heat Loss Floor 1			44.1700	0.1300	5.7421		(28a)
Brick Faced	99.3000	16.0200	83.2800	0.1800	14.9904		(29a)
Main Roof	44.1700		44.1700	0.1300	5.7421		(30)
Total net area of external elements Aum(A, m ²)			187.6400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	46.9933		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.2686 (36)
Total fabric heat loss						(33) + (36) =	59.2619 (37)

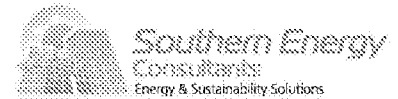
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	43.8856	43.6361	43.3916	42.2429	42.0280	41.0276	41.0276	40.8423	41.4129	42.0280	42.4628	42.9173 (38)
Average = Sum(39)m / 12 =	103.1475	102.8980	102.6535	101.5048	101.2899	100.2895	100.2895	100.1042	100.6748	101.2899	101.7247	102.1792 (39)
												101.5038 (39)
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1676	1.1648	1.1620	1.1490	1.1466	1.1353	1.1353	1.1332	1.1396	1.1466	1.1515	1.1567 (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												2.6023 (42)
Average daily hot water use (litres/day)												96.0049 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	105.6054	101.7652	97.9250	94.0848	90.2446	86.4044	86.4044	90.2446	94.0848	97.9250	101.7652	105.6054 (44)
Energy content (annual)	156.6097	136.9718	141.3427	123.2260	118.2382	102.0306	94.5464	108.4933	109.7891	127.9486	139.6659	151.6681 (45)
Distribution loss (46)m = 0.15 x (45)m												1510.5304 (45)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Heat gains from water heating, kWh/month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
	33.2796	29.1065	30.0353	26.1855	25.1256	21.6815	20.0911	23.0548	23.3302	27.1891	29.6790	32.2295 (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	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	130.1155	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.0514	19.5858	15.9283	12.0587	9.0140	7.6100	8.2229	10.6884	14.3460	18.2155	21.2602	22.6642	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	235.9904	238.4392	232.2682	219.1309	202.5474	186.9612	176.5487	174.0998	180.2708	193.4082	209.9917	225.5779	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	36.0116	(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)	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	(71)
Water heating gains (Table 5)	44.7306	43.3133	40.3700	36.3688	33.7710	30.1132	27.0042	30.9877	32.4030	36.5445	41.2208	43.3192	(72)
Total internal gains	364.8070	363.3730	350.6012	329.5930	307.3671	286.7191	273.8104	277.8106	289.0545	310.2028	334.5074	353.5960	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	8.1800	19.6403	0.6300	0.7000	0.7700	49.0990	(76)
South	1.0800	46.7521	0.6300	0.7000	0.7700	15.4311	(78)
West	4.5500	19.6403	0.6300	0.7000	0.7700	27.3106	(80)

Solar gains	91.8406	174.7454	278.3534	395.3956	477.8965	486.8874	464.4496	402.9537	319.9242	204.6210	113.5648	76.1694	(83)
Total gains	456.6476	538.1184	628.9546	724.9886	785.2636	773.6065	738.2600	680.7643	608.9787	514.8238	448.0722	429.7653	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	59.4752	59.6194	59.7615	60.4377	60.5660	61.1701	61.1701	61.2834	60.9360	60.5660	60.3071	60.0389	
alpha	4.9650	4.9746	4.9841	5.0292	5.0377	5.0780	5.0780	5.0856	5.0624	5.0377	5.0205	5.0026	
util living area	0.9990	0.9975	0.9921	0.9698	0.9002	0.7490	0.5793	0.6434	0.8848	0.9859	0.9979	0.9993	(86)
MIT	19.6580	19.8126	20.0829	20.4417	20.7499	20.9335	20.9855	20.9760	20.8340	20.4194	19.9724	19.6333	(87)
Th 2	19.9460	19.9483	19.9505	19.9610	19.9630	19.9721	19.9721	19.9738	19.9686	19.9630	19.9590	19.9548	(88)
util rest of house	0.9986	0.9966	0.9891	0.9577	0.8598	0.6586	0.4533	0.5159	0.8222	0.9784	0.9970	0.9990	(89)
MIT 2	18.7190	18.8751	19.1457	19.5055	19.7909	19.9409	19.9684	19.9668	19.8726	19.4899	19.0435	18.7014	(90)
Living area fraction									fLA = Living area / (4) =			0.2171	(91)
MIT	18.9229	19.0787	19.3492	19.7087	19.9991	20.1564	20.1892	20.1859	20.0813	19.6917	19.2452	18.9037	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9229	19.0787	19.3492	19.7087	19.9991	20.1564	20.1892	20.1859	20.0813	19.6917	19.2452	18.9037	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	455.8025	535.7344	620.6482	691.6333	676.4559	523.1450	355.0936	370.1949	505.6461	502.3235	446.3133	429.1793	(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	1508.3152	1458.9569	1319.0159	1097.1373	840.6132	557.2486	359.9614	378.9886	602.1689	920.9001	1235.4646	1502.4112	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	783.0695	620.4056	519.5856	291.9629	122.1331	0.0000	0.0000	0.0000	0.0000	311.4210	568.1889	798.4846	(98)
Space heating												4015.2511	(98)
Space heating per m2										(98) / (4) =		45.4522	(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	942.7211	742.1422	760.7920	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8601	0.9221	0.8951	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	810.7955	684.3481	680.9491	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1002.5364	959.1925	893.8065	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	138.0534	204.4842	158.3659	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												500.9035	(104)

Regs Region: England

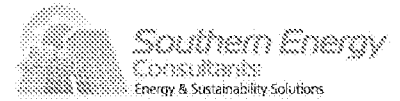
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction											FC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	34.5134	51.1211	39.5915	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												125.2259 (107)
Space cooling per m2												1.4175 (108)
Energy for space heating												45.4522 (99)
Energy for space cooling												1.4175 (108)
Total												46.8698 (109)
Target Fabric Energy Efficiency (TFEE)												53.9 (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	44.1700 (1b)	x 2.4700 (2b)	= 109.0999 (1b) - (3b)
First floor	44.1700 (1c)	x 2.6700 (2c)	= 117.9339 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.3400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 227.0338 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2500 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.8000	4.5000	4.4000	3.9000	3.9000	3.6000	3.7000	3.5000	3.7000	4.0000	4.1000	4.4000 (22)
Wind factor	1.2000	1.1250	1.1000	0.9750	0.9750	0.9000	0.9250	0.8750	0.9250	1.0000	1.0250	1.1000 (22a)
Adj infilt rate	0.2550	0.2391	0.2338	0.2072	0.2072	0.1913	0.1966	0.1859	0.1966	0.2125	0.2178	0.2338 (22b)
Mechanical extract ventilation - decentralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5050	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.40)			13.8100	1.3258	18.3087		(27)
Opening Type 3			2.2100	1.4000	3.0940		(26)
Heat Loss Floor 1			44.1700	0.1500	6.6255		(28a)
Brick Faced	99.3000	16.0200	83.2800	0.2400	19.9872		(29a)
Main Roof	44.1700		44.1700	0.1100	4.8587		(30)
Total net area of external elements Aum(A, m ²)			187.6400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.8741		(33)
Party Wall 1			44.3700	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)							15.1274 (36)
Total fabric heat loss						(33) + (36) =	68.0015 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	37.8352	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606 (38)
Heat transfer coeff	105.8367	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621 (39)
Average = Sum(39)m / 12 =												105.4933 (39)
HLP	1.1981	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938 (40)
HLP (average)												1.1942 (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												2.6023 (42)
Average daily hot water use (litres/day)												96.0049 (43)
Daily hot water use	105.6054	101.7652	97.9250	94.0848	90.2446	86.4044	86.4044	90.2446	94.0848	97.9250	101.7652	105.6054 (44)
Energy conte	156.6097	136.9718	141.3427	123.2260	118.2382	102.0306	94.5464	108.4933	109.7891	127.9486	139.6659	151.6681 (45)
Energy content (annual)										Total = Sum(45)m =		1510.5304 (45)
Distribution loss (46)m = 0.15 x (45)m	23.4915	20.5458	21.2014	18.4839	17.7357	15.3046	14.1820	16.2740	16.4684	19.1923	20.9499	22.7502 (46)

Regs Region: England

Elmhurst Energy Systems

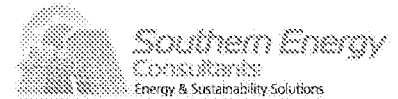
SAP2012 Calculator (Design

System) version 4.14r19



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	0.6709	0.6078	0.6228	0.5217	0.4802	0.3967	0.3676	0.4406	0.4648	0.5638	0.6198	0.6497	(61)
Total heat required for water heating calculated for each month	157.2806	137.5796	141.9655	123.7477	118.7184	102.4273	94.9140	108.9339	110.2539	128.5124	140.2857	152.3178	(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	157.2806	137.5796	141.9655	123.7477	118.7184	102.4273	94.9140	108.9339	110.2539	128.5124	140.2857	152.3178	(64)
RHI water heating demand	52.2404	45.6951	47.1521	41.1031	39.4343	34.0244	31.5286	36.1842	36.6211	42.6839	46.5938	50.5921	(65)
Heat gains from water heating, kWh/month													
	52.2404	45.6951	47.1521	41.1031	39.4343	34.0244	31.5286	36.1842	36.6211	42.6839	46.5938	50.5921	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.1284	48.9646	39.8207	30.1468	22.5351	19.0251	20.5573	26.7211	35.8650	45.5389	53.1506	56.6606	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	352.2245	355.8795	346.6690	327.0611	302.3095	279.0466	263.5055	259.8505	269.0610	288.6689	313.4204	336.6834	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	(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)	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	(71)
Water heating gains (Table 5)	70.2156	67.9986	63.3765	57.0876	53.0030	47.2561	42.3771	48.6347	50.8626	57.3708	64.7137	68.0001	(72)
Total internal gains	585.8309	581.1050	558.1286	522.5578	486.1100	453.5901	434.7022	443.4686	464.0509	499.8409	539.5471	569.6065	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d		Gains W	
East				8.1800	23.7288	0.7200	0.7000		0.7700		67.7943 (76)	
South				1.0800	53.5774	0.7200	0.7000		0.7700		20.2101 (78)	
West				4.5500	23.7288	0.7200	0.7000		0.7700		37.7095 (80)	
Solar gains	125.7139	212.7431	337.2671	503.6272	584.1603	635.6970	599.5393	525.8856	414.6074	266.3395	156.9966	100.8085 (83)
Total gains	711.5448	793.8482	895.3957	1026.1850	1070.2703	1089.2870	1034.2415	969.3542	878.6583	766.1804	696.5437	670.4149 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)														
tau	23.1856	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	
alpha	2.5457	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	
util living area	0.9331	0.9128	0.8661	0.7755	0.6477	0.4834	0.3485	0.3600	0.5934	0.8004	0.9025	0.9390	0.9390	(86)
MIT	18.9522	19.1661	19.6246	20.1693	20.6162	20.8725	20.9618	20.9599	20.7782	20.2678	19.5421	18.9346	18.9346	(87)
Th 2	19.9216	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	(88)
util rest of house	0.9233	0.9003	0.8465	0.7427	0.5943	0.4064	0.2514	0.2573	0.5164	0.7614	0.8856	0.9298	0.9298	(89)
MIT 2	18.0869	18.2971	18.7405	19.2530	19.6532	19.8562	19.9125	19.9123	19.7941	19.3591	18.6695	18.0731	18.0731	(90)
Living area fraction	18.2747	18.4858	18.9324	19.4520	19.8623	20.0769	20.1403	20.1398	20.0077	19.5564	18.8590	18.2601	18.2601	(92)
Temperature adjustment	18.1247	18.3358	18.7824	19.3020	19.7123	19.9269	19.9903	19.9898	19.8577	19.4064	18.7090	-0.1500	-0.1500	(93)
adjusted MIT														

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	641.8256	696.1826	735.5644	739.9134	623.7158	442.8757	266.3859	255.6707	449.0583	566.4022	600.1634	609.6728	(94)
Ext temp.	5.0000	5.4000	7.1000	9.5000	12.6000	15.4000	17.4000	17.5000	15.0000	11.7000	8.1000	5.2000	(96)
Heat loss rate W	1389.0790	1364.2319	1232.0536	1033.7355	750.0767	477.4141	273.1789	262.5758	512.3079	812.7336	1118.8437	1361.5305	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	555.9565	448.9292	369.3880	211.5519	94.0125	0.0000	0.0000	0.0000	0.0000	183.2706	373.4498	559.3821	(98)
Space heating													
RHI space heating demand													

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	44.1700 (1b)	x 2.4700 (2b)	= 109.0999 (1b) - (3b)
First floor	44.1700 (1c)	x 2.6700 (2c)	= 117.9339 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.3400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 227.0338 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2500 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497 (22b)
Mechanical extract ventilation - decentralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.40)			13.8100	1.3258	18.3087		(27)
Opening Type 3			2.2100	1.4000	3.0940		(26)
Heat Loss Floor 1			44.1700	0.1500	6.6255		(28a)
Brick Faced	99.3000	16.0200	83.2800	0.2400	19.9872		(29a)
Main Roof	44.1700		44.1700	0.1100	4.8587		(30)
Total net area of external elements Aum(A, m ²)			187.6400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.8741		(33)
Party Wall 1			44.3700	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)							15.1274 (36)
Total fabric heat loss						(33) + (36) =	68.0015 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	39.0292	38.6312	38.2332	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606 (38)
Heat transfer coeff	107.0308	106.6327	106.2347	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621 (39)
Average = Sum(39)m / 12 =												105.7547 (39)
HLP	1.2116	1.2071	1.2026	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938 (40)
HLP (average)												1.1971 (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												2.6023 (42)
Average daily hot water use (litres/day)												96.0049 (43)
Daily hot water use	105.6054	101.7652	97.9250	94.0848	90.2446	86.4044	86.4044	90.2446	94.0848	97.9250	101.7652	105.6054 (44)
Energy conte	156.6097	136.9718	141.3427	123.2260	118.2382	102.0306	94.5464	108.4933	109.7891	127.9486	139.6659	151.6681 (45)
Energy content (annual)										Total = Sum(45)m =		1510.5304 (45)
Distribution loss (46)m = 0.15 x (45)m	23.4915	20.5458	21.2014	18.4839	17.7357	15.3046	14.1820	16.2740	16.4684	19.1923	20.9499	22.7502 (46)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	0.6709	0.6078	0.6228	0.5217	0.4802	0.3967	0.3676	0.4406	0.4648	0.5638	0.6198	0.6497	(61)
Total heat required for water heating calculated for each month	157.2806	137.5796	141.9655	123.7477	118.7184	102.4273	94.9140	108.9339	110.2539	128.5124	140.2857	152.3178	(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	157.2806	137.5796	141.9655	123.7477	118.7184	102.4273	94.9140	108.9339	110.2539	128.5124	140.2857	152.3178	(64)
Heat gains from water heating, kWh/month	52.2404	45.6951	47.1521	41.1031	39.4343	34.0244	31.5286	36.1842	36.6211	42.6839	46.5938	50.5921	(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	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.1284	48.9646	39.8207	30.1468	22.5351	19.0251	20.5573	26.7211	35.8650	45.5389	53.1506	56.6606	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	352.2245	355.8795	346.6690	327.0611	302.3095	279.0466	263.5055	259.8505	269.0610	288.6689	313.4204	336.6834	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	(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)	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	(71)
Water heating gains (Table 5)	70.2156	67.9986	63.3765	57.0876	53.0030	47.2561	42.3771	48.6347	50.8626	57.3708	64.7137	68.0001	(72)
Total internal gains	585.8309	581.1050	558.1286	522.5578	486.1100	453.5901	434.7022	443.4686	464.0509	499.8409	539.5471	569.6065	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W		
East					8.1800	19.6403	0.7200	0.7000	0.7700		56.1131 (76)		
South					1.0800	46.7521	0.7200	0.7000	0.7700		17.6355 (78)		
West					4.5500	19.6403	0.7200	0.7000	0.7700		31.2121 (80)		
Solar gains	104.9607	199.7090	318.1181	451.8807	546.1674	556.4428	530.7995	460.5185	365.6276	233.8525	129.7883	87.0507	(83)
Total gains	690.7916	780.8140	876.2467	974.4385	1032.2774	1010.0328	965.5018	903.9871	829.6786	733.6935	669.3354	656.6572	(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	22.9270	23.0125	23.0987	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	
alpha	2.5285	2.5342	2.5399	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	
util living area	0.9425	0.9211	0.8810	0.8072	0.6998	0.5641	0.4390	0.4796	0.6699	0.8439	0.9216	0.9485	(86)
MIT	18.7499	19.0216	19.4737	20.0248	20.4852	20.7904	20.9200	20.8972	20.6575	20.0484	19.3086	18.7111	(87)
Th 2	19.9107	19.9143	19.9179	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	(88)
util rest of house	0.9342	0.9098	0.8637	0.7786	0.6535	0.4929	0.3452	0.3850	0.6043	0.8140	0.9085	0.9410	(89)
MIT 2	17.8802	18.1481	18.5899	19.1200	19.5408	19.7981	19.8904	19.8778	19.7000	19.1556	18.4419	17.8521	(90)
Living area fraction									fLA = Living area / (4) =			0.2171	(91)
MIT	18.0690	18.3378	18.7818	19.3165	19.7459	20.0135	20.1140	20.0991	19.9079	19.3494	18.6301	18.0386	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.9190	18.1878	18.6318	19.1665	19.5959	19.8635	19.9640	19.9491	19.7579	19.1994	18.4801	17.8886	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	631.5350	692.6551	734.9028	735.8370	658.3499	493.4469	336.8087	350.1133	491.9309	579.4075	592.9990	605.5655	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1457.6521	1416.9121	1288.8162	1082.7251	832.7165	555.1008	354.7709	374.2950	596.6946	906.9156	1200.1688	1443.6330	(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	614.6311	486.7007	412.1116	249.7595	129.7287	0.0000	0.0000	0.0000	0.0000	243.6660	437.1622	623.5222	(98)
Space heating												3197.2821	(98)
Space heating per m2												(98) / (4) =	36.1929 (99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3544.6586	(211)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec		
Space heating requirement	614.6311 486.7007 412.1116 249.7595 129.7287 0.0000 0.0000 0.0000 0.0000 243.6660 437.1622 623.5222	(98)
Space heating efficiency (main heating system 1)	90.2000 90.2000 90.2000 90.2000 90.2000 0.0000 0.0000 0.0000 0.0000 90.2000 90.2000 90.2000	(210)
Space heating fuel (main heating system)	681.4093 539.5795 456.8865 276.8952 143.8234 0.0000 0.0000 0.0000 0.0000 270.1397 484.6588 691.2663	(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	157.2806 137.5796 141.9655 123.7477 118.7184 102.4273 94.9140 108.9339 110.2539 128.5124 140.2857 152.3178	(64)
Efficiency of water heater	86.9981 86.7469 86.2101 85.1068 83.0333 76.4000 76.4000 76.4000 76.4000 84.9045 86.4082 87.1109	(216)
Fuel for water heating, kWh/month	180.7861 158.5990 164.6738 145.4028 142.9769 134.0672 124.2330 142.5837 144.3114 151.3612 162.3522 174.8551	(219)
Water heating fuel used		1826.2023 (219)
Annual totals kWh/year		
Space heating fuel - main system		3544.6586 (211)
Space heating fuel - secondary		0.0000 (215)
Electricity for pumps and fans:		
(MEV)Decentralised, Database: total watage = 4.7035, total flow = 29.0000, SFP = 0.1622)		
mechanical ventilation fans (SFP = 0.1622)		44.9235 (230a)
central heating pump		30.0000 (230c)
main heating flue fan		45.0000 (230e)
Total electricity for the above, kWh/year		119.9235 (231)
Electricity for lighting (calculated in Appendix L)		389.4339 (232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.10 * 853 * 1.00) =	-1433.0903	-1433.0903 (233)
Total delivered energy for all uses		4447.1281 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3544.6586	3.4800	123.3541 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1826.2023	3.4800	63.5518 (247)
Mechanical ventilation fans	44.9235	13.1900	5.9254 (249)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	389.4339	13.1900	51.3663 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-1433.0903	13.1900	-189.0246 (252)
Total energy cost			185.0656 (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] =	0.5829 (257)
SAP value	91.8682	
SAP rating (Section 12)	92	(258)
SAP band	A	

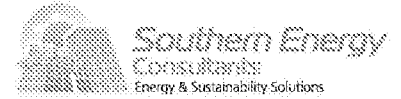
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3544.6586	0.2160	765.6463 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1826.2023	0.2160	394.4597 (264)
Space and water heating			1160.1060 (265)
Pumps and fans	119.9235	0.5190	62.2403 (267)
Energy for lighting	389.4339	0.5190	202.1162 (268)
Energy saving/generation technologies			
PV Unit	-1433.0903	0.5190	-743.7738 (269)
Total kg/year			680.6886 (272)
CO2 emissions per m2			7.7100 (273)
EI value			93.1594
EI rating			93
EI band			A

Calculation of stars for heating and DHW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9020 = 3.858$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9020 = 0.2395$, stars = 4
Water heating energy efficiency	$3.48 / 0.8268 = 4.209$, stars = 4
Water heating environmental impact	$0.216 / 0.8268 = 0.2613$, 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	44.1700 (1b)	x 2.4700 (2b)	= 109.0999 (1b) - (3b)
First floor	44.1700 (1c)	x 2.6700 (2c)	= 117.9339 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.3400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 227.0338 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2500 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.8000	4.5000	4.4000	3.9000	3.9000	3.6000	3.7000	3.5000	3.7000	4.0000	4.1000	4.4000 (22)
Wind factor	1.2000	1.1250	1.1000	0.9750	0.9750	0.9000	0.9250	0.8750	0.9250	1.0000	1.0250	1.1000 (22a)
Adj infilt rate	0.2550	0.2391	0.2338	0.2072	0.2072	0.1913	0.1966	0.1859	0.1966	0.2125	0.2178	0.2338 (22b)
Mechanical extract ventilation - decentralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5050	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.40)			13.8100	1.3258	18.3087		(27)
Opening Type 3			2.2100	1.4000	3.0940		(26)
Heat Loss Floor 1			44.1700	0.1500	6.6255		(28a)
Brick Faced	99.3000	16.0200	83.2800	0.2400	19.9872		(29a)
Main Roof	44.1700		44.1700	0.1100	4.8587		(30)
Total net area of external elements Aum(A, m ²)			187.6400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.8741		(33)
Party Wall 1			44.3700	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)							15.1274 (36)
Total fabric heat loss						(33) + (36) =	68.0015 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	37.8352	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606 (38)
Heat transfer coeff	105.8367	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621 (39)
Average = Sum(39)m / 12 =												105.4933 (39)
HLP	1.1981	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938 (40)
HLP (average)												1.1942 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

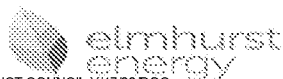
Assumed occupancy												2.6023 (42)
Average daily hot water use (litres/day)												96.0049 (43)
Daily hot water use	105.6054	101.7652	97.9250	94.0848	90.2446	86.4044	86.4044	90.2446	94.0848	97.9250	101.7652	105.6054 (44)
Energy conte	156.6097	136.9718	141.3427	123.2260	118.2382	102.0306	94.5464	108.4933	109.7891	127.9486	139.6659	151.6681 (45)
Energy content (annual)										Total = Sum(45)m =		1510.5304 (45)
Distribution loss (46)m = 0.15 x (45)m	23.4915	20.5458	21.2014	18.4839	17.7357	15.3046	14.1820	16.2740	16.4684	19.1923	20.9499	22.7502 (46)

Regs Region: England

Elmhurst Energy Systems

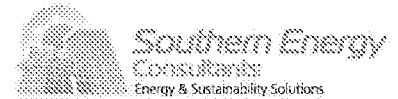
SAP2012 Calculator (Design

System) version 4.14r19



FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	0.6709	0.6078	0.6228	0.5217	0.4802	0.3967	0.3676	0.4406	0.4648	0.5638	0.6198	0.6497	(61)
Total heat required for water heating calculated for each month	157.2806	137.5796	141.9655	123.7477	118.7184	102.4273	94.9140	108.9339	110.2539	128.5124	140.2857	152.3178	(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	157.2806	137.5796	141.9655	123.7477	118.7184	102.4273	94.9140	108.9339	110.2539	128.5124	140.2857	152.3178	(64)
Heat gains from water heating, kWh/month	52.2404	45.6951	47.1521	41.1031	39.4343	34.0244	31.5286	36.1842	36.6211	42.6839	46.5938	50.5921	(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	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.1284	48.9646	39.8207	30.1468	22.5351	19.0251	20.5573	26.7211	35.8650	45.5389	53.1506	56.6606	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	352.2245	355.8795	346.6690	327.0611	302.3095	279.0466	263.5055	259.8505	269.0610	288.6689	313.4204	336.6834	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	(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)	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	(71)
Water heating gains (Table 5)	70.2156	67.9986	63.3765	57.0876	53.0030	47.2561	42.3771	48.6347	50.8626	57.3708	64.7137	68.0001	(72)
Total internal gains	585.8309	581.1050	558.1286	522.5578	486.1100	453.5901	434.7022	443.4686	464.0509	499.8409	539.5471	569.6065	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c	Access factor Table 6d		Gains W	
East				8.1800	23.7288	0.7200		0.7000	0.7700		67.7943 (76)	
South				1.0800	53.5774	0.7200		0.7000	0.7700		20.2101 (78)	
West				4.5500	23.7288	0.7200		0.7000	0.7700		37.7095 (80)	
Solar gains	125.7139	212.7431	337.2671	503.6272	584.1603	635.6970	599.5393	525.8856	414.6074	266.3395	156.9966	100.8085 (83)
Total gains	711.5448	793.8482	895.3957	1026.1850	1070.2703	1089.2870	1034.2415	969.3542	878.6583	766.1804	696.5437	670.4149 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	23.1856	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	
alpha	2.5457	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	
util living area	0.9331	0.9128	0.8661	0.7755	0.6477	0.4834	0.3485	0.3600	0.5934	0.8004	0.9025	0.9390	(86)
MIT	18.9522	19.1661	19.6246	20.1693	20.6162	20.8725	20.9618	20.9599	20.7782	20.2678	19.5421	18.9346	(87)
Th 2	19.9216	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	(88)
util rest of house	0.9233	0.9003	0.8465	0.7427	0.5943	0.4064	0.2514	0.2573	0.5164	0.7614	0.8856	0.9298	(89)
MIT 2	18.0869	18.2971	18.7405	19.2530	19.6532	19.8562	19.9125	19.9123	19.7941	19.3591	18.6695	18.0731	(90)
Living area fraction									fLA = Living area / (4) =			0.2171	(91)
MIT	18.2747	18.4858	18.9324	19.4520	19.8623	20.0769	20.1403	20.1398	20.0077	19.5564	18.8590	18.2601	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1247	18.3358	18.7824	19.3020	19.7123	19.9269	19.9903	19.9898	19.8577	19.4064	18.7090	18.1101	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9020	0.8770	0.8215	0.7210	0.5828	0.4066	0.2576	0.2638	0.5111	0.7393	0.8616	0.9094	(94)
Ext temp.	641.8256	696.1826	735.5644	739.9134	623.7158	442.8757	266.3859	255.6707	449.0583	566.4022	600.1634	609.6728	(95)
Heat loss rate W	5.0000	5.4000	7.1000	9.5000	12.6000	15.4000	17.4000	17.5000	15.0000	11.7000	8.1000	5.2000	(96)
Month fracti	1389.0790	1364.2319	1232.0536	1033.7355	750.0767	477.4141	273.1789	262.5758	512.3079	812.7336	1118.8437	1361.5305	(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	555.9565	448.9292	369.3880	211.5519	94.0125	0.0000	0.0000	0.0000	0.0000	183.2706	373.4498	559.3821	(98)
Space heating per m2													(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 %)												90.2000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												3099.7125 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	555.9565	448.9292	369.3880	211.5519	94.0125	0.0000	0.0000	0.0000	0.0000	183.2706	373.4498	559.3821 (98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000 (210)
Space heating fuel (main heating system)	616.3598	497.7042	409.5210	234.5365	104.2268	0.0000	0.0000	0.0000	0.0000	203.1825	414.0242	620.1576 (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	157.2806	137.5796	141.9655	123.7477	118.7184	102.4273	94.9140	108.9339	110.2539	128.5124	140.2857	152.3178 (64)
Efficiency of water heater (217)m	86.7448	86.5335	85.8927	84.5627	81.9402	76.4000	76.4000	76.4000	76.4000	83.9497	85.9601	76.4000 (216)
Fuel for water heating, kWh/month	181.3141	158.9900	165.2824	146.3383	144.8842	134.0672	124.2330	142.5837	144.3114	153.0826	163.1986	175.3948 (219)
Water heating fuel used												1833.6802 (219)
Annual totals kWh/year												
Space heating fuel - main system												3099.7125 (211)
Space heating fuel - secondary												0.0000 (215)
Electricity for pumps and fans:												
(MEV)Decentralised, Database: total watage = 4.7035, total flow = 29.0000, SFP = 0.1622)												
mechanical ventilation fans (SFP = 0.1622)												44.9235 (230a)
central heating pump												30.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												119.9235 (231)
Electricity for lighting (calculated in Appendix L)												389.4339 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 2.10 * 966 * 1.00) =										-1622.2204		-1622.2204 (233)
Total delivered energy for all uses												3820.5297 (238)

10a. Fuel costs - using BEDF prices (491)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3099.7125	3.6300	112.5196 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1833.6802	3.6300	66.5626 (247)
Mechanical ventilation fans	44.9235	19.4400	8.7331 (249)
Pumps and fans for heating	75.0000	19.4400	14.5800 (249)
Energy for lighting	389.4339	19.4400	75.7060 (250)
Additional standing charges			95.0000 (251)
Energy saving/generation technologies			
PV Unit	-1622.2204	19.4400	-315.3596 (252)
Total energy cost			57.7416 (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	3099.7125	0.2160	669.5379 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1833.6802	0.2160	396.0749 (264)
Space and water heating			1065.6128 (265)
Pumps and fans	119.9235	0.5190	62.2403 (267)
Energy for lighting	389.4339	0.5190	202.1162 (268)
Energy saving/generation technologies			
PV Unit	-1622.2204	0.5190	-841.9324 (269)
Total kg/year			488.0369 (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	3099.7125	1.2200	3781.6492 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1833.6802	1.2200	2237.0898 (264)
Space and water heating			6018.7390 (265)
Pumps and fans	119.9235	3.0700	368.1651 (267)
Energy for lighting	389.4339	3.0700	1195.5621 (268)
Energy saving/generation technologies			
PV Unit	-1622.2204	3.0700	-4980.2165 (269)
Primary energy kWh/year			2602.2497 (272)
Primary energy kWh/m2/year			29.4572 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92
Current environmental impact rating: A 93

(For testing purposes):

A	Not considered
B	Not considered
C	Not considered
D	Not considered
E Low energy lighting	Already installed
F	Not considered
G	Not considered
H	Not considered
I	Not considered
J	Not considered
K	Not considered
M	Not considered
N Solar water heating	Recommended
O	Not considered
P	Not considered
R	Not considered
S	Not considered
T	Not considered
U Solar photovoltaic panels	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	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	-£ 29	-203 kg (41.5%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£29	2.29 kg/m²	A 93 A 95
Total Savings	£29	2.29 kg/m²	
Potential energy efficiency rating:		A 93	
Potential environmental impact rating:			A 95

Fuel prices for cost data on this page from database revision number 491 TEST (28 Feb 2022)
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	£99	£109	-£10
Mains gas	£274	£236	£38
Space heating	£231	£231	£0
Water heating	£67	£38	£29
Lighting	£76	£76	£0
Generated (PV)	-£315	-£315	£0
Total cost of fuels	£58	£30	£28
Total cost of uses	£59	£30	£29
Delivered energy	43 kWh/m²	32 kWh/m²	11 kWh/m²
Carbon dioxide emissions	0.5 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m²	6 kg/m²	3 kg/m²	2 kg/m²
Primary energy	29 kWh/m²	17 kWh/m²	13 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	44.1700 (1b)	x 2.4700 (2b)	= 109.0999 (1b) - (3b)
First floor	44.1700 (1c)	x 2.6700 (2c)	= 117.9339 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.3400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 227.0338 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2500 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497 (22b)
Mechanical extract ventilation - decentralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.40)			13.8100	1.3258	18.3087		(27)
Opening Type 3			2.2100	1.4000	3.0940		(26)
Heat Loss Floor 1			44.1700	0.1500	6.6255		(28a)
Brick Faced	99.3000	16.0200	83.2800	0.2400	19.9872		(29a)
Main Roof	44.1700		44.1700	0.1100	4.8587		(30)
Total net area of external elements Aum(A, m ²)			187.6400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.8741		(33)
Party Wall 1			44.3700	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)							15.1274 (36)
Total fabric heat loss						(33) + (36) =	68.0015 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	39.0292	38.6312	38.2332	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606 (38)
Heat transfer coeff	107.0308	106.6327	106.2347	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621 (39)
Average = Sum(39)m / 12 =												105.7547 (39)
HLP	1.2116	1.2071	1.2026	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938 (40)
HLP (average)												1.1971 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

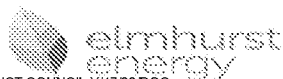
Assumed occupancy												2.6023 (42)
Average daily hot water use (litres/day)												96.0049 (43)
Daily hot water use	105.6054	101.7652	97.9250	94.0848	90.2446	86.4044	86.4044	90.2446	94.0848	97.9250	101.7652	105.6054 (44)
Energy conte	156.6097	136.9718	141.3427	123.2260	118.2382	102.0306	94.5464	108.4933	109.7891	127.9486	139.6659	151.6681 (45)
Energy content (annual)										Total = Sum(45)m =		1510.5304 (45)
Distribution loss (46)m = 0.15 x (45)m	23.4915	20.5458	21.2014	18.4839	17.7357	15.3046	14.1820	16.2740	16.4684	19.1923	20.9499	22.7502 (46)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19



Southern Energy
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Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	(57)
Combi loss	0.6709	0.6078	0.6228	0.5217	0.4802	0.3967	0.3676	0.4406	0.4648	0.5638	0.6198	0.6497 (61)
Total heat required for water heating calculated for each month												
	157.2806	137.5796	141.9655	123.7477	118.7184	102.4273	94.9140	108.9339	110.2539	128.5124	140.2857	152.3178 (62)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.7000 (H2)
Collector heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0050 (H3a)
Collector effective heat loss coefficient												1.8063 (H3b)
Collector performance ratio												2.5804 (H4)
Annual solar radiation per m ²												1079.5246 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												1813.6014 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.2006 (H8)
Utilisation factor												0.5652 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												96.0049 (H14)
Volume ratio Veff/V												0.7812 (H15)
Solar storage volume factor												0.9506 (H16)
Solar input												-856.8223 (H17)
Solar input	-24.8461	-41.4611	-70.6129	-94.6352	-116.9139	-114.9450	-113.4259	-99.1008	-77.6158	-53.0025	-29.4711	-20.7920 (63)
								Solar input (sum of months) = Sum(63)m = -856.8223 (63)				
Output from w/h	132.4344	96.1186	71.3526	29.1124	1.8045	0.0000	0.0000	9.8331	32.6381	75.5100	110.8146	131.5259 (64)
								Total per year (kWh/year) = Sum(64)m = 691.1441 (64)				
Heat gains from water heating, kWh/month	52.2404	45.6951	47.1521	41.1031	39.4343	34.0244	31.5286	36.1842	36.6211	42.6839	46.5938	50.5921 (65)

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
((66)m	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386 ((66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.1284	48.9646	39.8207	30.1468	22.5351	19.0251	20.5573	26.7211	35.8650	45.5389	53.1506	56.6606 ((67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	352.2245	355.8795	346.6690	327.0611	302.3095	279.0466	263.5055	259.8505	269.0610	288.6689	313.4204	336.6834 ((68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162 ((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)	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924 ((71)
Water heating gains (Table 5)	70.2156	67.9986	63.3765	57.0876	53.0030	47.2561	42.3771	48.6347	50.8626	57.3708	64.7137	68.0001 ((72)
Total internal gains	585.8309	581.1050	558.1286	522.5578	486.1100	453.5901	434.7022	443.4686	464.0509	499.8409	539.5471	569.6065 ((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			
East				8.1800	19.6403	0.7200	0.7000	0.7700	56.1131 (76)			
South				1.0800	46.7521	0.7200	0.7000	0.7700	17.6355 (78)			
West				4.5500	19.6403	0.7200	0.7000	0.7700	31.2121 (80)			
Solar gains	104.9607	199.7090	318.1181	451.8807	546.1674	556.4428	530.7995	460.5185	365.6276	233.8525	129.7883	87.0507 (83)
Total gains	690.7916	780.8140	876.2467	974.4385	1032.2774	1010.0328	965.5018	903.9871	829.6786	733.6935	669.3354	656.6572 (84)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	22.9270	23.0125	23.0987	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680
alpha	2.5285	2.5342	2.5399	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512
util living area												
	0.9425	0.9211	0.8810	0.8072	0.6998	0.5641	0.4390	0.4796	0.6699	0.8439	0.9216	0.9485 (86)
MIT	18.7499	19.0216	19.4737	20.0248	20.4852	20.7904	20.9200	20.8972	20.6575	20.0484	19.3086	18.7111 (87)
Th 2	19.9107	19.9143	19.9179	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249 (88)
util rest of house												
	0.9342	0.9098	0.8637	0.7786	0.6535	0.4929	0.3452	0.3850	0.6043	0.8140	0.9085	0.9410 (89)
MIT 2	17.8802	18.1481	18.5899	19.1200	19.5408	19.7981	19.8904	19.8778	19.7000	19.1556	18.4419	17.8521 (90)
Living area fraction												
MIT	18.0690	18.3378	18.7818	19.3165	19.7459	20.0135	20.1140	20.0991	19.9079	19.3494	18.6301	18.0386 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.9190	18.1878	18.6318	19.1665	19.5959	19.8635	19.9640	19.9491	19.7579	19.1994	18.4801	17.8886 (93)

 elmhurst
energy

ARUN DISTRICT COUNCIL Y/47/22/DOC

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9142	0.8871	0.8387	0.7551	0.6378	0.4885	0.3488	0.3873	0.5929	0.7897	0.8860	0.9222	(94)
Useful gains	631.5350	692.6551	734.9028	735.8370	658.3499	493.4469	336.8087	350.1133	491.9309	579.4075	592.9990	605.5655	(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	1457.6521	1416.9121	1288.8162	1082.7251	832.7165	555.1008	354.7709	374.2950	596.6946	906.9156	1200.1688	1443.6330	(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	614.6311	486.7007	412.1116	249.7595	129.7287	0.0000	0.0000	0.0000	0.0000	243.6660	437.1622	623.5222	(98)
Space heating												3197.2821	(98)
Space heating per m2											(98) / (4) =	36.1929	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3544.6586	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	614.6311	486.7007	412.1116	249.7595	129.7287	0.0000	0.0000	0.0000	0.0000	243.6660	437.1622	623.5222	(98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)	681.4093	539.5795	456.8865	276.8952	143.8234	0.0000	0.0000	0.0000	0.0000	270.1397	484.6588	691.2663	(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	132.4344	96.1186	71.3526	29.1124	1.8045	0.0000	0.0000	9.8331	32.6381	75.5100	110.8146	131.5259	(64)
Efficiency of water heater	87.4014	87.5907	87.8579	88.5306	89.9770	76.4000	76.4000	76.4000	76.4000	86.5035	87.0213	87.4485	(216)
Fuel for water heating, kWh/month	151.5244	109.7360	81.2136	32.8840	2.0055	0.0000	0.0000	12.8706	42.7200	87.2912	127.3418	150.4038	(219)
Water heating fuel used												797.9912	(219)
Annual totals kWh/year													
Space heating fuel - main system												3544.6586	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:

(MEV)Decentralised, Database: total watage = 4.7035, total flow = 29.0000, SFP = 0.1622)		
mechanical ventilation fans (SFP = 0.1622)	44.9235	(230a)
central heating pump	30.0000	(230c)
main heating flue fan	45.0000	(230e)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	169.9235	(231)
Electricity for lighting (calculated in Appendix L)	389.4339	(232)

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

PV Unit 0 (0.80 * 2.10 * 853 * 1.00) =	-1433.0903	-1433.0903	(233)
Total delivered energy for all uses		3468.9170	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3544.6586	3.4800	123.3541	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	797.9912	3.4800	27.7701	(247)
Mechanical ventilation fans	44.9235	13.1900	5.9254	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	389.4339	13.1900	51.3663	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1433.0903	13.1900	-189.0246	(252)
Total energy cost			155.8789	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):			0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$		0.4910 (257)
SAP value			93.1506
SAP rating (Section 12)		93	(258)
SAP band		A	

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

Regs Region: England

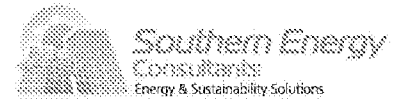
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3544.6586	0.2160	765.6463 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	797.9912	0.2160	172.3661 (264)
Space and water heating			938.0124 (265)
Pumps and fans	169.9235	0.5190	88.1903 (267)
Energy for lighting	389.4339	0.5190	202.1162 (268)
Energy saving/generation technologies			
PV Unit	-1433.0903	0.5190	-743.7738 (269)
Total kg/year			484.5450 (272)
CO2 emissions per m2			5.4900 (273)
EI value			95.1306
EI rating			95 (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	44.1700 (1b)	x 2.4700 (2b)	= 109.0999 (1b) - (3b)
First floor	44.1700 (1c)	x 2.6700 (2c)	= 117.9339 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	88.3400		(4)
Dwelling volume		(3a) + (3b) + (3c) + (3d) + (3e) ... (3n) =	227.0338 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					0 * 10 = 0.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					0.0000 / (5) = 0.0000 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.2500 (18)
Number of sides sheltered					2 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.2125 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.8000	4.5000	4.4000	3.9000	3.9000	3.6000	3.7000	3.5000	3.7000	4.0000	4.1000	4.4000 (22)
Wind factor	1.2000	1.1250	1.1000	0.9750	0.9750	0.9000	0.9250	0.8750	0.9250	1.0000	1.0250	1.1000 (22a)
Adj infilt rate	0.2550	0.2391	0.2338	0.2072	0.2072	0.1913	0.1966	0.1859	0.1966	0.2125	0.2178	0.2338 (22b)
Mechanical extract ventilation - decentralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5050	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 2 (Uw = 1.40)			13.8100	1.3258	18.3087		(27)
Opening Type 3			2.2100	1.4000	3.0940		(26)
Heat Loss Floor 1			44.1700	0.1500	6.6255		(28a)
Brick Faced	99.3000	16.0200	83.2800	0.2400	19.9872		(29a)
Main Roof	44.1700		44.1700	0.1100	4.8587		(30)
Total net area of external elements Aum(A, m ²)			187.6400				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.8741		(33)
Party Wall 1			44.3700	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)							15.1274 (36)
Total fabric heat loss						(33) + (36) =	68.0015 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	37.8352	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606	37.4606 (38)
Heat transfer coeff	105.8367	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621	105.4621 (39)
Average = Sum(39)m / 12 =												105.4933 (39)
HLP	1.1981	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938	1.1938 (40)
HLP (average)												1.1942 (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												2.6023 (42)
Average daily hot water use (litres/day)												96.0049 (43)
Daily hot water use	105.6054	101.7652	97.9250	94.0848	90.2446	86.4044	86.4044	90.2446	94.0848	97.9250	101.7652	105.6054 (44)
Energy conte	156.6097	136.9718	141.3427	123.2260	118.2382	102.0306	94.5464	108.4933	109.7891	127.9486	139.6659	151.6681 (45)
Energy content (annual)										Total = Sum(45)m =		1510.5304 (45)
Distribution loss (46)m = 0.15 x (45)m	23.4915	20.5458	21.2014	18.4839	17.7357	15.3046	14.1820	16.2740	16.4684	19.1923	20.9499	22.7502 (46)

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Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	(57)
Combi loss	0.6709	0.6078	0.6228	0.5217	0.4802	0.3967	0.3676	0.4406	0.4648	0.5638	0.6198	0.6497 (61)
Total heat required for water heating calculated for each month												
	157.2806	137.5796	141.9655	123.7477	118.7184	102.4273	94.9140	108.9339	110.2539	128.5124	140.2857	152.3178 (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												1204.7564 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2023.9908 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.3399 (H8)
Utilisation factor												0.5259 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												96.0049 (H14)
Volume ratio Veff/V												0.7812 (H15)
Solar storage volume factor												0.9506 (H16)
Solar input												-889.6968 (H17)
Solar input	-27.4349	-40.7531	-69.2175	-97.7795	-116.1444	-122.0545	-119.0434	-105.0043	-81.4625	-55.7362	-32.8718	-22.1945 (63)
												-889.6968 (63)
Output from w/h	129.8456	96.8265	72.7480	25.9681	2.5740	0.0000	0.0000	3.9296	28.7914	72.7762	107.4139	130.1233 (64)
												670.9966 (64)
Heat gains from water heating, kWh/month	52.2404	45.6951	47.1521	41.1031	39.4343	34.0244	31.5286	36.1842	36.6211	42.6839	46.5938	50.5921 (65)

Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386	156.1386 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.1284	48.9646	39.8207	30.1468	22.5351	19.0251	20.5573	26.7211	35.8650	45.5389	53.1506	56.6606 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	352.2245	355.8795	346.6690	327.0611	302.3095	279.0466	263.5055	259.8505	269.0610	288.6689	313.4204	336.6834 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162	53.2162 (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)	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924	-104.0924 (71)
Water heating gains (Table 5)	70.2156	67.9986	63.3765	57.0876	53.0030	47.2561	42.3771	48.6347	50.8626	57.3708	64.7137	68.0001 (72)
Total internal gains	585.8309	581.1050	558.1286	522.5578	486.1100	453.5901	434.7022	443.4686	464.0509	499.8409	539.5471	569.6065 (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	
East					8.1800	23.7288		0.7200	0.7000	0.7700	67.7943 (76)	
South					1.0800	53.5774		0.7200	0.7000	0.7700	20.2101 (78)	
West					4.5500	23.7288		0.7200	0.7000	0.7700	37.7095 (80)	
Solar gains	125.7139	212.7431	337.2671	503.6272	584.1603	635.6970	599.5393	525.8856	414.6074	266.3395	156.9966	100.8085 (83)
Total gains	711.5448	793.8482	895.3957	1026.1850	1070.2703	1089.2870	1034.2415	969.3542	878.6583	766.1804	696.5437	670.4149 (84)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, n _{l,m} (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	23.1856	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680	23.2680
alpha	2.5457	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512	2.5512
util living area												
	0.9331	0.9128	0.8661	0.7755	0.6477	0.4834	0.3485	0.3600	0.5934	0.8004	0.9025	0.9390 (86)
MIT	18.9522	19.1661	19.6246	20.1693	20.6162	20.8725	20.9618	20.9599	20.7782	20.2678	19.5421	18.9346 (87)
Th 2	19.9216	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249	19.9249 (88)
util rest of house												
	0.9233	0.9003	0.8465	0.7427	0.5943	0.4064	0.2514	0.2573	0.5164	0.7614	0.8856	0.9298 (89)
MIT 2	18.0869	18.2971	18.7405	19.2530	19.6532	19.8562	19.9125	19.9123	19.7941	19.3591	18.6695	18.0731 (90)
Living area fraction									fLA = Living area / (4) =			0.2171 (91)
MIT	18.2747	18.4858	18.9324	19.4520	19.8623	20.0769	20.1403	20.1398	20.0077	19.5564	18.8590	18.2601 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1247	18.3358	18.7824	19.3020	19.7123	19.9269	19.9903	19.9898	19.8577	19.4064	18.7090	18.1101 (93)

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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9020	0.8770	0.8215	0.7210	0.5828	0.4066	0.2576	0.2638	0.5111	0.7393	0.8616	0.9094	(94)
Useful gains	641.8256	696.1826	735.5644	739.9134	623.7158	442.8757	266.3859	255.6707	449.0583	566.4022	600.1634	609.6728	(95)
Ext temp.	5.0000	5.4000	7.1000	9.5000	12.6000	15.4000	17.4000	17.5000	15.0000	11.7000	8.1000	5.2000	(96)
Heat loss rate W	1389.0790	1364.2319	1232.0536	1033.7355	750.0767	477.4141	273.1789	262.5758	512.3079	812.7336	1118.8437	1361.5305	(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	555.9565	448.9292	369.3880	211.5519	94.0125	0.0000	0.0000	0.0000	0.0000	183.2706	373.4498	559.3821	(98)
Space heating												2795.9406	(98)
Space heating per m2											(98) / (4) =	31.6498	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.2000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3099.7125	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	555.9565	448.9292	369.3880	211.5519	94.0125	0.0000	0.0000	0.0000	0.0000	183.2706	373.4498	559.3821	(98)
Space heating efficiency (main heating system 1)	90.2000	90.2000	90.2000	90.2000	90.2000	0.0000	0.0000	0.0000	0.0000	90.2000	90.2000	90.2000	(210)
Space heating fuel (main heating system)	616.3598	497.7042	409.5210	234.5365	104.2268	0.0000	0.0000	0.0000	0.0000	203.1825	414.0242	620.1576	(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	129.8456	96.8265	72.7480	25.9681	2.5740	0.0000	0.0000	3.9296	28.7914	72.7762	107.4139	130.1233	(64)
Efficiency of water heater	87.2173	87.3992	87.5966	88.4532	89.7679	76.4000	76.4000	76.4000	76.4000	85.7953	86.7017	87.2266	(216)
Fuel for water heating, kWh/month	148.8761	110.7866	83.0489	29.3580	2.8674	0.0000	0.0000	5.1434	37.6851	84.8254	123.8889	149.1785	(219)
Water heating fuel used												775.6583	(219)
Annual totals kWh/year													
Space heating fuel - main system												3099.7125	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:

(MEV)Decentralised, Database: total watage = 4.7035, total flow = 29.0000, SFP = 0.1622)		
mechanical ventilation fans (SFP = 0.1622)		44.9235 (230a)
central heating pump		30.0000 (230c)
main heating flue fan		45.0000 (230e)
pump for solar water heating		50.0000 (230g)
Total electricity for the above, kWh/year		169.9235 (231)
Electricity for lighting (calculated in Appendix L)		389.4339 (232)

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

PV Unit 0 (0.80 * 2.10 * 966 * 1.00) =	-1622.2204	-1622.2204 (233)
Total delivered energy for all uses		2812.5078 (238)

10a. Fuel costs - using BEDF prices (491)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3099.7125	3.6300	112.5196	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	775.6583	3.6300	28.1564	(247)
Mechanical ventilation fans	44.9235	19.4400	8.7331	(249)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Pump for solar water heating	50.0000	19.4400	9.7200	(249)
Energy for lighting	389.4339	19.4400	75.7060	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-1622.2204	19.4400	-315.3596	(252)
Total energy cost			29.0554	(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	3099.7125	0.2160	669.5379	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	775.6583	0.2160	167.5422	(264)
Space and water heating			837.0801	(265)
Pumps and fans	169.9235	0.5190	88.1903	(267)
Energy for lighting	389.4339	0.5190	202.1162	(268)
Energy saving/generation technologies				
PV Unit	-1622.2204	0.5190	-841.9324	(269)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Total kg/year

285.4542 (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	3099.7125	1.2200	3781.6492 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	775.6583	1.2200	946.3031 (264)
Space and water heating			4727.9523 (265)
Pumps and fans	169.9235	3.0700	521.6651 (267)
Energy for lighting	389.4339	3.0700	1195.5621 (268)
Energy saving/generation technologies			
PV Unit	-1622.2204	3.0700	-4980.2165 (269)
Primary energy kWh/year			1464.9630 (272)
Primary energy kWh/m2/year			16.5832 (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	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	299.68 (P1)
Transmission heat loss coefficient	68.00 (37)
Summer heat loss coefficient	367.69 (P2)

Overhangs Orientation	Ratio	Z_overhangs	Overhang type
East	0.000	1.000	None
South	0.000	1.000	None
West	0.000	1.000	None

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

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific g or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	8.1800	124.7972	0.7200	0.7000	0.9000	416.7483
South	1.0800	118.3991	0.7200	0.7000	0.9000	52.2021
West	4.5500	124.7972	0.7200	0.7000	0.9000	231.8099

total: 700.7602

	Jun	Jul	Aug	
Solar gains	743	701	615	(P3)
Internal gains	451	432	440	
Total summer gains	1194	1132	1055	(P5)
Summer gain/loss ratio	3.25	3.08	2.87	(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	19.95	21.78	21.67	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r19



Proposed PV Locations



Coloured Site Layout
Land at Blissham Road, Yepton

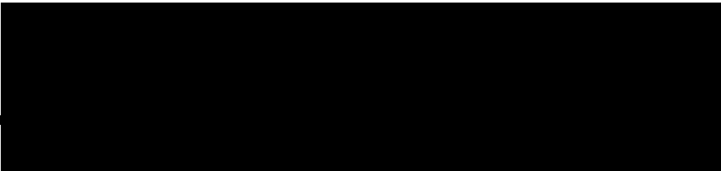
19284 / C201A

Scale 1:1000 @ A0 - November 2021

100% of the site area is shown in green. The area shown in green is the area that is available for development. The area shown in yellow is the area that is available for development. The area shown in red is the area that is available for development.

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