

FULL SAP CALCULATION PRINTOUT

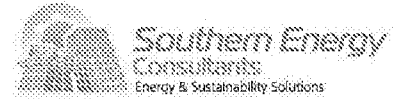
Calculation Type: New Build (As Designed)



Property Reference	SECANG010c				Issued on Date	04/02/2021
Assessment Reference	001	Prop Type Ref	Det Br Ea Ga			
Property	Warwick, Plot 56					
SAP Rating	84 B	DER	16.62	TER	17.12	
Environmental	85 B	% DER<TER	2.91			
CO ₂ Emissions (t/year)	1.70	DFEE	51.84	TFEE	55.96	
General Requirements Compliance	Pass	% DFEE<TFEE	7.37			
Assessor Details	Mr. Stuart Harvey, Stuart Harvey, [REDACTED]			Assessor ID	T555-0001	
Client	Persimon Homes Thames Valley					

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

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DWELLING AS DESIGNED

Detached House, total floor area 122 m²

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

1a TER and DER

Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.12 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.62 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)56.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.8 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.27 (max. 0.30)	0.41 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.31 (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
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system:

None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls:

No cylinder

Boiler interlock

Yes OK

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK

Based on:

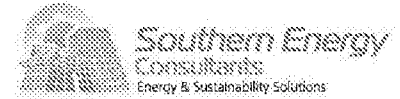
Overshading: Average
Windows facing North: 5.03 m², No overhang
Windows facing South: 11.54 m², No overhang
Windows facing West: 0.51 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key Features

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

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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	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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)	=	0.3262 (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	0.4159	0.4077	0.3995	0.3588	0.3506	0.3098	0.3098	0.3017	0.3262	0.3506	0.3669	0.3832 (22b)
Effective ac	0.5865	0.5831	0.5798	0.5644	0.5615	0.5480	0.5480	0.5455	0.5532	0.5615	0.5673	0.5734 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			17.0800	1.2357	21.1065		(27)
Heat Loss Floor 1			50.9800	0.2000	10.1960	75.0000	3823.5000 (28a)
Exposed Floor Over Garage			18.0600	0.1838	3.3187	20.0000	361.2000 (28b)
Brick Cavity	145.7100	19.2300	126.4800	0.2500	31.6200	60.0000	7588.8000 (29a)
Solid Garage Wall	21.8500		21.8500	0.4056	8.8615	9.0000	196.6500 (29a)
Main Plane	70.9300		70.9300	0.1100	7.8023	9.0000	638.3700 (30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.9150		(33)
Internal Wall 1			24.2700			75.0000	1820.2500 (32c)
Internal Wall 2			215.2700			9.0000	1937.4300 (32c)
Internal Floor 1			50.9800			18.0000	917.6400 (32d)
Internal Ceiling 1			50.9800			18.0000	917.6400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18201.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							149.3026 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8356 (36)
Total fabric heat loss						(33) + (36) =	100.7506 (37)

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

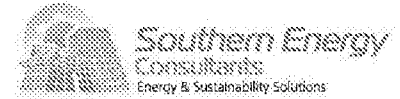
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	57.8947	57.5632	57.2383	55.7123	55.4268	54.0977	54.0977	53.8516	54.6097	55.4268	56.0044	56.6082 (38)
Heat transfer coeff	158.6452	158.3138	157.9889	156.4629	156.1774	154.8483	154.8483	154.6022	155.3603	156.1774	156.7550	157.3588 (39)
Average = Sum(39)m / 12 =												156.4615 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3013	1.2986	1.2959	1.2834	1.2811	1.2702	1.2702	1.2682	1.2744	1.2811	1.2858	1.2908 (40)
HLP (average)												1.2834 (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												2.8704 (42)
Average daily hot water use (litres/day)												102.3720 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (45)

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1610.7108 (45)										
Distribution loss (46)m = 0.15 x (45)m											
25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590 (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											
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	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702 (61)
Total heat required for water heating calculated for each month											
181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717 (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)
Solar input (sum of months) = Sum(63)m =											0.0000 (63)
Output from w/h											
181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717 (64)
Heat gains from water heating, kWh/month											
59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104 (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	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.5099	24.4340	19.8711	15.0437	11.2453	9.4938	10.2584	13.3342	17.8972	22.7246	26.5229	28.2745	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	287.6793	290.6645	283.1419	267.1271	246.9112	227.9112	215.2181	212.2329	219.7555	235.7703	255.9861	274.9861	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains	463.6344	461.1748	444.1696	416.6393	388.2792	361.4103	344.2858	351.0377	365.4925	393.2571	425.0878	449.3467	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W				
North				5.0300	10.6334	0.4400	0.0000	0.7700	18.1210 (74)				
South				11.5400	46.7521	0.4400	0.0000	0.7700	182.7890 (78)				
West				0.5100	19.6403	0.4400	0.0000	0.7700	3.3936 (80)				
Solar gains	204.3036	340.6301	451.1112	541.4547	595.9863	588.5264	568.6053	527.4359	481.8139	371.9892	243.2533	175.8438	(83)
Total gains	667.9381	801.8048	895.2808	958.0940	984.2655	949.9367	912.8911	878.4736	847.3064	765.2463	668.3411	625.1905	(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	31.8696	31.9364	32.0020	32.3142	32.3732	32.6511	32.6511	32.7031	32.5435	32.3732	32.2539	32.1302
alpha	3.1246	3.1291	3.1335	3.1543	3.1582	3.1767	3.1767	3.1802	3.1696	3.1582	3.1503	3.1420
util living area	0.9899	0.9815	0.9672	0.9388	0.8823	0.7764	0.6404	0.6753	0.8409	0.9487	0.9831	0.9918 (86)
MIT	18.8401	19.0846	19.4499	19.9154	20.3623	20.7224	20.8941	20.8708	20.6067	20.0190	19.3402	18.7957 (87)
Th 2	19.8398	19.8419	19.8440	19.8538	19.8557	19.8643	19.8643	19.8659	19.8610	19.8557	19.8520	19.8481 (88)
util rest of house	0.9876	0.9774	0.9595	0.9227	0.8469	0.6996	0.5124	0.5534	0.7806	0.9320	0.9787	0.9899 (89)
MIT 2	16.9668	17.3232	17.8537	18.5273	19.1517	19.6227	19.8038	19.7861	19.4866	18.6844	17.7036	16.9069 (90)
Living area fraction	17.1833	17.5268	18.0382	18.6878	19.2916	19.7498	19.9298	19.9115	19.6161	18.8387	17.8928	17.1252 (91)
MIT	17.1833	17.5268	18.0382	18.6878	19.2916	19.7498	19.9298	19.9115	19.6161	18.8387	17.8928	17.1252 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.0333	17.3768	17.8882	18.5378	19.1416	19.5998	19.7798	19.7615	19.4661	18.6887	17.7428	16.9752 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	653.7105	772.7428	841.8061	859.5749	805.5648	644.0274	457.8586	474.7033	638.8401	694.4980	645.3775	614.1265	(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	2020.0822	1975.2524	1799.2085	1507.9523	1162.2158	774.2053	492.3904	519.6946	833.6730	1263.2699	1668.3042	2010.2941	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1016.5805	808.0865	712.3073	466.8318	265.3484	0.0000	0.0000	0.0000	0.0000	423.1663	736.5072	1038.7487	(98)
Space heating												5467.5767	(98)
Space heating per m2												44.8493	(99)

Regs Region: England

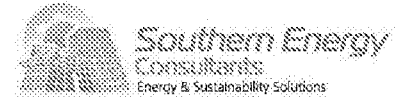
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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 %)													90.5000	(206)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement													6041.5213	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	1016.5805	808.0865	712.3073	466.8318	265.3484	0.0000	0.0000	0.0000	0.0000	423.1663	736.5072	1038.7487	(98)	
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)	
Space heating fuel (main heating system)	1123.2934	892.9133	787.0799	515.8362	293.2026	0.0000	0.0000	0.0000	0.0000	467.5870	813.8201	1147.7886	(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	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(64)	
Efficiency of water heater (217)m	90.0010	89.9583	89.8809	89.7205	89.3679	87.3000	87.3000	87.3000	87.3000	89.6379	89.9040	90.0222	(217)	
Fuel for water heating, kWh/month	201.2795	176.5615	183.3927	161.6427	156.7987	140.1498	131.4963	148.5825	149.6726	167.9181	180.8584	195.3647	(219)	
Water heating fuel used												1993.7175	(219)	
Annual totals kWh/year														
Space heating fuel - main system													6041.5213	(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)													485.8334	(232)
Total delivered energy for all uses													8596.0722	(238)

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

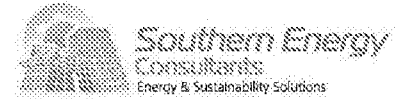
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	6041.5213	0.2160	1304.9686 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1993.7175	0.2160	430.6430 (264)
Space and water heating			1735.6116 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	485.8334	0.5190	252.1475 (268)
Total CO2, kg/year			2026.6841 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.6200 (273)

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

DER			16.6200	ZC1
Total Floor Area		TFA	121.9100	
Assumed number of occupants		N	2.8704	
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190	
CO2 emissions from appliances, equation (L14)			13.9835	ZC2
CO2 emissions from cooking, equation (L16)			1.5412	ZC3
Total CO2 emissions			32.1447	ZC4
Residual CO2 emissions offset from biofuel CHP			0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year			0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000	ZC7
Net CO2 emissions			32.1447	ZC8

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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	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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) =	0.3262 (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	0.4159	0.4077	0.3995	0.3588	0.3506	0.3098	0.3098	0.3017	0.3262	0.3506	0.3669	0.3832 (22b)
Effective ac	0.5865	0.5831	0.5798	0.5644	0.5615	0.5480	0.5480	0.5455	0.5532	0.5615	0.5673	0.5734 (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			2.1500	1.0000	2.1500		(26)
TER Opening Type (Uw = 1.40)			17.0800	1.3258	22.6439		(27)
Heat Loss Floor 1			50.9800	0.1300	6.6274		(28a)
Exposed Floor Over Garage			18.0600	0.1300	2.3478		(28b)
Brick Cavity	145.7100	19.2300	126.4800	0.1800	22.7664		(29a)
Solid Garage Wall	21.8500		21.8500	0.1800	3.9330		(29a)
Main Plane	70.9300		70.9300	0.1300	9.2209		(30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.6894		(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)							17.6246 (36)
Total fabric heat loss						(33) + (36) =	87.3140 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	57.8947	57.5632	57.2383	55.7123	55.4268	54.0977	54.0977	53.8516	54.6097	55.4268	56.0044	56.6082 (38)
Heat transfer coeff	145.2087	144.8772	144.5524	143.0264	142.7409	141.4118	141.4118	141.1656	141.9237	142.7409	143.3184	143.9223 (39)
Average = Sum(39)m / 12 =												143.0250 (39)
HLP	1.1911	1.1884	1.1857	1.1732	1.1709	1.1600	1.1600	1.1579	1.1642	1.1709	1.1756	1.1806 (40)
HLP (average)												1.1732 (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												2.8704 (42)
Average daily hot water use (litres/day)												102.3720 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (45)
Energy content (annual)												1610.7108 (45)
Distribution loss	Total = Sum(45)m =											
	(46)m = 0.15 x (45)m											
	25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590 (46)
Water storage loss:												
Total storage loss												

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 (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	50.9589	46.0274	50.9589	49.3151	49.0376	45.4364	46.9509	49.0376	49.3151	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	217.9552	192.0834	201.6756	180.7135	175.1176	154.2338	147.7677	164.7264	166.3855	187.3932	198.2438	212.6859 (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	217.9552	192.0834	201.6756	180.7135	175.1176	154.2338	147.7677	164.7264	166.3855	187.3932	198.2438	212.6859 (64)
Heat gains from water heating, kWh/month	68.2660	60.0705	62.8530	56.0188	54.1810	47.5342	45.2593	50.7259	51.2547	58.1041	61.8476	66.5139 (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	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.5099	24.4340	19.8711	15.0437	11.2453	9.4938	10.2584	13.3342	17.8972	22.7246	26.5229	28.2745	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	287.6793	290.6645	283.1419	267.1271	246.9112	227.9112	215.2181	212.2329	219.7555	235.7703	255.9861	274.9861	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	91.7553	89.3906	84.4799	77.8038	72.8239	66.0198	60.8324	68.1800	71.1871	78.0970	85.8994	89.4005	(72)
Total internal gains	476.0005	473.5451	456.5489	429.0306	400.0365	372.4808	355.3649	362.8031	377.8958	405.6478	437.4645	461.7171	(73)

6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W					
North			5.0300	10.6334	0.6300	0.7000	0.7700	16.3460	(74)				
South			11.5400	46.7521	0.6300	0.7000	0.7700	164.8840	(78)				
West			0.5100	19.6403	0.6300	0.7000	0.7700	3.0612	(80)				
Solar gains	184.2912	307.2638	406.9228	488.4167	537.6068	530.8776	512.9078	475.7712	434.6180	335.5512	219.4256	158.6191	(83)
Total gains	660.2917	780.8090	863.4717	917.4473	937.6433	903.3584	868.2727	838.5743	812.5138	741.1990	656.8900	620.3362	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.3021	58.4355	58.5668	59.1917	59.3101	59.8675	59.8675	59.9719	59.6516	59.3101	59.0711	58.8232	
alpha	4.8868	4.8957	4.9045	4.9461	4.9540	4.9912	4.9912	4.9981	4.9768	4.9540	4.9381	4.9215	
util living area	0.9987	0.9969	0.9924	0.9792	0.9400	0.8339	0.6721	0.7123	0.9000	0.9837	0.9972	0.9991	(86)
MIT	19.6500	19.8110	20.0516	20.3615	20.6576	20.8833	20.9703	20.9600	20.8094	20.4203	19.9747	19.6224	(87)
Th 2	19.9271	19.9293	19.9314	19.9415	19.9434	19.9522	19.9522	19.9538	19.9488	19.9434	19.9396	19.9356	(88)
util rest of house	0.9983	0.9958	0.9895	0.9703	0.9110	0.7519	0.5335	0.5789	0.8415	0.9750	0.9960	0.9988	(89)
MIT 2	18.1240	18.3607	18.7127	19.1673	19.5809	19.8647	19.9400	19.9355	19.7840	19.2566	18.6077	18.0896	(90)
Living area fraction	18.3004	18.5283	18.8674	19.3053	19.7054	19.9824	20.0591	20.0539	19.9025	19.3911	18.7657	18.2668	(91)
MIT	18.3004	18.5283	18.8674	19.3053	19.7054	19.9824	20.0591	20.0539	19.9025	19.3911	18.7657	18.2668	(92)
Temperature adjustment	18.3004	18.5283	18.8674	19.3053	19.7054	19.9824	20.0591	20.0539	19.9025	19.3911	18.7657	18.2668	(93)

8. Space heating requirement

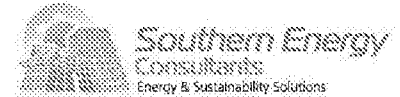
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9972	0.9935	0.9852	0.9629	0.9026	0.7547	0.5489	0.5930	0.8382	0.9685	0.9940	0.9979	(94)
Ext temp.	658.4592	775.7585	850.7188	883.3723	846.3636	681.7196	476.5692	497.3097	681.0787	717.8342	652.9184	619.0599	(95)
Heat loss rate 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	2032.9744	1974.4366	1787.7425	1488.2345	1142.6927	761.1388	489.1557	515.8098	823.5187	1254.8490	1671.9134	2024.5224	(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	1022.6394	805.5117	697.1456	435.5008	220.4688	0.0000	0.0000	0.0000	0.0000	399.5390	733.6764	1045.6641	(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 TARGET EMISSIONS 09 Jan 2014

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

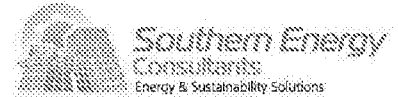
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													5738.9141 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1022.6394	805.5117	697.1456	435.5008	220.4688	0.0000	0.0000	0.0000	0.0000	399.5390	733.6764	1045.6641	(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)	1094.9030	862.4323	746.4086	466.2749	236.0480	0.0000	0.0000	0.0000	0.0000	427.7720	785.5208	1119.5547	(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	217.9552	192.0834	201.6756	180.7135	175.1176	154.2338	147.7677	164.7264	166.3855	187.3932	198.2438	212.6859	(64)
Efficiency of water heater (217)m	88.4456	88.2624	87.9188	87.1841	85.6321	80.3000	80.3000	80.3000	80.3000	86.9099	88.0443	88.5182	(217)
Fuel for water heating, kWh/month	246.4286	217.6275	229.3886	207.2781	204.5000	192.0719	184.0196	205.1387	207.2049	215.6179	225.1638	240.2736	(219)
Water heating fuel used												2574.7131	(219)
Annual totals kWh/year													
Space heating fuel - main system												5738.9141	(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)												485.8334	(232)
Total delivered energy for all uses												8874.4606	(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	5738.9141	0.2160	1239.6055 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2574.7131	0.2160	556.1380 (264)
Space and water heating			1795.7435 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	485.8334	0.5190	252.1475 (268)
Total CO2, kg/m2/year			2086.8160 (272)
Emissions per m2 for space and water heating			14.7301 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.0683 (272b)
Emissions per m2 for pumps and fans			0.3193 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.7301 * 1.00) + 2.0683 + 0.3193, rounded to 2 d.p.			17.1200 (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	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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) =	0.3262 (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	0.4159	0.4077	0.3995	0.3588	0.3506	0.3098	0.3098	0.3017	0.3262	0.3506	0.3669	0.3832 (22b)
Effective ac	0.5865	0.5831	0.5798	0.5644	0.5615	0.5480	0.5480	0.5455	0.5532	0.5615	0.5673	0.5734 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			17.0800	1.2357	21.1065		(27)
Heat Loss Floor 1			50.9800	0.2000	10.1960	75.0000	3823.5000 (28a)
Exposed Floor Over Garage			18.0600	0.1838	3.3187	20.0000	361.2000 (28b)
Brick Cavity	145.7100	19.2300	126.4800	0.2500	31.6200	60.0000	7588.8000 (29a)
Solid Garage Wall	21.8500		21.8500	0.4056	8.8615	9.0000	196.6500 (29a)
Main Plane	70.9300		70.9300	0.1100	7.8023	9.0000	638.3700 (30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.9150		(33)
Internal Wall 1			24.2700			75.0000	1820.2500 (32c)
Internal Wall 2			215.2700			9.0000	1937.4300 (32c)
Internal Floor 1			50.9800			18.0000	917.6400 (32d)
Internal Ceiling 1			50.9800			9.0000	458.8200 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17742.6600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							145.5390 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8356 (36)
Total fabric heat loss						(33) + (36) =	100.7506 (37)

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

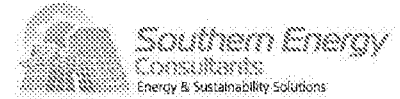
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	57.8947	57.5632	57.2383	55.7123	55.4268	54.0977	54.0977	53.8516	54.6097	55.4268	56.0044	56.6082 (38)
Heat transfer coeff	158.6452	158.3138	157.9889	156.4629	156.1774	154.8483	154.8483	154.6022	155.3603	156.1774	156.7550	157.3588 (39)
Average = Sum(39)m / 12 =												156.4615 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3013	1.2986	1.2959	1.2834	1.2811	1.2702	1.2702	1.2682	1.2744	1.2811	1.2858	1.2908 (40)
HLP (average)												1.2834 (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												2.8704 (42)
Average daily hot water use (litres/day)												102.3720 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1610.7108 (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	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	35.4867	31.0369	32.0273	27.9222	26.7920	23.1195	21.4236	24.5839	24.8775	28.9923	31.6474	34.3670 (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)
(66)m	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.5099	24.4340	19.8711	15.0437	11.2453	9.4938	10.2584	13.3342	17.8972	22.7246	26.5229	28.2745	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	287.6793	290.6645	283.1419	267.1271	246.9112	227.9112	215.2181	212.2329	219.7555	235.7703	255.9861	274.9861	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	47.6972	46.1859	43.0474	38.7808	36.0107	32.1103	28.7951	33.0428	34.5520	38.9681	43.9547	46.1922	(72)
Total internal gains	428.9424	427.3404	412.1164	387.0076	360.2234	335.5714	320.3276	324.6659	338.2607	363.5190	392.5197	415.5088	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				5.0300	10.6334		0.4400		0.0000		0.7700		18.1210 (74)
South				11.5400	46.7521		0.4400		0.0000		0.7700		182.7890 (78)
West				0.5100	19.6403		0.4400		0.0000		0.7700		3.3936 (80)
Solar gains	204.3036	340.6301	451.1112	541.4547	595.9863	588.5264	568.6053	527.4359	481.8139	371.9892	243.2533	175.8438	(83)
Total gains	633.2460	767.9705	863.2276	928.4622	956.2097	924.0978	888.9329	852.1019	820.0746	735.5083	635.7731	591.3526	(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	31.0663	31.1313	31.1953	31.4996	31.5572	31.8280	31.8280	31.8787	31.7231	31.5572	31.4409	31.3202	
alpha	3.0711	3.0754	3.0797	3.1000	3.1038	3.1219	3.1219	3.1252	3.1149	3.1038	3.0961	3.0880	
util living area	0.9906	0.9824	0.9686	0.9408	0.8862	0.7832	0.6493	0.6854	0.8472	0.9513	0.9843	0.9924	(86)
MIT	18.7658	19.0160	19.3904	19.8681	20.3279	20.7023	20.8840	20.8583	20.5803	19.9731	19.2770	18.7212	(87)
Th 2	19.8398	19.8419	19.8440	19.8538	19.8557	19.8643	19.8643	19.8659	19.8610	19.8557	19.8520	19.8481	(88)
util rest of house	0.9885	0.9786	0.9612	0.9254	0.8520	0.7080	0.5220	0.5646	0.7890	0.9357	0.9802	0.9907	(89)
MIT 2	17.8075	18.0574	18.4295	18.9051	19.3458	19.6850	19.8181	19.8048	19.5850	19.0145	18.3257	17.7690	(90)
Living area fraction	17.9183	18.1682	18.5405	19.0164	19.4593	19.8026	19.9413	19.9266	19.7000	19.1252	18.4357	17.8791	(91)
MIT	17.9183	18.1682	18.5405	19.0164	19.4593	19.8026	19.9413	19.9266	19.7000	19.1252	18.4357	17.8791	(92)
Temperature adjustment	17.9183	18.1682	18.5405	19.0164	19.4593	19.8026	19.9413	19.9266	19.7000	19.1252	18.4357	17.8791	(93)
adjusted MIT	17.9183	18.1682	18.5405	19.0164	19.4593	19.8026	19.9413	19.9266	19.7000	19.1252	18.4357	17.8791	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	622.8454	745.5294	820.1407	845.7293	800.7071	649.8075	472.6670	487.4165	638.7332	678.3219	618.5743	583.3750	(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	2160.4771	2100.5314	1902.2726	1582.8442	1211.8270	805.6119	517.3885	545.2195	870.0248	1331.4507	1776.9198	2152.5197	(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	1143.9980	910.5613	805.1061	530.7227	305.8733	0.0000	0.0000	0.0000	0.0000	485.9278	834.0087	1167.4437	(98)
Space heating													(98)
Space heating per m2													(98) / (4) = 50.7230 (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	1455.5741	1145.8775	1174.9766	0.0000	0.0000	0.0000	0.0000	(100)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

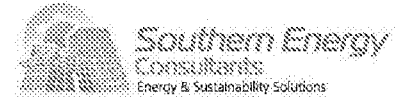


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6788	0.7597	0.7364	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	988.0492	870.4735	865.2273	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1196.3997	1152.7665	1112.1283	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												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	150.0124	210.0260	183.6943	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction												543.7327 (104)
Intermittency factor (Table 10b)									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												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	37.5031	52.5065	45.9236	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												135.9332 (107)
Energy for space heating												1.1150 (108)
Energy for space cooling												50.7230 (99)
Total												1.1150 (108)
Dwelling Fabric Energy Efficiency (DFEE)												51.8380 (109)
												51.8 (109)

FULL SAP CALCULATION PRINTOUT

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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	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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) =	0.3262 (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	0.4159	0.4077	0.3995	0.3588	0.3506	0.3098	0.3098	0.3017	0.3262	0.3506	0.3669	0.3832 (22b)
Effective ac	0.5865	0.5831	0.5798	0.5644	0.5615	0.5480	0.5480	0.5455	0.5532	0.5615	0.5673	0.5734 (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			2.1500	1.0000	2.1500		(26)
TER Opening Type (Uw = 1.40)			17.0800	1.3258	22.6439		(27)
Heat Loss Floor 1			50.9800	0.1300	6.6274		(28a)
Exposed Floor Over Garage			18.0600	0.1300	2.3478		(28b)
Brick Cavity	145.7100	19.2300	126.4800	0.1800	22.7664		(29a)
Solid Garage Wall	21.8500		21.8500	0.1800	3.9330		(29a)
Main Plane	70.9300		70.9300	0.1300	9.2209		(30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.6894		(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)							17.6246 (36)
Total fabric heat loss						(33) + (36) =	87.3140 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	57.8947	57.5632	57.2383	55.7123	55.4268	54.0977	54.0977	53.8516	54.6097	55.4268	56.0044	56.6082 (38)
Heat transfer coeff	145.2087	144.8772	144.5524	143.0264	142.7409	141.4118	141.4118	141.1656	141.9237	142.7409	143.3184	143.9223 (39)
Average = Sum(39)m / 12 =												143.0250 (39)
HLP	1.1911	1.1884	1.1857	1.1732	1.1709	1.1600	1.1600	1.1579	1.1642	1.1709	1.1756	1.1806 (40)
HLP (average)												1.1732 (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												2.8704 (42)
Average daily hot water use (litres/day)												102.3720 (43)
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (45)
Energy content (annual)										Total = Sum(45)m =		1610.7108 (45)
Distribution loss (46)m = 0.15 x (45)m												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	35.4867	31.0369	32.0273	27.9222	26.7920	23.1195	21.4236	24.5839	24.8775	28.9923	31.6474	34.3670 (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	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.5099	24.4340	19.8711	15.0437	11.2453	9.4938	10.2584	13.3342	17.8972	22.7246	26.5229	28.2745	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	287.6793	290.6645	283.1419	267.1271	246.9112	227.9112	215.2181	212.2329	219.7555	235.7703	255.9861	274.9861	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	47.6972	46.1859	43.0474	38.7808	36.0107	32.1103	28.7951	33.0428	34.5520	38.9681	43.9547	46.1922	(72)
Total internal gains	428.9424	427.3404	412.1164	387.0076	360.2234	335.5714	320.3276	324.6659	338.2607	363.5190	392.5197	415.5088	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
North	5.0300	10.6334	0.6300		0.7000	0.7700	16.3460 (74)
South	11.5400	46.7521	0.6300		0.7000	0.7700	164.8840 (78)
West	0.5100	19.6403	0.6300		0.7000	0.7700	3.0612 (80)

Solar gains	184.2912	307.2638	406.9228	488.4167	537.6068	530.8776	512.9078	475.7712	434.6180	335.5512	219.4256	158.6191	(83)
Total gains	613.2335	734.6042	819.0392	875.4243	897.8301	866.4490	833.2354	800.4371	772.8787	699.0702	611.9453	574.1279	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	58.3021	58.4355	58.5668	59.1917	59.3101	59.8675	59.8675	59.9719	59.6516	59.3101	59.0711	58.8232	
alpha	4.8868	4.8957	4.9045	4.9461	4.9540	4.9912	4.9912	4.9981	4.9768	4.9540	4.9381	4.9215	
util living area	0.9991	0.9976	0.9939	0.9827	0.9483	0.8507	0.6935	0.7360	0.9143	0.9872	0.9980	0.9994	(86)
MIT	19.6142	19.7762	20.0188	20.3324	20.6347	20.8709	20.9659	20.9536	20.7905	20.3903	19.9407	19.5872	(87)
Th 2	19.9271	19.9293	19.9314	19.9415	19.9434	19.9522	19.9522	19.9538	19.9488	19.9434	19.9396	19.9356	(88)
util rest of house	0.9988	0.9968	0.9916	0.9752	0.9224	0.7722	0.5537	0.6026	0.8609	0.9802	0.9971	0.9991	(89)
MIT 2	18.6603	18.8237	19.0670	19.3849	19.6759	19.8846	19.9424	19.9389	19.8222	19.4457	18.9964	18.6400	(90)
Living area fraction									fLA = Living area / (4) =			0.1156	(91)
MIT	18.7706	18.9338	19.1770	19.4944	19.7867	19.9986	20.0607	20.0562	19.9341	19.5549	19.1056	18.7495	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7706	18.9338	19.1770	19.4944	19.7867	19.9986	20.0607	20.0562	19.9341	19.5549	19.1056	18.7495	(93)

8. Space heating requirement

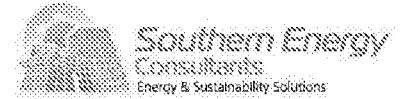
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9983	0.9956	0.9893	0.9709	0.9175	0.7763	0.5696	0.6173	0.8600	0.9766	0.9961	0.9988	(94)
Ext temp.	612.1759	731.3837	810.2378	849.9422	823.7941	672.6483	474.5930	494.0948	664.6827	682.6854	609.5480	573.4129	(95)
Heat loss rate 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	2101.2528	2033.1762	1832.4894	1515.2807	1154.3090	763.4299	489.3839	516.1326	828.0042	1278.2277	1720.6180	2093.9983	(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	1107.8732	874.8046	760.5552	479.0438	245.9030	0.0000	0.0000	0.0000	0.0000	443.0835	799.9704	1131.3155	(98)
Space heating per m ²												5842.5492	(98)
										(98) / (4) =		47.9251	(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	1329.2706	1046.4471	1072.8589	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7586	0.8488	0.8249	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1008.3693	888.1793	884.9906	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1129.0179	1087.6656	1051.7409	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

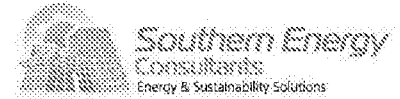


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	86.8670	148.4178	124.0622	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												359.3470 (104)
Cooled fraction									FC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	21.7168	37.1045	31.0155	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												89.8368 (107)
Space cooling per m2												0.7369 (108)
Energy for space heating												47.9251 (99)
Energy for space cooling												0.7369 (108)
Total												48.6620 (109)
Target Fabric Energy Efficiency (TFEE)												56.0 (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	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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)	=	0.3262 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)
Adj infilt rate	0.3425	0.3262	0.3262	0.3017	0.3017	0.2691	0.2772	0.2609	0.2691	0.2854	0.2854	0.3098 (22b)
Effective ac	0.5586	0.5532	0.5532	0.5455	0.5455	0.5362	0.5384	0.5340	0.5362	0.5407	0.5407	0.5480 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			17.0800	1.2357	21.1065		(27)
Heat Loss Floor 1			50.9800	0.2000	10.1960	75.0000	3823.5000 (28a)
Exposed Floor Over Garage			18.0600	0.1838	3.3187	20.0000	361.2000 (28b)
Brick Cavity	145.7100	19.2300	126.4800	0.2500	31.6200	60.0000	7588.8000 (29a)
Solid Garage Wall	21.8500		21.8500	0.4056	8.8615	9.0000	196.6500 (29a)
Main Plane	70.9300		70.9300	0.1100	7.8023	9.0000	638.3700 (30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.9150		(33)
Internal Wall 1			24.2700			75.0000	1820.2500 (32c)
Internal Wall 2			215.2700			9.0000	1937.4300 (32c)
Internal Floor 1			50.9800			18.0000	917.6400 (32d)
Internal Ceiling 1			50.9800			18.0000	917.6400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18201.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							149.3026 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8356 (36)
Total fabric heat loss						(33) + (36) =	100.7506 (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	55.1479	54.6097	54.6097	53.8516	53.8516	52.9327	53.1526	52.7194	52.9327	53.3790	53.3790	54.0977 (38)
Heat transfer coeff	155.8985	155.3603	155.3603	154.6022	154.6022	153.6833	153.9032	153.4700	153.6833	154.1296	154.1296	154.8483 (39)
Average = Sum(39)m / 12 =												154.4726 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2788	1.2744	1.2744	1.2682	1.2682	1.2606	1.2624	1.2589	1.2606	1.2643	1.2643	1.2702 (40)
HLP (average)												1.2671 (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	2.8704 (42)
Average daily hot water use (litres/day)	102.3720 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (45)

Regs Region: England

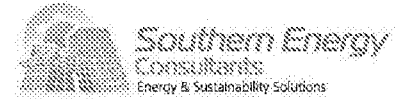
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1610.7108 (45)										
Distribution loss (46)m = 0.15 x (45)m											
25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590 (46)
Water storage loss:											
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
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	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702 (61)
Total heat required for water heating calculated for each month	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990 (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)
Solar input (sum of months) = Sum(63)m =											0.0000 (63)
Output from w/h	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990 (64)
RHI water heating demand											Total per year (kWh/year) = Sum(64)m = 1776.4874 (64)
Heat gains from water heating, kWh/month	59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364 (65)
											1776 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.7747	61.0851	49.6778	37.6093	28.1134	23.7345	25.6459	33.3356	44.7429	56.8114	66.3073	70.6862	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	429.3721	433.8276	422.5998	398.6971	368.5243	340.1660	321.2210	316.7655	327.9933	351.8960	382.0688	410.4270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains	693.0369	687.4337	659.8790	617.2197	573.2050	534.3506	512.1211	522.0165	547.0209	589.9144	637.3997	673.6442	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				5.0300	11.9814	0.4400	0.0000	0.7700	20.4183 (74)			
South				11.5400	50.9848	0.4400	0.0000	0.7700	199.3380 (78)			
West				0.5100	22.3313	0.4400	0.0000	0.7700	3.8586 (80)			
Solar gains	223.6149	335.1961	439.1575	546.5743	590.3098	625.9792	597.3543	563.1894	509.4036	390.8805	272.6631	190.6901 (83)
Total gains	916.6518	1022.6299	1099.0366	1163.7941	1163.5148	1160.3298	1109.4754	1085.2059	1056.4245	980.7949	910.0628	864.3343 (84)

7. Mean internal temperature (heating season)

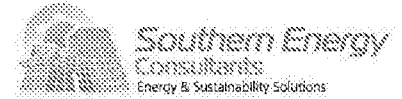
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	32.4312	32.5435	32.5435	32.7031	32.7031	32.8986	32.8516	32.9443	32.8986	32.8033	32.8033	32.6511
alpha	3.1621	3.1696	3.1696	3.1802	3.1802	3.1932	3.1901	3.1963	3.1932	3.1869	3.1869	3.1767
util living area	0.9724	0.9601	0.9353	0.8834	0.7835	0.5893	0.4129	0.4322	0.6934	0.8842	0.9542	0.9764 (86)
MIT	19.2655	19.4568	19.8132	20.2462	20.6437	20.9071	20.9792	20.9757	20.8256	20.3621	19.7548	19.2279 (87)
Th 2	19.8575	19.8610	19.8610	19.8659	19.8659	19.8718	19.8704	19.8732	19.8718	19.8689	19.8689	19.8643 (88)
util rest of house	0.9665	0.9516	0.9207	0.8548	0.7248	0.4813	0.2701	0.2891	0.6005	0.8498	0.9426	0.9712 (89)
MIT 2	17.5934	17.8704	18.3804	18.9898	19.5157	19.8130	19.8647	19.8660	19.7374	19.1606	18.3083	17.5437 (90)
Living area fraction	fLA = Living area / (4) =											0.1156 (91)
MIT	17.7866	18.0537	18.5460	19.1350	19.6461	19.9394	19.9935	19.9942	19.8632	19.2994	18.4755	17.7384 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.6366	17.9037	18.3960	18.9850	19.4961	19.7894	19.8435	19.8442	19.7132	19.1494	18.3255	17.5884 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9494	0.9309	0.8952	0.8268	0.7022	0.4726	0.2666	0.2852	0.5856	0.8217	0.9202	0.9556 (94)
Useful gains	870.2497	951.9359	983.8811	962.2654	816.9726	548.3833	295.7620	309.4819	618.6009	805.9231	837.4309	825.9871 (95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000 (96)
Heat loss rate W	1954.4443	1911.5092	1708.3356	1404.5663	1004.3086	582.3723	299.1125	313.7290	693.6048	1163.5915	1591.4607	1933.8044 (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	806.6408	644.8333	538.9942	318.4566	139.3780	0.0000	0.0000	0.0000	0.0000	266.1053	542.9015	824.2161 (98)
Space heating												4081.5257 (98)
RHI space heating demand												4082 (98)

FULL SAP CALCULATION PRINTOUT

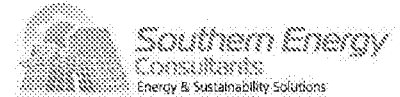
Calculation Type: New Build (As Designed)



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	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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)	=	0.3262 (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	0.4159	0.4077	0.3995	0.3588	0.3506	0.3098	0.3098	0.3017	0.3262	0.3506	0.3669	0.3832 (22b)
Effective ac	0.5865	0.5831	0.5798	0.5644	0.5615	0.5480	0.5480	0.5455	0.5532	0.5615	0.5673	0.5734 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			17.0800	1.2357	21.1065		(27)
Heat Loss Floor 1			50.9800	0.2000	10.1960	75.0000	3823.5000 (28a)
Exposed Floor Over Garage			18.0600	0.1838	3.3187	20.0000	361.2000 (28b)
Brick Cavity	145.7100	19.2300	126.4800	0.2500	31.6200	60.0000	7588.8000 (29a)
Solid Garage Wall	21.8500		21.8500	0.4056	8.8615	9.0000	196.6500 (29a)
Main Plane	70.9300		70.9300	0.1100	7.8023	9.0000	638.3700 (30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.9150		(33)
Internal Wall 1			24.2700			75.0000	1820.2500 (32c)
Internal Wall 2			215.2700			9.0000	1937.4300 (32c)
Internal Floor 1			50.9800			18.0000	917.6400 (32d)
Internal Ceiling 1			50.9800			18.0000	917.6400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18201.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							149.3026 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8356 (36)
Total fabric heat loss						(33) + (36) =	100.7506 (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	57.8947	57.5632	57.2383	55.7123	55.4268	54.0977	54.0977	53.8516	54.6097	55.4268	56.0044	56.6082 (38)
Heat transfer coeff	158.6452	158.3138	157.9889	156.4629	156.1774	154.8483	154.8483	154.6022	155.3603	156.1774	156.7550	157.3588 (39)
Average = Sum(39)m / 12 =												156.4615 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3013	1.2986	1.2959	1.2834	1.2811	1.2702	1.2702	1.2682	1.2744	1.2811	1.2858	1.2908 (40)
HLP (average)												1.2834 (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												2.8704 (42)
Average daily hot water use (litres/day)												102.3720 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (45)

Regs Region: England

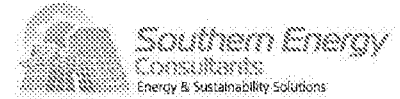
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1610.7108 (45)										
Distribution loss (46)m = 0.15 x (45)m											
25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590 (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											
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	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702 (61)
Total heat required for water heating calculated for each month											
181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717 (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)
Solar input (sum of months) = Sum(63)m =	0.0000 (63)										
Output from w/h											
181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717 (64)
Heat gains from water heating, kWh/month											
59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104 (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	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.7747	61.0851	49.6778	37.6093	28.1134	23.7345	25.6459	33.3356	44.7429	56.8114	66.3073	70.6862	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	429.3721	433.8276	422.5998	398.6971	368.5243	340.1660	321.2210	316.7655	327.9933	351.8960	382.0688	410.4270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains	693.0369	687.4337	659.8790	617.2197	573.2050	534.3506	512.1211	522.0165	547.0209	589.9144	637.3997	673.6442	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				5.0300	10.6334	0.4400	0.0000	0.7700	18.1210 (74)			
South				11.5400	46.7521	0.4400	0.0000	0.7700	182.7890 (78)			
West				0.5100	19.6403	0.4400	0.0000	0.7700	3.3936 (80)			
Solar gains	204.3036	340.6301	451.1112	541.4547	595.9863	588.5264	568.6053	527.4359	481.8139	371.9892	243.2533	175.8438 (83)
Total gains	897.3405	1028.0638	1110.9902	1158.6744	1169.1913	1122.8770	1080.7264	1049.4524	1028.8348	961.9037	880.6530	849.4880 (84)

7. Mean internal temperature (heating season)

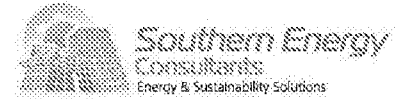
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	31.8696	31.9364	32.0020	32.3142	32.3732	32.6511	32.6511	32.7031	32.5435	32.3732	32.2539	32.1302
alpha	3.1246	3.1291	3.1335	3.1543	3.1582	3.1767	3.1767	3.1802	3.1696	3.1582	3.1503	3.1420
util living area	0.9773	0.9643	0.9438	0.9052	0.8346	0.7111	0.5675	0.5988	0.7755	0.9121	0.9648	0.9807 (86)
MIT	19.0745	19.3069	19.6486	20.0785	20.4795	20.7892	20.9255	20.9093	20.7002	20.1844	19.5503	19.0278 (87)
Th 2	19.8398	19.8419	19.8440	19.8538	19.8557	19.8643	19.8643	19.8659	19.8610	19.8557	19.8520	19.8481 (88)
util rest of house	0.9725	0.9569	0.9316	0.8827	0.7910	0.6284	0.4445	0.4792	0.7048	0.8868	0.9562	0.9766 (89)
MIT 2	17.3058	17.6419	18.1341	18.7491	19.2976	19.6886	19.8240	19.8130	19.5888	18.9079	18.0040	17.2431 (90)
Living area fraction	17.5102	17.8344	18.3091	18.9028	19.4342	19.8158	19.9513	19.9398	19.7172	19.0555	18.1827	17.4494 (92)
MIT	17.5102	17.8344	18.3091	18.9028	19.4342	19.8158	19.9513	19.9398	19.7172	19.0555	18.1827	17.4494 (92)
Temperature adjustment	17.3602	17.6844	18.1591	18.7528	19.2842	19.6658	19.8013	19.7898	19.5672	18.9055	18.0327	-0.1500
adjusted MIT	17.3602	17.6844	18.1591	18.7528	19.2842	19.6658	19.8013	19.7898	19.5672	18.9055	18.0327	17.2994 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9572	0.9371	0.9071	0.8547	0.7644	0.6118	0.4370	0.4703	0.6830	0.8587	0.9363	0.9628 (94)
Useful gains	858.8899	963.3715	1007.7994	990.3331	893.7557	686.9948	472.2445	493.5610	702.7454	826.0175	824.5511	817.8642 (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	2071.9376	2023.9403	1842.0107	1541.5949	1184.4786	784.4343	495.7128	524.0628	849.3926	1297.1241	1713.7553	2061.3023 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	902.5075	712.7023	620.6532	396.9086	216.2978	0.0000	0.0000	0.0000	0.0000	350.5033	640.2270	925.1179 (98)
Space heating												4764.9175 (98)
Space heating per m2												(98) / (4) = 39.0855 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Calculation of Energy Ratings 09 Jan 2014

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 %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													5265.1022 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	902.5075	712.7023	620.6532	396.9086	216.2978	0.0000	0.0000	0.0000	0.0000	350.5033	640.2270	925.1179	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	997.2458	787.5163	685.8046	438.5730	239.0031	0.0000	0.0000	0.0000	0.0000	387.2964	707.4332	1022.2297	(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	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(64)
Efficiency of water heater (217)m	89.9488	89.8995	89.8092	89.6209	89.2143	87.3000	87.3000	87.3000	87.3000	89.5143	89.8331	89.9732	(217)
Fuel for water heating, kWh/month	201.3963	176.6772	183.5391	161.8224	157.0686	140.1498	131.4963	148.5825	149.6726	168.1501	181.0012	195.4712	(219)
Water heating fuel used												1995.0272	(219)
Annual totals kWh/year													
Space heating fuel - main system												5265.1022	(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)												485.8334	(232)
Total delivered energy for all uses												7820.9628	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5265.1022	3.4800	183.2256 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1995.0272	3.4800	69.4269 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	485.8334	13.1900	64.0814 (250)
Additional standing charges			120.0000 (251)
Total energy cost			446.6264 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200 (256)
Energy cost factor (ECF)	1.1239 (257)
SAP value	84.3222
SAP rating (Section 12)	84 (258)
SAP band	B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	5265.1022	0.2160	1137.2621 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1995.0272	0.2160	430.9259 (264)
Space and water heating			1568.1880 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	485.8334	0.5190	252.1475 (268)
Total kg/year			1859.2605 (272)
CO2 emissions per m2			15.2500 (273)
EI value			85.0733
EI rating			85 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$, stars = 4
Water heating energy efficiency	$3.48 / 0.8892 = 3.914$, stars = 4
Water heating environmental impact	$0.216 / 0.8892 = 0.2429$, stars = 4

Regs Region: England

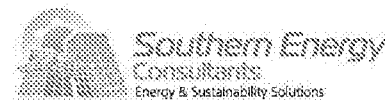
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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)	=	0.3262 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)
Adj infilt rate	0.3425	0.3262	0.3262	0.3017	0.3017	0.2691	0.2772	0.2609	0.2691	0.2854	0.2854	0.3098 (22b)
Effective ac	0.5586	0.5532	0.5532	0.5455	0.5455	0.5362	0.5384	0.5340	0.5362	0.5407	0.5407	0.5480 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			17.0800	1.2357	21.1065		(27)
Heat Loss Floor 1			50.9800	0.2000	10.1960	75.0000	3823.5000 (28a)
Exposed Floor Over Garage			18.0600	0.1838	3.3187	20.0000	361.2000 (28b)
Brick Cavity	145.7100	19.2300	126.4800	0.2500	31.6200	60.0000	7588.8000 (29a)
Solid Garage Wall	21.8500		21.8500	0.4056	8.8615	9.0000	196.6500 (29a)
Main Plane	70.9300		70.9300	0.1100	7.8023	9.0000	638.3700 (30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.9150		(33)
Internal Wall 1			24.2700			75.0000	1820.2500 (32c)
Internal Wall 2			215.2700			9.0000	1937.4300 (32c)
Internal Floor 1			50.9800			18.0000	917.6400 (32d)
Internal Ceiling 1			50.9800			18.0000	917.6400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18201.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							149.3026 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8356 (36)
Total fabric heat loss						(33) + (36) =	100.7506 (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	55.1479	54.6097	54.6097	53.8516	53.8516	52.9327	53.1526	52.7194	52.9327	53.3790	53.3790	54.0977 (38)
Heat transfer coeff	155.8985	155.3603	155.3603	154.6022	154.6022	153.6833	153.9032	153.4700	153.6833	154.1296	154.1296	154.8483 (39)
Average = Sum(39)m / 12 =												154.4726 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2788	1.2744	1.2744	1.2682	1.2682	1.2606	1.2624	1.2589	1.2606	1.2643	1.2643	1.2702 (40)
HLP (average)												1.2671 (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												2.8704 (42)
Average daily hot water use (litres/day)												102.3720 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (45)

Regs Region: England

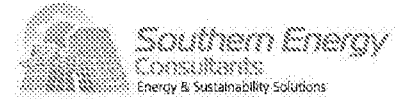
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Energy content (annual)	Total = Sum(45)m = 1610.7108 (45)										
Distribution loss (46)m = 0.15 x (45)m											
25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590 (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											
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	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702 (61)
Total heat required for water heating calculated for each month											
181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717 (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)
Solar input (sum of months) = Sum(63)m =	0.0000 (63)										
Output from w/h											
181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717 (64)
Total per year (kWh/year) = Sum(64)m =	1776.4874 (64)										
Heat gains from water heating, kWh/month											
59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104 (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	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.7747	61.0851	49.6778	37.6093	28.1134	23.7345	25.6459	33.3356	44.7429	56.8114	66.3073	70.6862	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	429.3721	433.8276	422.5998	398.6971	368.5243	340.1660	321.2210	316.7655	327.9933	351.8960	382.0688	410.4270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains	693.0369	687.4337	659.8790	617.2197	573.2050	534.3506	512.1211	522.0165	547.0209	589.9144	637.3997	673.6442	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	5.0300	11.9814	0.4400	0.0000	0.7700	20.4183 (74)
South	11.5400	50.9848	0.4400	0.0000	0.7700	199.3380 (78)
West	0.5100	22.3313	0.4400	0.0000	0.7700	3.8586 (80)

Solar gains	223.6149	335.1961	439.1575	546.5743	590.3098	625.9792	597.3543	563.1894	509.4036	390.8805	272.6631	190.6901	(83)
Total gains	916.6518	1022.6299	1099.0366	1163.7941	1163.5148	1160.3298	1109.4754	1085.2059	1056.4245	980.7949	910.0628	864.3343	(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	32.4312	32.5435	32.5435	32.7031	32.7031	32.8986	32.8516	32.9443	32.8986	32.8033	32.8033	32.6511
alpha	3.1621	3.1696	3.1696	3.1802	3.1802	3.1932	3.1901	3.1963	3.1932	3.1869	3.1869	3.1767
util living area	0.9724	0.9601	0.9353	0.8834	0.7835	0.5893	0.4129	0.4322	0.6934	0.8842	0.9542	0.9764 (86)
MIT	19.2655	19.4568	19.8132	20.2462	20.6437	20.9071	20.9792	20.9757	20.8256	20.3621	19.7548	19.2279 (87)
Th 2	19.8575	19.8610	19.8610	19.8659	19.8659	19.8718	19.8704	19.8732	19.8718	19.8689	19.8689	19.8643 (88)
util rest of house	0.9665	0.9516	0.9207	0.8548	0.7248	0.4813	0.2701	0.2891	0.6005	0.8498	0.9426	0.9712 (89)
MIT 2	17.5934	17.8704	18.3804	18.9898	19.5157	19.8130	19.8647	19.8660	19.7374	19.1606	18.3083	17.5437 (90)
Living area fraction	17.7866	18.0537	18.5460	19.1350	19.6461	19.9394	19.9935	19.9942	fLA = Living area / (4) =	19.8632	19.2994	18.4755 (91)
MIT	17.7866	18.0537	18.5460	19.1350	19.6461	19.9394	19.9935	19.9942	19.8632	19.2994	18.4755	17.7384 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.6366	17.9037	18.3960	18.9850	19.4961	19.7894	19.8435	19.8442	19.7132	19.1494	18.3255	17.5884 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation	0.9494	0.9309	0.8952	0.8268	0.7022	0.4726	0.2666	0.2852	0.5856	0.8217	0.9202	0.9556	(94)	
Useful gains	870.2497	951.9359	983.8811	962.2654	816.9726	548.3833	295.7620	309.4819	618.6009	805.9231	837.4309	825.9871	(95)	
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)	
Heat loss rate W	1954.4443	1911.5092	1708.3356	1404.5663	1004.3086	582.3723	299.1125	313.7290	693.6048	1163.5915	1591.4607	1933.8044	(97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	(97a)	
Space heating kWh	806.6408	644.8333	538.9942	318.4566	139.3780	0.0000	0.0000	0.0000	0.0000	266.1053	542.9015	824.2161	(98)	
Space heating												4081.5257	(98)	
Space heating per m2												(98) / (4) =	33.4798	(99)

Regs Region: England

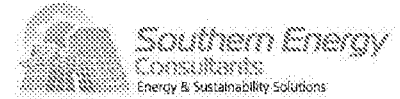
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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 %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4509.9732 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	806.6408	644.8333	538.9942	318.4566	139.3780	0.0000	0.0000	0.0000	0.0000	266.1053	542.9015	824.2161	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	891.3158	712.5229	595.5737	351.8858	154.0088	0.0000	0.0000	0.0000	0.0000	294.0391	599.8911	910.7361	(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	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(64)
Efficiency of water heater (217)m	89.8957	89.8491	89.7297	89.4738	88.8669	87.3000	87.3000	87.3000	87.3000	89.3172	89.7419	89.9204	(216)
Fuel for water heating, kWh/month	201.5153	176.7762	183.7017	162.0884	157.6826	140.1498	131.4963	148.5825	149.6726	168.5211	181.1852	195.5860	(219)
Water heating fuel used													1996.9578 (219)
Annual totals kWh/year													
Space heating fuel - main system													4509.9732 (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)													485.8334 (232)
Total delivered energy for all uses													7067.7644 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4509.9732	3.8700	174.5360 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1996.9578	3.8700	77.2823 (247)
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)
Energy for lighting	485.8334	18.9000	91.8225 (250)
Additional standing charges			93.0000 (251)
Total energy cost			450.8157 (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	4509.9732	0.2160	974.1542 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1996.9578	0.2160	431.3429 (264)
Space and water heating			1405.4971 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	485.8334	0.5190	252.1475 (268)
Total kg/year			1696.5696 (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	4509.9732	1.2200	5502.1673 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1996.9578	1.2200	2436.2885 (264)
Space and water heating			7938.4558 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	485.8334	3.0700	1491.5085 (268)
Primary energy kWh/year			9660.2143 (272)
Primary energy kWh/m2/year			79.2405 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84
Current environmental impact rating: B 85

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 30	-193 kg (11.4%)
U Solar photovoltaic panels	+ 8.0	-£ 345	-947 kg (63.0%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£30	1.58 kg/m²	B 85 B 87
Solar photovoltaic panels	£345	7.77 kg/m²	A 93 A 94
Total Savings	£374	9.35 kg/m²	

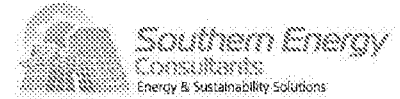
Potential energy efficiency rating: A 93
Potential environmental impact rating: A 94

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

Typical heating and lighting costs of this home (per year, Thames Valley):			
	Current	Potential	Saving
Electricity	£106	£115	-£9
Mains gas	£345	£306	£39
Space heating	£282	£282	£0
Water heating	£77	£48	£30
Lighting	£92	£92	£0
Generated (PV)	-£0	-£345	£345
Total cost of fuels	£451	£76	£375
Total cost of uses	£451	£77	£375
Delivered energy	58 kWh/m²	35 kWh/m²	23 kWh/m²
Carbon dioxide emissions	1.7 tonnes	0.6 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	5 kg/m²	9 kg/m²
Primary energy	79 kWh/m²	24 kWh/m²	55 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	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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)	=	0.3262 (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	0.4159	0.4077	0.3995	0.3588	0.3506	0.3098	0.3098	0.3017	0.3262	0.3506	0.3669	0.3832 (22b)
Effective ac	0.5865	0.5831	0.5798	0.5644	0.5615	0.5480	0.5480	0.5455	0.5532	0.5615	0.5673	0.5734 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			17.0800	1.2357	21.1065		(27)
Heat Loss Floor 1			50.9800	0.2000	10.1960	75.0000	3823.5000 (28a)
Exposed Floor Over Garage			18.0600	0.1838	3.3187	20.0000	361.2000 (28b)
Brick Cavity	145.7100	19.2300	126.4800	0.2500	31.6200	60.0000	7588.8000 (29a)
Solid Garage Wall	21.8500		21.8500	0.4056	8.8615	9.0000	196.6500 (29a)
Main Plane	70.9300		70.9300	0.1100	7.8023	9.0000	638.3700 (30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.9150		(33)
Internal Wall 1			24.2700			75.0000	1820.2500 (32c)
Internal Wall 2			215.2700			9.0000	1937.4300 (32c)
Internal Floor 1			50.9800			18.0000	917.6400 (32d)
Internal Ceiling 1			50.9800			18.0000	917.6400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18201.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							149.3026 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8356 (36)
Total fabric heat loss						(33) + (36) =	100.7506 (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	57.8947	57.5632	57.2383	55.7123	55.4268	54.0977	54.0977	53.8516	54.6097	55.4268	56.0044	56.6082 (38)
Heat transfer coeff	158.6452	158.3138	157.9889	156.4629	156.1774	154.8483	154.8483	154.6022	155.3603	156.1774	156.7550	157.3588 (39)
Average = Sum(39)m / 12 =												156.4615 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3013	1.2986	1.2959	1.2834	1.2811	1.2702	1.2702	1.2682	1.2744	1.2811	1.2858	1.2908 (40)
HLP (average)												1.2834 (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												2.8704 (42)
Average daily hot water use (litres/day)												102.3720 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1610.7108 (45)										
Distribution loss (46)m = 0.15 x (45)m											
25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590 (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											
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	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702 (61)
Total heat required for water heating calculated for each month											
181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717 (62)
Aperture area of solar collector											
Zero-loss collector efficiency											
Collector heat loss coefficient											
Collector 2nd order heat loss coefficient											
Collector effective heat loss coefficient											
Collector performance ratio											
Annual solar radiation per m2											
Overshading factor											
Solar energy available											
Adjustment factor for showers											
Solar-to-load ratio											
Utilisation factor											
Collector performance factor											
Dedicated solar storage volume											
Effective solar volume											
Daily hot water demand											
Volume ratio Veff/V											
Solar storage volume factor											
Solar input											
Solar input	-25.5237	-42.5918	-72.5387	-97.2161	-120.1023	-118.0797	-116.5192	-101.8034	-79.7325	-54.4479	-30.2748
Output from w/h											
155.6299	116.2400	92.2963	47.8105	20.0254	4.2711	0.0000	27.9091	50.9317	96.0704	132.3241	154.5127 (64)
Heat gains from water heating, kWh/month											
59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104 (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	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.7747	61.0551	49.6778	37.6093	28.1134	23.7345	25.6459	33.3356	44.7429	56.8114	66.3073	70.6862	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	429.3721	433.8276	422.5998	398.6971	368.5243	340.1660	321.2210	316.7655	327.9933	351.8960	382.0688	410.4270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains	693.0369	687.4337	659.8790	617.2197	573.2050	534.3506	512.1211	522.0165	547.0209	589.9144	637.3997	673.6442	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W

North	5.0300	10.6334	0.4400	0.0000	0.7700	18.1210 (74)
South	11.5400	46.7521	0.4400	0.0000	0.7700	182.7890 (78)
West	0.5100	19.6403	0.4400	0.0000	0.7700	3.3936 (80)

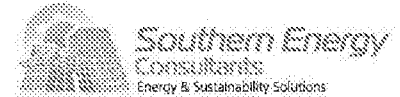
Solar gains	204.3036	340.6301	451.1112	541.4547	595.9863	588.5264	568.6053	527.4359	481.8139	371.9892	243.2533	175.8438	(83)
Total gains	897.3405	1028.0638	1110.9902	1158.6744	1169.1913	1122.8770	1080.7264	1049.4524	1028.8348	961.9037	880.6530	849.4880	(84)

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	31.8696	31.9364	32.0020	32.3142	32.3732	32.6511	32.6511	32.7031	32.5435	32.3732	32.2539	32.1302
alpha	3.1246	3.1291	3.1335	3.1543	3.1582	3.1767	3.1767	3.1802	3.1696	3.1582	3.1503	3.1420
util living area												
	0.9773	0.9643	0.9438	0.9052	0.8346	0.7111	0.5675	0.5988	0.7755	0.9121	0.9648	0.9807 (86)
MIT	19.0745	19.3069	19.6486	20.0785	20.4795	20.7892	20.9255	20.9093	20.7002	20.1844	19.5503	19.0278 (87)
Th 2	19.8398	19.8419	19.8440	19.8538	19.8557	19.8643	19.8643	19.8659	19.8610	19.8557	19.8520	19.8481 (88)
util rest of house												
	0.9725	0.9569	0.9316	0.8827	0.7910	0.6284	0.4445	0.4792	0.7048	0.8868	0.9562	0.9766 (89)
MIT 2	17.3058	17.6419	18.1341	18.7491	19.2976	19.6886	19.8240	19.8130	19.5888	18.9079	18.0040	17.2431 (90)
Living area fraction												
MIT	17.5102	17.8344	18.3091	18.9028	19.4342	19.8158	19.9513	19.9398	19.7172	19.0555	18.1827	17.4494 (91)
Temperature adjustment												
adjusted MIT	17.3602	17.6844	18.1591	18.7528	19.2842	19.6658	19.8013	19.7898	19.5672	18.9055	18.0327	17.2994 (93)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9572	0.9371	0.9071	0.8547	0.7644	0.6118	0.4370	0.4703	0.6830	0.8587	0.9363	0.9628	(94)
Useful gains	858.8899	963.3715	1007.7994	990.3331	893.7557	686.9948	472.2445	493.5610	702.7454	826.0175	824.5511	817.8642	(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	2071.9376	2023.9403	1842.0107	1541.5949	1184.4786	784.4343	495.7128	524.0628	849.3926	1297.1241	1713.7553	2061.3023	(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	902.5075	712.7023	620.6532	396.9086	216.2978	0.0000	0.0000	0.0000	0.0000	350.5033	640.2270	925.1179	(98)
Space heating												4764.9175	(98)
Space heating per m2												(98) / (4) =	39.0855 (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 %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													5265.1022 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	902.5075	712.7023	620.6532	396.9086	216.2978	0.0000	0.0000	0.0000	0.0000	350.5033	640.2270	925.1179	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	997.2458	787.5163	685.8046	438.5730	239.0031	0.0000	0.0000	0.0000	0.0000	387.2964	707.4332	1022.2297	(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	155.6299	116.2400	92.2963	47.8105	20.0254	4.2711	0.0000	27.9091	50.9317	96.0704	132.3241	154.5127	(64)
Efficiency of water heater	90.0147	90.0372	90.0726	90.1448	90.2198	87.3000	87.3000	87.3000	87.3000	89.7919	89.9354	90.0277	(217)
Fuel for water heating, kWh/month	172.8938	129.1022	102.4688	53.0375	22.1962	4.8924	0.0000	31.9691	58.3410	106.9922	147.1325	171.6279	(219)
Water heating fuel used												1000.6538	(219)
Annual totals kWh/year													
Space heating fuel - main system												5265.1022	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump													30.0000 (230c)
main heating flue fan													45.0000 (230e)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													125.0000 (231)
Electricity for lighting (calculated in Appendix L)													485.8334 (232)
Energy saving/generation technologies (Appendices M, N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =									-1727.2394			-1727.2394	(233)
Total delivered energy for all uses												5149.3500	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5265.1022	3.4800	183.2256	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1000.6538	3.4800	34.8228	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	485.8334	13.1900	64.0814	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			190.7944	(255)

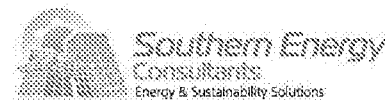
11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4801 (257)
SAP value		93.3026
SAP rating (Section 12)		93 (258)
SAP band		A

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

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	5265.1022	0.2160	1137.2621 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1000.6538	0.2160	216.1412 (264)
Space and water heating			1353.4033 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	485.8334	0.5190	252.1475 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			773.9886 (272)
CO2 emissions per m2			6.3500 (273)
EI value			93.7862
EI rating			94 (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	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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) =	0.3262 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)
Adj infilt rate	0.3425	0.3262	0.3262	0.3017	0.3017	0.2691	0.2772	0.2609	0.2691	0.2854	0.2854	0.3098 (22b)
Effective ac	0.5586	0.5532	0.5532	0.5455	0.5455	0.5362	0.5384	0.5340	0.5362	0.5407	0.5407	0.5480 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			17.0800	1.2357	21.1065		(27)
Heat Loss Floor 1			50.9800	0.2000	10.1960	75.0000	3823.5000 (28a)
Exposed Floor Over Garage			18.0600	0.1838	3.3187	20.0000	361.2000 (28b)
Brick Cavity	145.7100	19.2300	126.4800	0.2500	31.6200	60.0000	7588.8000 (29a)
Solid Garage Wall	21.8500		21.8500	0.4056	8.8615	9.0000	196.6500 (29a)
Main Plane	70.9300		70.9300	0.1100	7.8023	9.0000	638.3700 (30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.9150		(33)
Internal Wall 1			24.2700			75.0000	1820.2500 (32c)
Internal Wall 2			215.2700			9.0000	1937.4300 (32c)
Internal Floor 1			50.9800			18.0000	917.6400 (32d)
Internal Ceiling 1			50.9800			18.0000	917.6400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18201.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							149.3026 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8356 (36)
Total fabric heat loss						(33) + (36) =	100.7506 (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	55.1479	54.6097	54.6097	53.8516	53.8516	52.9327	53.1526	52.7194	52.9327	53.3790	53.3790	54.0977 (38)
Heat transfer coeff	155.8985	155.3603	155.3603	154.6022	154.6022	153.6833	153.9032	153.4700	153.6833	154.1296	154.1296	154.8483 (39)
Average = Sum(39)m / 12 =												154.4726 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2788	1.2744	1.2744	1.2682	1.2682	1.2606	1.2624	1.2589	1.2606	1.2643	1.2643	1.2702 (40)
HLP (average)												1.2671 (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												2.8704 (42)
Average daily hot water use (litres/day)												102.3720 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Energy content (annual)	Total = Sum(45)m = 1610.7108 (45)										
Distribution loss (46)m = 0.15 x (45)m											
25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590 (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											
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	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702 (61)
Total heat required for water heating calculated for each month											
181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717 (62)
Aperture area of solar collector											
Zero-loss collector efficiency											
Collector heat loss coefficient											
Collector 2nd order heat loss coefficient											
Collector effective heat loss coefficient											
Collector performance ratio											
Annual solar radiation per m2											
Overshading factor											
Solar energy available											
Adjustment factor for showers											
Solar-to-load ratio											
Utilisation factor											
Collector performance factor											
Dedicated solar storage volume											
Effective solar volume											
Daily hot water demand											
Volume ratio Veff/V											
Solar storage volume factor											
Solar input											
Solar input	-27.6456	-41.5513	-69.9776	-96.7305	-116.4960	-122.6070	-119.6629	-106.8597	-83.4044	-56.7385	-33.6039 (63)
Output from w/h											
153.5080	117.2805	94.8574	48.2962	23.6317	0.0000	0.0000	22.8528	47.2598	93.7799	128.9950	152.9671 (64)
Heat gains from water heating, kWh/month											
59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104 (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	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.7747	61.0551	49.6778	37.6093	28.1134	23.7345	25.6459	33.3356	44.7429	56.8114	66.3073	70.6862	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	429.3721	433.8276	422.5998	398.6971	368.5243	340.1660	321.2210	316.7655	327.9933	351.8960	382.0688	410.4270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains	693.0369	687.4337	659.8790	617.2197	573.2050	534.3506	512.1211	522.0165	547.0209	589.9144	637.3997	673.6442	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	5.0300	11.9814	0.4400	0.0000	0.7700	20.4183 (74)
South	11.5400	50.9848	0.4400	0.0000	0.7700	199.3380 (78)
West	0.5100	22.3313	0.4400	0.0000	0.7700	3.8586 (80)

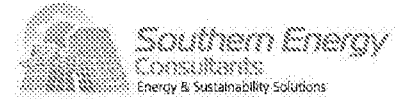
Solar gains	223.6149	335.1961	439.1575	546.5743	590.3098	625.9792	597.3543	563.1894	509.4036	390.8805	272.6631	190.6901	(83)
Total gains	916.6518	1022.6299	1099.0366	1163.7941	1163.5148	1160.3298	1109.4754	1085.2059	1056.4245	980.7949	910.0628	864.3343	(84)

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	32.4312	32.5435	32.5435	32.7031	32.7031	32.8986	32.8516	32.9443	32.8986	32.8033	32.8033	32.6511
alpha	3.1621	3.1696	3.1696	3.1802	3.1802	3.1932	3.1901	3.1963	3.1932	3.1869	3.1869	3.1767
util living area												
	0.9724	0.9601	0.9353	0.8834	0.7835	0.5893	0.4129	0.4322	0.6934	0.8842	0.9542	0.9764 (86)
MIT	19.2655	19.4568	19.8132	20.2462	20.6437	20.9071	20.9792	20.9757	20.8256	20.3621	19.7548	19.2279 (87)
Th 2	19.8575	19.8610	19.8610	19.8659	19.8659	19.8718	19.8704	19.8732	19.8718	19.8689	19.8689	19.8643 (88)
util rest of house												
	0.9665	0.9516	0.9207	0.8548	0.7248	0.4813	0.2701	0.2891	0.6005	0.8498	0.9426	0.9712 (89)
MIT 2	17.5934	17.8704	18.3804	18.9898	19.5157	19.8130	19.8647	19.8660	19.7374	19.1606	18.3083	17.5437 (90)
Living area fraction												
MIT	17.7866	18.0537	18.5460	19.1350	19.6461	19.9394	19.9935	19.9942	19.8632	19.2994	18.4755	17.7384 (91)
Temperature adjustment												
adjusted MIT	17.6366	17.9037	18.3960	18.9850	19.4961	19.7894	19.8435	19.8442	19.7132	19.1494	18.3255	17.5884 (93)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9494	0.9309	0.8952	0.8268	0.7022	0.4726	0.2666	0.2852	0.5856	0.8217	0.9202	0.9556	(94)
Useful gains	870.2497	951.9359	983.8811	962.2654	816.9726	548.3833	295.7620	309.4819	618.6009	805.9231	837.4309	825.9871	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1954.4443	1911.5092	1708.3356	1404.5663	1004.3086	582.3723	299.1125	313.7290	693.6048	1163.5915	1591.4607	1933.8044	(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													
	806.6408	644.8333	538.9942	318.4566	139.3780	0.0000	0.0000	0.0000	0.0000	266.1053	542.9015	824.2161	(98)
Space heating												4081.5257	(98)
Space heating per m2											(98) / (4) =	33.4798	(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 %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4509.9732 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	806.6408	644.8333	538.9942	318.4566	139.3780	0.0000	0.0000	0.0000	0.0000	266.1053	542.9015	824.2161	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	891.3158	712.5229	595.5737	351.8858	154.0088	0.0000	0.0000	0.0000	0.0000	294.0391	599.8911	910.7361	(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	153.5080	117.2805	94.8574	48.2962	23.6317	0.0000	0.0000	22.8528	47.2598	93.7799	128.9950	152.9671	(64)
Efficiency of water heater	89.9727	89.9924	90.0063	90.0653	90.0216	87.3000	87.3000	87.3000	87.3000	89.6437	89.8676	89.9837	(217)
Fuel for water heating, kWh/month	170.6162	130.3228	105.3897	53.6235	26.2511	0.0000	0.0000	26.1773	54.1350	104.6139	143.5390	169.9943	(219)
Water heating fuel used												984.6628	(219)
Annual totals kWh/year													
Space heating fuel - main system												4509.9732	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												485.8334	(232)
Energy saving/generation technologies (Appendices M, N and Q)													
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) =									-1824.1596			-1824.1596	(233)
Total delivered energy for all uses												4281.3097	(238)

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

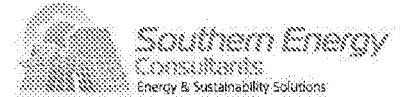
	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4509.9732	3.8700	174.5360 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	984.6628	3.8700	38.1064 (247)
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)
Pump for solar water heating	50.0000	18.9000	9.4500 (249)
Energy for lighting	485.8334	18.9000	91.8225 (250)
Additional standing charges			93.0000 (251)
Energy saving/generation technologies			
PV Unit	-1824.1596	18.9000	-344.7662 (252)
Total energy cost			76.3238 (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	4509.9732	0.2160	974.1542 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	984.6628	0.2160	212.6872 (264)
Space and water heating			1186.8414 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	485.8334	0.5190	252.1475 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	0.5190	-946.7389 (269)

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 557.1250 (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	4509.9732	1.2200	5502.1673 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	984.6628	1.2200	1201.2886 (264)
Space and water heating			6703.4558 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	485.8334	3.0700	1491.5085 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	3.0700	-5600.1701 (269)
Primary energy kWh/year			2978.5443 (272)
Primary energy kWh/m2/year			24.4323 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	149.3 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	394.87 (P1)
Transmission heat loss coefficient	100.75 (37)
Summer heat loss coefficient	495.62 (P2)

Overhangs Orientation	Ratio	Z_overhangs	Overhang type
North	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
North	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 data g or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	5.0300	81.1852	0.4400	0.0000	0.9000	161.7111
South	11.5400	112.2060	0.4400	0.0000	0.9000	512.7635
West	0.5100	117.5071	0.4400	0.0000	0.9000	23.7317

total: 698.2063

	Jun	Jul	Aug	
Solar gains	732	698	658	(P4)
Internal gains	531	509	519	
Total summer gains	1263	1207	1177	(P5)

Summer gain/loss ratio	2.55	2.44	2.38	(P6)
Summer external temperature	16.00	17.90	17.60	
Thermal mass temperature increment (TMP = 149.3)	0.95	0.95	0.95	
Threshold temperature	19.50	21.29	21.13	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight