

FULL SAP CALCULATION PRINTOUT

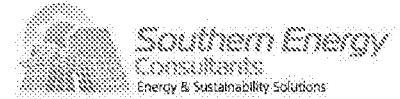
Calculation Type: New Build (As Designed)



Property Reference	SECANG010		Issued on Date	04/02/2021	
Assessment Reference	001	Prop Type Ref	Det Br Ea Ga		
Property	Warwick, Plot 41				
SAP Rating	84 B	DER	17.17	TET	17.70
Environmental	85 B	% DER<TER	2.97		
CO ₂ Emissions (t/year)	1.75	DPEE	54.54	TPEE	59.19
General Requirements Compliance	Pass	% DPEE<TPEE	7.86		
Assessor Details	Mr. Stuart Harvey, Stuart Harvey [REDACTED]			Assessor ID	T555-0001
Client	Persimmon Homes Thames Valley [REDACTED]				

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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) 17.70 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.17 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)59.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)54.5 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:

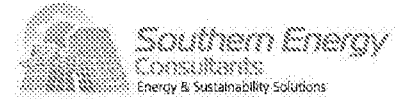
Overshading: Average
Windows facing North: 0.51 m², No overhang
Windows facing East: 11.54 m², No overhang
Windows facing West: 5.03 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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)

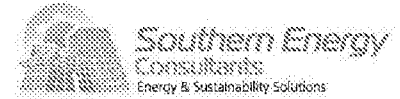
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	57.8947	57.5632	57.2383	55.7123	55.4268	54.0977	54.0977	53.8516	54.6097	55.4268	56.0044	56.6082 (38)
Heat transfer coeff	158.6452	158.3138	157.9889	156.4629	156.1774	154.8483	154.8483	154.6022	155.3603	156.1774	156.7550	157.3588 (39)
Average = Sum(39)m / 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				0.5100	10.6334	0.4400	0.0000	0.7700	1.8373 (74)			
East				11.5400	19.6403	0.4400	0.0000	0.7700	76.7886 (76)			
West				5.0300	19.6403	0.4400	0.0000	0.7700	33.4702 (80)			
Solar gains	112.0961	219.2008	361.1764	527.6362	647.8029	663.7464	631.6592	541.7393	420.2975	260.1135	139.7463	92.2031 (83)
Total gains	575.7305	680.3756	805.3461	944.2756	1036.0821	1025.1568	975.9450	892.7770	785.7901	653.3706	564.8341	541.5499 (84)

7. Mean internal temperature (heating season)

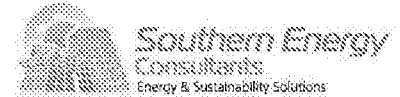
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	31.8696	31.9364	32.0020	32.3142	32.3732	32.6511	32.6511	32.7031	32.5435	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	0.9933	0.9882	0.9752	0.9408	0.8693	0.7475	0.6115	0.6684	0.8626	0.9655	0.9894	0.9945 (86)
MIT	18.7432	18.9600	19.3623	19.9034	20.3974	20.7540	20.9074	20.8747	20.5688	19.9152	19.2331	18.7070 (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	0.9918	0.9855	0.9691	0.9252	0.8314	0.6675	0.4849	0.5465	0.8071	0.9537	0.9865	0.9933 (89)
MIT 2	16.8258	17.1431	17.7285	18.5108	19.1961	19.6544	19.8126	19.7890	19.4431	18.5403	17.5489	16.7777 (90)
Living area fraction	17.0474	17.3531	17.9174	18.6717	19.3349	19.7815	19.9392	19.9144	19.5732	18.6992	17.7435	17.0007 (92)
Temperature adjustment	16.8974	17.2031	17.7674	18.5217	19.1849	19.6315	19.7892	19.7644	19.4232	18.5492	17.5935	-0.1500
adjusted MIT												16.8507 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9853	0.9755	0.9526	0.9000	0.8032	0.6482	0.4755	0.5339	0.7792	0.9330	0.9771	0.9878 (94)
Useful gains	567.2897	663.6845	767.1740	849.8425	832.1724	664.4872	464.0847	476.6498	612.3103	609.5758	551.8926	534.9226 (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	1998.5154	1947.7482	1780.1165	1505.4463	1168.9793	779.1146	493.8349	520.1498	827.0138	1241.4811	1644.9137	1990.7030 (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	1064.8319	862.8908	753.6292	472.0347	250.5844	0.0000	0.0000	0.0000	0.0000	470.1376	786.9752	1083.1007 (98)
Space heating												5744.1845 (98)
Space heating per m2												(98) / (4) = 47.1182 (99)

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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													6347.1652	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	1064.8319	862.8908	753.6292	472.0347	250.5844	0.0000	0.0000	0.0000	0.0000	470.1376	786.9752	1083.1007	(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)	1176.6099	953.4705	832.7395	521.5853	276.8888	0.0000	0.0000	0.0000	0.0000	519.4890	869.5859	1196.7963	(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	90.0203	89.9872	89.9085	89.7270	89.3257	87.3000	87.3000	87.3000	87.3000	89.7026	89.9355	90.0390	(217)	
Fuel for water heating, kWh/month	201.2365	176.5048	183.3363	161.6310	156.8728	140.1498	131.4963	148.5825	149.6726	167.7971	180.7951	195.3284	(219)	
Water heating fuel used												1993.4031	(219)	
Annual totals kWh/year														
Space heating fuel - main system													6347.1652	(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													8901.4017	(238)

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

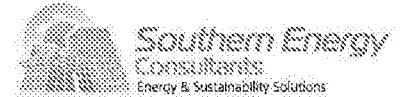
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	6347.1652	0.2160	1370.9877 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1993.4031	0.2160	430.5751 (264)
Space and water heating			1801.5628 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	485.8334	0.5190	252.1475 (268)
Total CO2, kg/year			2092.6353 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.1700 (273)

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

DER			17.1700	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			32.6947	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			32.6947	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)

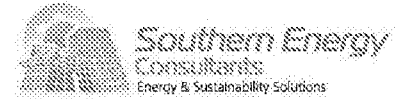
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	57.8947	57.5632	57.2383	55.7123	55.4268	54.0977	54.0977	53.8516	54.6097	55.4268	56.0044	56.6082 (38)
Heat transfer coeff	145.2087	144.8772	144.5524	143.0264	142.7409	141.4118	141.4118	141.1656	141.9237	142.7409	143.3184	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)												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												

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				0.5100	10.6334	0.6300		0.7000		0.7700		1.6573 (74)	
East				11.5400	19.6403	0.6300		0.7000		0.7700		69.2668 (76)	
West				5.0300	19.6403	0.6300		0.7000		0.7700		30.1917 (80)	
Solar gains	101.1158	197.7291	325.7976	475.9519	584.3477	598.7295	569.7853	488.6735	379.1275	234.6342	126.0575	83.1714	(83)
Total gains	577.1163	671.2742	782.3464	904.9825	984.3842	971.2103	925.1502	851.4766	757.0232	640.2821	563.5220	544.8885	(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	0.9993	0.9984	0.9950	0.9803	0.9293	0.8024	0.6390	0.7045	0.9197	0.9911	0.9986	0.9995	(86)
MIT	19.5867	19.7283	19.9915	20.3529	20.6833	20.9033	20.9762	20.9619	20.7825	20.3477	19.9039	19.5649	(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	0.9991	0.9978	0.9930	0.9718	0.8968	0.7154	0.5033	0.5712	0.8686	0.9861	0.9980	0.9993	(89)
MIT 2	18.0315	18.2401	18.6258	19.1552	19.6131	19.8823	19.9427	19.9366	19.7546	19.1540	18.5045	18.0054	(90)
Living area fraction									fLA = Living area / (4) =				0.1156 (91)
MIT	18.2112	18.4121	18.7837	19.2937	19.7368	20.0003	20.0622	20.0551	19.8734	19.2919	18.6663	18.1856	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2112	18.4121	18.7837	19.2937	19.7368	20.0003	20.0622	20.0551	19.8734	19.2919	18.6663	18.1856	(93)

8. Space heating requirement

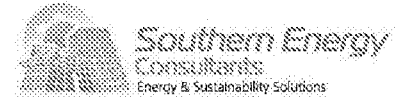
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9984	0.9965	0.9899	0.9645	0.8888	0.7200	0.5186	0.5854	0.8638	0.9814	0.9968	0.9988	(94)
Useful gains	576.2116	668.9317	774.4249	872.8990	874.9324	699.2536	479.7542	498.4759	653.9444	628.3575	561.7136	544.2482	(95)
Ext temp.	4.3000	4.9000	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	2020.0344	1957.5906	1775.6360	1486.5680	1147.1748	763.6641	489.5926	515.9701	819.3820	1240.6942	1657.6602	2012.8453	(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	1074.2042	865.9788	744.9010	441.8417	202.5483	0.0000	0.0000	0.0000	0.0000	455.5785	789.0816	1092.6363	(98)
Space heating												5666.7704	(98)
Space heating per m ²												(98) / (4) =	46.4832 (99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

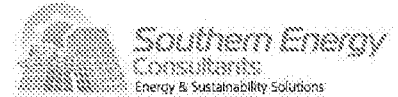
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													6067.2060 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1074.2042	865.9788	744.9010	441.8417	202.5483	0.0000	0.0000	0.0000	0.0000	455.5785	789.0816	1092.6363	(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)	1150.1115	927.1722	797.5385	473.0639	216.8612	0.0000	0.0000	0.0000	0.0000	487.7715	844.8411	1169.8461	(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	88.5219	88.3819	88.0407	87.2157	85.4183	80.3000	80.3000	80.3000	80.3000	87.2033	88.1732	88.5845	(217)
Fuel for water heating, kWh/month	246.2160	217.3335	229.0709	207.2030	205.0118	192.0719	184.0196	205.1387	207.2049	214.8923	224.8345	240.0936	(219)
Water heating fuel used												2573.0906	(219)
Annual totals kWh/year													
Space heating fuel - main system												6067.2060	(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												9201.1300	(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	6067.2060	0.2160	1310.5165 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2573.0906	0.2160	555.7876 (264)
Space and water heating			1866.3041 (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			2157.3766 (272)
Emissions per m2 for space and water heating			15.3089 (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) = (15.3089 * 1.00) + 2.0683 + 0.3193, rounded to 2 d.p.			17.7000 (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)

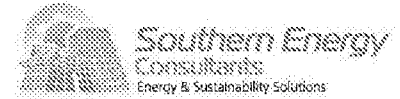
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	57.8947	57.5632	57.2383	55.7123	55.4268	54.0977	54.0977	53.8516	54.6097	55.4268	56.0044	56.6082 (38)
Heat transfer coeff	158.6452	158.3138	157.9889	156.4629	156.1774	154.8483	154.8483	154.6022	155.3603	156.1774	156.7550	157.3588 (39)
Average = Sum(39)m / 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			0.5100		10.6334		0.4400		0.0000		0.7700		1.8373 (74)
East			11.5400		19.6403		0.4400		0.0000		0.7700		76.7886 (76)
West			5.0300		19.6403		0.4400		0.0000		0.7700		33.4702 (80)
Solar gains	112.0961	219.2008	361.1764	527.6362	647.8029	663.7464	631.6592	541.7393	420.2975	260.1135	139.7463	92.2031	(83)
Total gains	541.0385	646.5412	773.2929	914.6438	1008.0263	999.3178	951.9868	866.4052	758.5583	623.6325	532.2660	507.7119	(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	0.9939	0.9890	0.9764	0.9429	0.8732	0.7542	0.6200	0.6784	0.8688	0.9678	0.9903	0.9950	(86)
MIT	18.6669	18.8888	19.3007	19.8558	20.3644	20.7356	20.8985	20.8625	20.5405	19.8663	19.1676	18.6307	(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	0.9926	0.9865	0.9707	0.9279	0.8365	0.6756	0.4937	0.5575	0.8155	0.9568	0.9877	0.9939	(89)
MIT 2	17.7093	17.9316	18.3419	18.8935	19.3775	19.7083	19.8248	19.8070	19.5534	18.9128	18.2176	17.6790	(90)
Living area fraction	17.8199	18.0423	18.4527	19.0047	19.4915	19.8270	19.9489	19.9290	19.6675	19.0230	18.3274	17.7890	(91)
MIT	17.8199	18.0423	18.4527	19.0047	19.4915	19.8270	19.9489	19.9290	19.6675	19.0230	18.3274	17.7890	(92)
Temperature adjustment	17.8199	18.0423	18.4527	19.0047	19.4915	19.8270	19.9489	19.9290	19.6675	19.0230	18.3274	17.7890	(93)

8. Space heating requirement

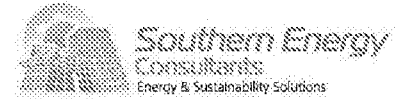
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	535.1291	634.1921	743.3051	835.5928	828.8508	672.1816	479.9735	489.6851	610.0041	589.7072	523.0412	503.1330	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2144.8732	2080.6016	1888.3969	1581.0100	1216.8595	809.3986	518.5649	545.5886	864.9687	1315.4842	1759.9542	2138.3518	(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	1197.6496	971.9872	851.9483	536.7004	288.6785	0.0000	0.0000	0.0000	0.0000	539.9781	890.5774	1216.6028	(98)
Space heating												6494.1223	(98)
Space heating per m2												53.2698	(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)

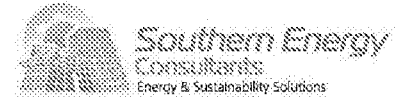


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7081	0.7825	0.7422	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1030.6887	896.6283	872.0794	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1284.3192	1226.4659	1128.8465	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	182.6140	245.3992	191.0347	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												619.0478 (104)
Cooled fraction									FC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
Intermittency factor	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	45.6535	61.3498	47.7587	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												154.7620 (107)
Space cooling per m2												1.2695 (108)
Energy for space heating												53.2698 (99)
Energy for space cooling												1.2695 (108)
Total												54.5393 (109)
Dwelling Fabric Energy Efficiency (DFEE)												54.5 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	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)

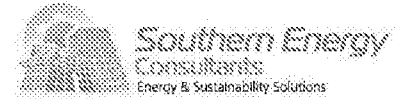
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	57.8947	57.5632	57.2383	55.7123	55.4268	54.0977	54.0977	53.8516	54.6097	55.4268	56.0044	56.6082 (38)
Heat transfer coeff	145.2087	144.8772	144.5524	143.0264	142.7409	141.4118	141.4118	141.1656	141.9237	142.7409	143.3184	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	0.5100	10.6334	0.6300		0.7000	0.7700	1.6573	(74)
East	11.5400	19.6403	0.6300		0.7000	0.7700	69.2668	(76)
West	5.0300	19.6403	0.6300		0.7000	0.7700	30.1917	(80)

Solar gains	101.1158	197.7291	325.7976	475.9519	584.3477	598.7295	569.7853	488.6735	379.1275	234.6342	126.0575	83.1714	(83)
Total gains	530.0582	625.0695	737.9140	862.9594	944.5711	934.3009	890.1129	813.3394	717.3882	598.1532	518.5772	498.6802	(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	0.9995	0.9988	0.9961	0.9837	0.9384	0.8196	0.6591	0.7279	0.9327	0.9934	0.9990	0.9997	(86)
MIT	19.5509	19.6932	19.9583	20.3236	20.6615	20.8929	20.9727	20.9559	20.7617	20.3167	19.8697	19.5295	(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	0.9994	0.9984	0.9946	0.9765	0.9090	0.7351	0.5216	0.5945	0.8871	0.9895	0.9986	0.9995	(89)
MIT 2	18.5970	18.7410	19.0071	19.3765	19.6993	19.8983	19.9446	19.9398	19.8000	19.3741	18.9256	18.5824	(90)
Living area fraction									fLA = Living area / (4) =			0.1156	(91)
MIT	18.7073	18.8510	19.1171	19.4859	19.8105	20.0132	20.0635	20.0572	19.9111	19.4830	19.0348	18.6919	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7073	18.8510	19.1171	19.4859	19.8105	20.0132	20.0635	20.0572	19.9111	19.4830	19.0348	18.6919	(93)

8. Space heating requirement

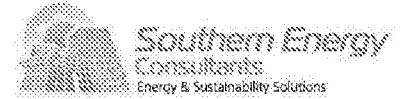
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9991	0.9978	0.9929	0.9724	0.9043	0.7408	0.5373	0.6092	0.8850	0.9871	0.9981	0.9993	(94)
Useful gains	529.5753	623.6877	732.6954	839.1086	854.1917	692.0972	478.2848	495.4657	634.8900	590.4235	517.5798	498.3484	(95)
Ext temp.	4.3000	4.9000	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	2092.0623	2021.1862	1823.8268	1514.0695	1157.6964	765.4933	489.7747	516.2764	824.7352	1267.9712	1710.4702	2085.7087	(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	(98a)
Space heating kWh	1162.4903	939.1190	811.8018	485.9718	225.8075	0.0000	0.0000	0.0000	0.0000	504.0955	858.8811	1180.9960	(98)
Space heating												6169.1630	(98)
Space heating per m ²										(98) / (4) =		50.6042	(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	0.7910	0.8711	0.8309	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1051.4512	911.5527	891.4612	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1208.3254	1154.1457	1066.8215	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)

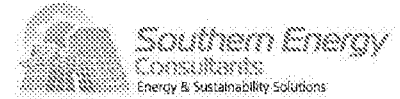


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	112.9494	180.4892	130.4680	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												423.9066 (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	28.2373	45.1223	32.6170	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												105.9766 (107)
Space cooling per m2												0.8693 (108)
Energy for space heating												50.6042 (99)
Energy for space cooling												0.8693 (108)
Total												51.4735 (109)
Target Fabric Energy Efficiency (TFEE)												59.2 (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

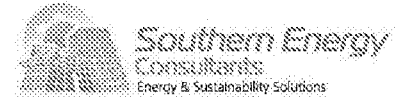
Elmhurst Energy Systems

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	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)
RHI water heating demand											
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					0.5100	11.9814	0.4400	0.0000	0.7700		2.0702 (74)	
East					11.5400	22.3313	0.4400	0.0000	0.7700		87.3099 (76)	
West					5.0300	22.3313	0.4400	0.0000	0.7700		38.0562 (80)	
Solar gains	127.4364	224.1916	364.3061	546.9880	652.9641	715.4380	673.7026	591.7632	459.0496	283.9229	162.7630	103.7997 (83)
Total gains	820.4733	911.6253	1024.1851	1164.2077	1226.1691	1249.7886	1185.8237	1113.7796	1006.0705	873.8373	800.1627	777.4438 (84)

7. Mean internal temperature (heating season)

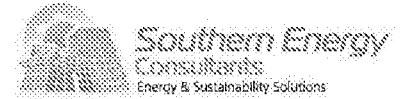
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	32.4312	32.5435	32.5435	32.7031	32.7031	32.8986	32.8516	32.9443	32.8986	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	0.9795	0.9704	0.9454	0.8833	0.7641	0.5572	0.3889	0.4223	0.7136	0.9099	0.9671	0.9823 (86)
MIT	19.1697	19.3505	19.7479	20.2465	20.6713	20.9210	20.9825	20.9773	20.8096	20.2831	19.6511	19.1401 (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	0.9750	0.9638	0.9327	0.8547	0.7034	0.4517	0.2533	0.2819	0.6217	0.8811	0.9584	0.9783 (89)
MIT 2	17.4558	17.7189	18.2897	18.9902	19.5464	19.8228	19.8657	19.8665	19.7231	19.0584	18.1621	17.4172 (90)
Living area fraction	fLA = Living area / (4) =											0.1156 (91)
MIT	17.6538	17.9075	18.4582	19.1354	19.6765	19.9497	19.9948	19.9949	19.8487	19.1999	18.3342	17.6164 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.5038	17.7575	18.3082	18.9854	19.5265	19.7997	19.8448	19.8449	19.6987	19.0499	18.1842	17.4664 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9606	0.9460	0.9086	0.8267	0.6822	0.4444	0.2501	0.2782	0.6053	0.8531	0.9391	0.9653	(94)
Useful gains	788.1628	862.3992	930.6003	962.4903	836.4927	555.3778	296.5263	309.8737	609.0137	745.4610	751.4491	750.4657	(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	1933.7393	1888.7937	1694.7005	1404.6231	1009.0052	583.9475	299.3044	313.8254	691.3708	1148.2559	1569.6867	1914.9089	(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	852.3089	689.7372	568.4906	318.3356	128.3493	0.0000	0.0000	0.0000	0.0000	299.6794	589.1311	866.3457	(98)
Space heating												4312.3779	(98)
RHI space heating demand												4312	(98)

FULL SAP CALCULATION PRINTOUT

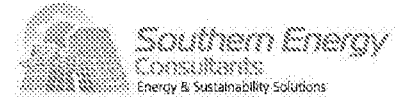
Calculation Type: New Build (As Designed)



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

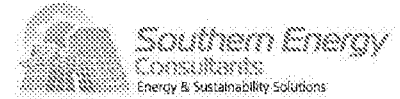
Elmhurst Energy Systems

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	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	0.5100	10.6334	0.4400	0.0000	0.7700	1.8373 (74)
East	11.5400	19.6403	0.4400	0.0000	0.7700	76.7886 (76)
West	5.0300	19.6403	0.4400	0.0000	0.7700	33.4702 (80)

Solar gains	112.0961	219.2008	361.1764	527.6362	647.8029	663.7464	631.6592	541.7393	420.2975	260.1135	139.7463	92.2031	(83)
Total gains	805.1330	906.6345	1021.0555	1144.8560	1221.0080	1198.0971	1143.7803	1063.7557	967.3184	850.0279	777.1460	765.8473	(84)

7. Mean internal temperature (heating season)

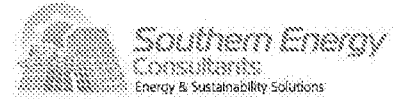
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	31.8696	31.9364	32.0020	32.3142	32.3732	32.6511	32.6511	Aug	Sep	Oct	Nov	Dec
alpha	3.1246	3.1291	3.1335	3.1543	3.1582	3.1767	3.1767	3.1802	3.1696	3.1582	3.1503	3.1420
util living area	0.9830	0.9743	0.9543	0.9077	0.8209	0.6842	0.5432	0.5929	0.7977	0.9339	0.9746	0.9854 (86)
MIT	18.9817	19.1894	19.5679	20.0680	20.5084	20.8124	20.9343	20.9119	20.6714	20.0931	19.4496	18.9424 (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	0.9794	0.9687	0.9440	0.8856	0.7753	0.6004	0.4229	0.4738	0.7299	0.9135	0.9682	0.9823 (89)
MIT 2	17.1719	17.4739	18.0208	18.7350	19.3326	19.7105	19.8293	19.8147	19.5581	18.7856	17.8607	17.1198 (90)
Living area fraction	17.3810	17.6722	18.1996	18.8890	19.4685	19.8379	19.9570	19.9415	fLA = Living area / (4) =	18.9367	18.0444	0.1156 (91)
Ext temp.	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310 (92)
Temperature adjustment	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310 (93)
adjusted MIT	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310	17.2310 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9666	0.9521	0.9215	0.8577	0.7496	0.5856	0.4163	0.4651	0.7064	0.8870	0.9515	0.9708	(94)
Heat loss rate W	778.2489	863.2603	940.8603	981.9448	915.2676	701.6507	476.1282	494.7724	683.2872	753.9497	739.4332	743.5126	(95)
Month fracti	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)
Space heating kWh	2051.4479	1998.2662	1824.7071	1539.4420	1189.8310	787.8498	496.6007	524.3403	844.6605	1278.5778	1692.0695	2042.5832	(97)
Space heating per m2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating	947.2601	762.7642	657.5820	401.3980	204.2752	0.0000	0.0000	0.0000	0.0000	390.3233	685.8981	966.5085	(98)
Space heating per m2												5016.0094	(98)
												41.1452	(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													5542.5518	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	947.2601	762.7642	657.5820	401.3980	204.2752	0.0000	0.0000	0.0000	0.0000	390.3233	685.8981	966.5085	(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)	1046.6962	842.8333	726.6100	443.5337	225.7184	0.0000	0.0000	0.0000	0.0000	431.2965	757.8985	1067.9652	(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	89.9706	89.9319	89.8400	89.6280	89.1701	87.3000	87.3000	87.3000	87.3000	89.5861	89.8687	89.9922	(217)	
Fuel for water heating, kWh/month	201.3476	176.6135	183.4762	161.8094	157.1465	140.1498	131.4963	148.5825	149.6726	168.0152	180.9294	195.4300	(219)	
Water heating fuel used												1994.6691	(219)	
Annual totals kWh/year														
Space heating fuel - main system												5542.5518	(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													8098.0543	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5542.5518	3.4800	192.8808 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1994.6691	3.4800	69.4145 (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			456.2692 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] = 1.1481 (257)
SAP value	83.9837
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	5542.5518	0.2160	1197.1912 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1994.6691	0.2160	430.8485 (264)
Space and water heating			1628.0397 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	485.8334	0.5190	252.1475 (268)
Total kg/year			1919.1122 (272)
CO2 emissions per m2			15.7400 (273)
EI value			84.5928
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	$3.48 / 0.8893 = 3.913$, stars = 4
Water heating environmental impact	$0.216 / 0.8893 = 0.2429$, stars = 4

Regs Region: England

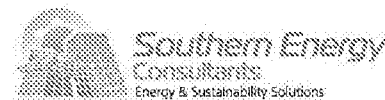
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

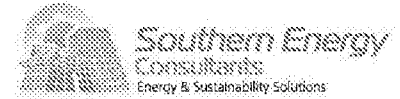
Calculation Type: New Build (As Designed)



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

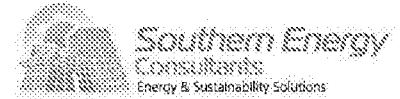
Elmhurst Energy Systems

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)
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					0.5100	11.9814	0.4400	0.0000	0.7700		2.0702 (74)	
East					11.5400	22.3313	0.4400	0.0000	0.7700		87.3099 (76)	
West					5.0300	22.3313	0.4400	0.0000	0.7700		38.0562 (80)	
Solar gains	127.4364	224.1916	364.3061	546.9880	652.9641	715.4380	673.7026	591.7632	459.0496	283.9229	162.7630	103.7997 (83)
Total gains	820.4733	911.6253	1024.1851	1164.2077	1226.1691	1249.7886	1185.8237	1113.7796	1006.0705	873.8373	800.1627	777.4438 (84)

7. Mean internal temperature (heating season)

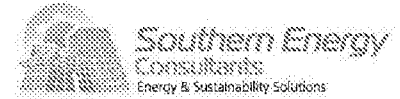
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	32.4312	32.5435	32.5435	32.7031	32.7031	32.8986	32.8516	32.9443	32.8986	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	0.9795	0.9704	0.9454	0.8833	0.7641	0.5572	0.3889	0.4223	0.7136	0.9099	0.9671	0.9823 (86)
MIT	19.1697	19.3505	19.7479	20.2465	20.6713	20.9210	20.9825	20.9773	20.8096	20.2831	19.6511	19.1401 (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	0.9750	0.9638	0.9327	0.8547	0.7034	0.4517	0.2533	0.2819	0.6217	0.8811	0.9584	0.9783 (89)
MIT 2	17.4558	17.7189	18.2897	18.9902	19.5464	19.8228	19.8657	19.8665	19.7231	19.0584	18.1621	17.4172 (90)
Living area fraction	17.6538	17.9075	18.4582	19.1354	19.6765	19.9497	19.9948	19.9949	19.8487	19.1999	18.3342	17.6164 (91)
MIT	17.6538	17.9075	18.4582	19.1354	19.6765	19.9497	19.9948	19.9949	19.8487	19.1999	18.3342	17.6164 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.5038	17.7575	18.3082	18.9854	19.5265	19.7997	19.8448	19.8449	19.6987	19.0499	18.1842	17.4664 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9606	0.9460	0.9086	0.8267	0.6822	0.4444	0.2501	0.2782	0.6053	0.8531	0.9391	0.9653	(94)
Useful gains	788.1628	862.3992	930.6003	962.4903	836.4927	555.3778	296.5263	309.8737	609.0137	745.4610	751.4491	750.4657	(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	1933.7393	1888.7937	1694.7005	1404.6231	1009.0052	583.9475	299.3044	313.8254	691.3708	1148.2559	1569.6867	1914.9089	(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	852.3089	689.7372	568.4906	318.3356	128.3493	0.0000	0.0000	0.0000	0.0000	299.6794	589.1311	866.3457	(98)
Space heating												4312.3779	(98)
Space heating per m2												35.3735	(99)
												(98) / (4) =	(99)

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													4765.0585	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	852.3089	689.7372	568.4906	318.3356	128.3493	0.0000	0.0000	0.0000	0.0000	299.6794	589.1311	866.3457	(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)	941.7778	762.1405	628.1664	351.7521	141.8225	0.0000	0.0000	0.0000	0.0000	331.1375	650.9736	957.2881	(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	89.9222	89.8833	89.7604	89.4735	88.8011	87.3000	87.3000	87.3000	87.3000	89.4043	89.7881	89.9437	(216)	
Fuel for water heating, kWh/month	201.4559	176.7089	183.6388	162.0889	157.7995	140.1498	131.4963	148.5825	149.6726	168.3569	181.0918	195.5354	(219)	
Water heating fuel used												1996.5773	(219)	
Annual totals kWh/year														
Space heating fuel - main system												4765.0585	(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												7322.4692	(238)	

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4765.0585	3.8700	184.4078 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1996.5773	3.8700	77.2675 (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			460.6728 (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	4765.0585	0.2160	1029.2526 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1996.5773	0.2160	431.2607 (264)
Space and water heating			1460.5133 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	485.8334	0.5190	252.1475 (268)
Total kg/year			1751.9859 (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	4765.0585	1.2200	5813.3713 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1996.5773	1.2200	2435.8243 (264)
Space and water heating			8249.1956 (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			9970.9542 (272)
Primary energy kWh/m2/year			81.7895 (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 (11.0%)
U Solar photovoltaic panels	+ 8.0	-£ 345	-947 kg (60.7%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£30	1.58 kg/m²	B 85 B 86
Solar photovoltaic panels	£345	7.77 kg/m²	A 93 A 93
Total Savings	£374	9.35 kg/m²	

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

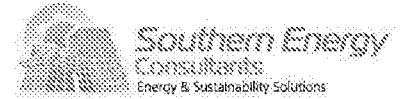
Fuel prices for cost data on this page from database revision number 470 TEST (21 Dec 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£106	£115	-£9
Mains gas	£355	£316	£39
Space heating	£292	£292	£0
Water heating	£77	£48	£30
Lighting	£92	£92	£0
Generated (PV)	-£0	-£345	£345
Total cost of fuels	£461	£86	£375
Total cost of uses	£461	£87	£375
Delivered energy	60 kWh/m²	37 kWh/m²	23 kWh/m²
Carbon dioxide emissions	1.8 tonnes	0.6 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	5 kg/m²	9 kg/m²
Primary energy	82 kWh/m²	27 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	0.5100	10.6334	0.4400	0.0000	0.7700	1.8373 (74)
East	11.5400	19.6403	0.4400	0.0000	0.7700	76.7886 (76)
West	5.0300	19.6403	0.4400	0.0000	0.7700	33.4702 (80)

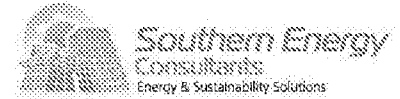
Solar gains	112.0961	219.2008	361.1764	527.6362	647.8029	663.7464	631.6592	541.7393	420.2975	260.1135	139.7463	92.2031	(83)
Total gains	805.1330	906.6345	1021.0555	1144.8560	1221.0080	1198.0971	1143.7803	1063.7557	967.3184	850.0279	777.1460	765.8473	(84)

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												
	0.9830	0.9743	0.9543	0.9077	0.8209	0.6842	0.5432	0.5929	0.7977	0.9339	0.9746	0.9854 (86)
MIT	18.9817	19.1894	19.5679	20.0680	20.5084	20.8124	20.9343	20.9119	20.6714	20.0931	19.4496	18.9424 (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												
	0.9794	0.9687	0.9440	0.8856	0.7753	0.6004	0.4229	0.4738	0.7299	0.9135	0.9682	0.9823 (89)
MIT 2	17.1719	17.4739	18.0208	18.7350	19.3326	19.7105	19.8293	19.8147	19.5581	18.7856	17.8607	17.1198 (90)
Living area fraction												
MIT	17.3810	17.6722	18.1996	18.8890	19.4685	19.8379	19.9570	19.9415	19.6868	18.9367	18.0444	17.3304 (92)
Temperature adjustment												
adjusted MIT	17.2310	17.5222	18.0496	18.7390	19.3185	19.6879	19.8070	19.7915	19.5368	18.7867	17.8944	17.1804 (93)
												-0.1500

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	0.9666	0.9521	0.9215	0.8577	0.7496	0.5856	0.4163	0.4651	0.7064	0.8870	0.9515	0.9708	(94)
Useful gains	778.2489	863.2005	940.8603	981.9448	915.2676	701.6507	476.1282	494.7724	683.2872	753.9497	739.4332	743.5126	(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	2051.4479	1998.2662	1824.7071	1539.4420	1189.8310	787.8498	496.6007	524.3403	844.6605	1278.5778	1692.0695	2042.5832	(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	947.2601	762.7642	657.5820	401.3980	204.2752	0.0000	0.0000	0.0000	0.0000	390.3233	685.8981	966.5085	(98)
Space heating												5016.0094	(98)
Space heating per m2											(98) / (4) =	41.1452	(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													5542.5518	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	947.2601	762.7642	657.5820	401.3980	204.2752	0.0000	0.0000	0.0000	0.0000	390.3233	685.8981	966.5085	(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)	1046.6962	842.8333	726.6100	443.5337	225.7184	0.0000	0.0000	0.0000	0.0000	431.2965	757.8985	1067.9652	(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	90.0343	90.0634	90.0935	90.1483	90.2048	87.3000	87.3000	87.3000	87.3000	89.8495	89.9667	90.0451	(217)	
Fuel for water heating, kWh/month	172.8562	129.0646	102.4450	53.0354	22.1999	4.8924	0.0000	31.9691	58.3410	106.9237	147.0813	171.5948	(219)	
Water heating fuel used												1000.4035	(219)	
Annual totals kWh/year														
Space heating fuel - main system												5542.5518	(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												5426.5493	(238)	

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5542.5518	3.4800	192.8808	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1000.4035	3.4800	34.8140	(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			200.4409	(255)

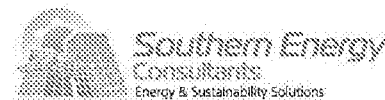
11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5044	(257)
SAP value		92.9640	
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)

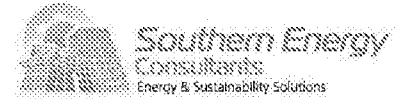


CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	5542.5518	0.2160	1197.1912 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1000.4035	0.2160	216.0872 (264)
Space and water heating			1413.2783 (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			833.8636 (272)
CO2 emissions per m2			6.8400 (273)
EI value			93.3055
EI rating			93 (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	14.1447	(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	-898.1819	(H17)
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	Specific data or Table 6b	g	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	0.5100	11.9814	0.4400	0.0000	0.7700	2.0702	(74)
East	11.5400	22.3313	0.4400	0.0000	0.7700	87.3099	(76)
West	5.0300	22.3313	0.4400	0.0000	0.7700	38.0562	(80)

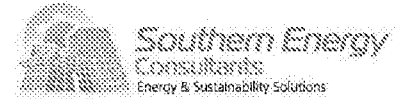
Solar gains	127.4364	224.1916	364.3061	546.9880	652.9641	715.4380	673.7026	591.7632	459.0496	283.9229	162.7630	103.7997	(83)
Total gains	820.4733	911.6253	1024.1851	1164.2077	1226.1691	1249.7886	1185.8237	1113.7796	1006.0705	873.8373	800.1627	777.4438	(84)

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	0.9795	0.9704	0.9454	0.8833	0.7641	0.5572	0.3889	0.4223	0.7136	0.9099	0.9671	0.9823	(86)
MIT	19.1697	19.3505	19.7479	20.2465	20.6713	20.9210	20.9825	20.9773	20.8096	20.2831	19.6511	19.1401	(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	0.9750	0.9638	0.9327	0.8547	0.7034	0.4517	0.2533	0.2819	0.6217	0.8811	0.9584	0.9783	(89)
MIT 2	17.4558	17.7189	18.2897	18.9902	19.5464	19.8228	19.8657	19.8665	19.7231	19.0584	18.1621	17.4172	(90)
Living area fraction													
MIT	17.6538	17.9075	18.4582	19.1354	19.6765	19.9497	19.9948	19.9949	19.8487	19.1999	18.3342	17.6164	(92)
Temperature adjustment													
adjusted MIT	17.5038	17.7575	18.3082	18.9854	19.5265	19.7997	19.8448	19.8449	19.6987	19.0499	18.1842	17.4664	(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	0.9606	0.9460	0.9086	0.8267	0.6822	0.4444	0.2501	0.2782	0.6053	0.8531	0.9391	0.9653	(94)
Useful gains	788.1628	862.3992	930.6003	962.4903	836.4927	555.3778	296.5263	309.8737	609.0137	745.4610	751.4491	750.4657	(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													
	1933.7393	1888.7937	1694.7005	1404.6231	1009.0052	583.9475	299.3044	313.8254	691.3708	1148.2559	1569.6867	1914.9089	(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													
	852.3089	689.7372	568.4906	318.3356	128.3493	0.0000	0.0000	0.0000	0.0000	299.6794	589.1311	866.3457	(98)
Space heating													4312.3779 (98)
Space heating per m2											(98) / (4) =	35.3735	(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													4765.0585 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	852.3089	689.7372	568.4906	318.3356	128.3493	0.0000	0.0000	0.0000	0.0000	299.6794	589.1311	866.3457	(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)	941.7778	762.1405	628.1664	351.7521	141.8225	0.0000	0.0000	0.0000	0.0000	331.1375	650.9736	957.2881	(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	89.9965	90.0205	90.0281	90.0651	89.9871	87.3000	87.3000	87.3000	87.3000	89.7162	89.9080	90.0049	(217)
Fuel for water heating, kWh/month	170.5710	130.2821	105.3642	53.6236	26.2612	0.0000	0.0000	26.1773	54.1350	104.5295	143.4744	169.9542	(219)
Water heating fuel used												984.3724	(219)
Annual totals kWh/year													
Space heating fuel - main system												4765.0585	(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												4536.1047	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4765.0585	3.8700	184.4078	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	984.3724	3.8700	38.0952	(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			86.1843	(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	4765.0585	0.2160	1029.2526	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	984.3724	0.2160	212.6244	(264)
Space and water heating			1241.8771	(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)

Regs Region: England

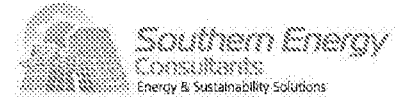
Elmhurst Energy Systems

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

Total kg/year 612.1608 (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	4765.0585	1.2200	5813.3713 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	984.3724	1.2200	1200.9343 (264)
Space and water heating			7014.3057 (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			3289.3941 (272)
Primary energy kWh/m2/year			26.9822 (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	West
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
East	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)
East	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	0.5100	81.1852	0.4400	0.0000	0.9000	16.3962
East	11.5400	117.5071	0.4400	0.0000	0.9000	536.9885
West	5.0300	117.5071	0.4400	0.0000	0.9000	234.0600

total: 787.4446

	Jun	Jul	Aug	
Solar gains	836	787	692	(P4)
Internal gains	531	509	519	
Total summer gains	1368	1297	1211	(P5)

Summer gain/loss ratio	2.76	2.62	2.44	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 149.3)	0.95	0.95	0.95	
Threshold temperature	19.71	21.47	21.20	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight