

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	SECANG008g		Issued on Date	04/02/2021	
Assessment Reference	001	Prop Type Ref	Sem Bri Ga Ea		
Property	WP3520A+, Plot 65				
SAP Rating	84 B	DER	17.33	TET	18.02
Environmental	36 B	% DER<TER	3.81		
CO ₂ Emissions (t/year)	1.32	DPEE	48.37	TPEE	52.20
General Requirements Compliance	Pass	% DPEE<TPEE	7.34		
Assessor Details	Mr. Stuart Harvey, Stuart Harvey, [REDACTED]			Assessor ID	T555-0001
Client	Persimon Homes Thames Valley				

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

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 93 m²

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

1a TER and DER

Fuel for main heating: Mains gas
Fuel factor: 1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.02 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.33 kgCO₂/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 52.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 48.4 kWh/m²/yr OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.18 (max. 0.25)	0.18 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.36 (max. 2.00)	1.60 (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:

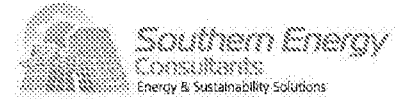
Overshading: Average
Windows facing North: 2.13 m², No overhang
Windows facing East: 3.49 m², No overhang
Windows facing West: 4.52 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					2 * 10 = 20.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					20.0000 / (5) = 0.0857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3357 (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) =	0.2854 (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	0.3638	0.3567	0.3496	0.3139	0.3068	0.2711	0.2711	0.2640	0.2854	0.3068	0.3210	0.3353 (22b)
Effective ac	0.5662	0.5636	0.5611	0.5493	0.5471	0.5367	0.5367	0.5348	0.5407	0.5471	0.5515	0.5562 (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)			10.1400	1.2357	12.5304		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1800	8.3988	75.0000	3499.5000 (28a)
Brick Cavity	96.8000	14.4400	82.3600	0.2500	20.5900	60.0000	4941.6000 (29a)
External Roof 1	46.6600		46.6600	0.1100	5.1326	9.0000	419.9400 (30)
Total net area of external elements Aum (A, m ²)			190.1200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	53.1018			(33)
Party Wall 1			45.2500	0.0000	0.0000	110.0000	4977.5000 (32)
Internal Wall 1			159.3600			9.0000	1434.2400 (32c)
Internal Wall 2			24.2000			75.0000	1815.0000 (32c)
Internal Floor 1			46.6600			18.0000	839.8800 (32d)
Internal Ceiling 1			46.6600			18.0000	839.8800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18767.5400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							201.1095 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9937 (36)
Total fabric heat loss						(33) + (36) =	62.0955 (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	43.5905	43.3926	43.1986	42.2876	42.1171	41.3236	41.3236	41.1767	41.6293	42.1171	42.4620	42.8225 (38)
Heat transfer coeff	105.6860	105.4881	105.2941	104.3831	104.2126	103.4191	103.4191	103.2722	103.7248	104.2126	104.5575	104.9180 (39)
Average = Sum(39)m / 12 =												104.3823 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1325	1.1304	1.1283	1.1186	1.1167	1.1082	1.1082	1.1066	1.1115	1.1167	1.1204	1.1243 (40)
HLP (average)												1.1185 (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												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)

Regs Region: England

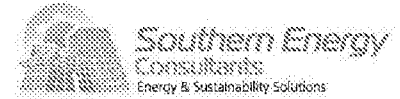
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1535.2611 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.8761	20.8822	21.5485	18.7865	18.0261	15.5552	14.4141	16.5404	16.7380	19.5065	21.2929	23.1227 (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	14.1386	12.7594	14.0997	13.6002	14.0211	13.5314	13.9591	13.9993	13.5689	14.0672	13.6535 (61)
Total heat required for water heating calculated for each month											
173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778 (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											
173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778 (64)
Heat gains from water heating, kWh/month											
56.4599	49.4786	51.2908	45.0435	43.4632	37.8634	35.4411	40.1645	40.4948	46.7562	50.6126	54.7869 (65)
Total per year (kWh/year) = Sum(64)m = 1700.7860 (64)											

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.7833	22.0123	17.9016	13.5527	10.1308	8.5528	9.2416	12.0126	16.1233	20.4723	23.8942	25.4721	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.0548	247.5977	241.1897	227.5478	210.3273	194.1424	183.3300	180.7871	187.1951	200.8370	218.0575	234.2424	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	(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)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	(71)
Water heating gains (Table 5)	75.8870	73.6289	68.9392	62.5604	58.4182	52.5881	47.6359	53.9845	56.2427	62.8444	70.2953	73.6383	(72)
Total internal gains	411.7525	409.2663	394.0579	369.6882	344.9036	321.3108	306.2349	312.8116	325.5885	350.1811	378.2743	399.3802	(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					2.1300	10.6334	0.4400	0.0000	0.7700		7.6735 (74)	
East					3.4900	19.6403	0.4400	0.0000	0.7700		23.2229 (76)	
West					4.5200	19.6403	0.4400	0.0000	0.7700		30.0766 (80)	
Solar gains	60.9730	118.9296	196.6284	290.4542	360.8278	371.8976	352.9989	299.6849	229.6659	141.1756	75.9245	50.2280 (83)
Total gains	472.7255	528.1960	590.6864	660.1424	705.7314	693.2084	659.2338	612.4965	555.2544	491.3566	454.1988	449.6081 (84)

7. Mean internal temperature (heating season)

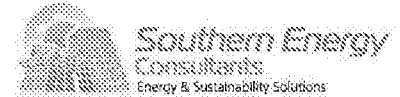
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	49.3273	49.4198	49.5109	49.9430	50.0247	50.4085	50.4085	50.4802	50.2600	50.0247	49.8597	49.6884
alpha	4.2885	4.2947	4.3007	4.3295	4.3350	4.3606	4.3606	4.3653	4.3507	4.3350	4.3240	4.3126
util living area	0.9974	0.9954	0.9896	0.9703	0.9158	0.7942	0.6411	0.6985	0.9000	0.9820	0.9955	0.9979 (86)
MIT	19.4544	19.5982	19.8731	20.2539	20.6129	20.8662	20.9610	20.9432	20.7407	20.2790	19.8005	19.4271 (87)
Th 2	19.9744	19.9761	19.9778	19.9857	19.9872	19.9941	19.9941	19.9954	19.9915	19.9872	19.9842	19.9811 (88)
util rest of house	0.9967	0.9941	0.9864	0.9602	0.8845	0.7162	0.5160	0.5774	0.8499	0.9742	0.9940	0.9974 (89)
MIT 2	17.8997	18.1109	18.5125	19.0671	19.5667	19.8861	19.9750	19.9643	19.7467	19.1098	18.4125	17.8643 (90)
Living area fraction	18.2299	18.4268	18.8015	19.3192	19.7889	20.0943	20.1844	20.1722	19.9578	19.3582	18.7073	18.1963 (92)
MIT	18.2299	18.4268	18.8015	19.3192	19.7889	20.0943	20.1844	20.1722	19.9578	19.3582	18.7073	18.1963 (92)
Temperature adjustment	18.0799	18.2768	18.6515	19.1692	19.6389	19.9443	20.0344	20.0222	19.8078	19.2082	18.5573	18.0463 (93)
adjusted MIT	18.0799	18.2768	18.6515	19.1692	19.6389	19.9443	20.0344	20.0222	19.8078	19.2082	18.5573	18.0463 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9946	0.9908	0.9803	0.9491	0.8710	0.7117	0.5214	0.5810	0.8382	0.9653	0.9906	0.9956 (94)
Useful gains	470.1568	523.3122	579.0440	626.5103	614.6606	493.3572	343.7219	355.8654	465.4249	474.3215	449.9182	447.6300 (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	1456.3467	1411.0890	1279.4786	1071.9259	827.3330	552.6988	355.1833	374.0776	592.0444	897.0802	1197.9460	1452.7215 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	733.7253	596.5861	521.1233	320.6992	158.2283	0.0000	0.0000	0.0000	0.0000	314.5325	538.5800	747.7881 (98)
Space heating												3931.2628 (98)
Space heating per m2												(98) / (4) = 42.1267 (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													4343.9368	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	733.7253	596.5861	521.1233	320.6992	158.2283	0.0000	0.0000	0.0000	0.0000	314.5325	538.5800	747.7881	(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)	810.7462	659.2111	575.8269	354.3638	174.8379	0.0000	0.0000	0.0000	0.0000	347.5497	595.1160	826.2852	(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	173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778	(64)	
Efficiency of water heater (217)m	89.8706	89.8315	89.7356	89.5087	89.0029	87.3000	87.3000	87.3000	87.3000	89.4695	89.7625	89.8947	(217)	
Fuel for water heating, kWh/month	192.8466	169.1765	175.8013	155.1175	150.7762	134.2869	126.0634	142.3470	143.3625	161.0722	173.3531	187.1943	(219)	
Water heating fuel used												1911.3976	(219)	
Annual totals kWh/year														
Space heating fuel - main system													4343.9368	(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)													437.6809	(232)
Total delivered energy for all uses													6768.0153	(238)

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

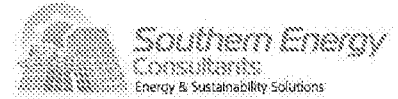
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4343.9368	0.2160	938.2903 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1911.3976	0.2160	412.8619 (264)
Space and water heating			1351.1522 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	437.6809	0.5190	227.1564 (268)
Total CO2, kg/year			1617.2336 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.3300 (273)

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

DER		17.3300	ZC1
Total Floor Area	TFA	93.3200	
Assumed number of occupants	N	2.6685	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.5609	ZC2
CO2 emissions from cooking, equation (L16)		1.9615	ZC3
Total CO2 emissions		34.8524	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		34.8524	ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1286 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3786 (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) =	0.3218 (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	0.4103	0.4023	0.3942	0.3540	0.3459	0.3057	0.3057	0.2977	0.3218	0.3459	0.3620	0.3781 (22b)
Effective ac	0.5842	0.5809	0.5777	0.5627	0.5598	0.5467	0.5467	0.5443	0.5518	0.5598	0.5655	0.5715 (25)

3. Heat losses and heat loss parameter

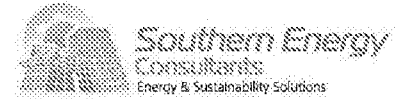
Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1500	1.0000	2.1500		(26)
TER Semi-glazed door			2.1500	1.2000	2.5800		(26a)
TER Opening Type (Uw = 1.40)			10.1400	1.3258	13.4432		(27)
Heat Loss Floor 1			46.6600	0.1300	6.0658		(28a)
Brick Cavity	96.8000	14.4400	82.3600	0.1800	14.8248		(29a)
External Roof 1	46.6600		46.6600	0.1300	6.0658		(30)
Total net area of external elements Aum(A, m ²)			190.1200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.1296		(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)							9.9943 (36)
Total fabric heat loss						(33) + (36) =	55.1239 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	44.9748	44.7232	44.4765	43.3180	43.1012	42.0922	42.0922
Heat transfer coeff	100.0987	99.8470	99.6004	98.4419	98.2251	97.2161	97.2161
Average = Sum(39)m / 12 =							
HLP	1.0726	1.0699	1.0673	1.0549	1.0526	1.0397	1.0397
HLP (average)							
Days in month	31	28	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)
Energy content (annual)												Total = Sum(45)m = 1535.2611 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8761	20.8822	21.5485	18.7865	18.0261	15.5552	14.4141	16.5404	16.7380	19.5065	21.2929	23.1227 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	50.9589	46.0274	50.7185	47.1576	46.7406	43.3080	44.7516	46.7406	47.1576	50.7185	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	210.1326	185.2418	194.3752	172.4010	166.9146	147.0091	140.8459	157.0102	158.7442	180.7619	191.2676	205.1102 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)												
Output from w/h												
	210.1326	185.2418	194.3752	172.4010	166.9146	147.0091	140.8459	157.0102	158.7442	180.7619	191.2676	205.1102 (64)
Total per year (kWh/year) = Sum(64)m = 2109.8143 (64)												
Heat gains from water heating, kWh/month												
	65.6650	57.7956	60.4455	53.4328	51.6430	45.3076	43.1393	48.3498	48.8919	55.9191	59.5280	63.9950 (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	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.7833	22.0123	17.9016	13.5527	10.1308	8.5528	9.2416	12.0126	16.1233	20.4723	23.8942	25.4721	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.0548	247.5977	241.1897	227.5478	210.3273	194.1424	183.3300	180.7871	187.1951	200.8370	218.0575	234.2424	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	(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)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	(71)
Water heating gains (Table 5)	88.2594	86.0054	81.2439	74.2123	69.4127	62.9272	57.9829	64.9863	67.9055	75.1600	82.6778	86.0148	(72)
Total internal gains	424.1249	421.6428	406.3626	381.3401	355.8981	331.6499	316.5818	323.8133	337.2513	362.4967	390.6568	411.7567	(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	2.1300	10.6334	0.6300		0.7000	0.7700	6.9219 (74)
East	3.4900	19.6403	0.6300		0.7000	0.7700	20.9481 (76)
West	4.5200	19.6403	0.6300		0.7000	0.7700	27.1305 (80)

Solar gains	55.0004	107.2799	177.3678	262.0029	325.4831	335.4685	318.4210	270.3294	207.1690	127.3468	68.4874	45.3079	(83)
Total gains	479.1254	528.9228	583.7304	643.3430	681.3811	667.1184	635.0029	594.1428	544.4203	489.8435	459.1442	457.0646	(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	64.7417	64.9048	65.0656	65.8313	65.9766	66.6614	66.6614	66.7897	66.3959	65.9766	65.6834	65.3796	
alpha	5.3161	5.3270	5.3377	5.3888	5.3984	5.4441	5.4441	5.4526	5.4264	5.3984	5.3789	5.3586	
util living area	0.9991	0.9982	0.9953	0.9830	0.9384	0.8139	0.6459	0.7046	0.9189	0.9901	0.9981	0.9993	(86)
MIT	19.7823	19.8975	20.1180	20.4278	20.7191	20.9187	20.9819	20.9715	20.8223	20.4503	20.0652	19.7640	(87)
Th 2	20.0232	20.0255	20.0276	20.0378	20.0398	20.0487	20.0487	20.0503	20.0452	20.0398	20.0359	20.0318	(88)
util rest of house	0.9988	0.9976	0.9934	0.9758	0.9101	0.7338	0.5202	0.5813	0.8700	0.9847	0.9974	0.9990	(89)
MIT 2	18.3856	18.5557	18.8791	19.3349	19.7411	19.9883	20.0412	20.0371	19.8850	19.3722	18.8089	18.3651	(90)
Living area fraction									fLA = Living area / (4) =			0.2124	(91)
MIT	18.6822	18.8407	19.1422	19.5670	19.9488	20.1859	20.2410	20.2355	20.0841	19.6011	19.0757	18.6622	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6822	18.8407	19.1422	19.5670	19.9488	20.1859	20.2410	20.2355	20.0841	19.6011	19.0757	18.6622	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9964	0.9911	0.9711	0.9068	0.7468	0.5469	0.6072	0.8725	0.9812	0.9962	0.9985	(94)
Useful gains	478.2027	527.0252	578.5192	624.7510	617.8752	498.1855	347.3064	360.7517	474.9949	480.6198	457.4014	456.3832	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1439.6440	1391.9331	1259.1698	1050.0814	810.2381	543.0384	353.9640	372.1579	584.0770	884.1374	1181.5687	1433.5254	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	715.3123	581.2181	506.4041	306.2379	143.1180	0.0000	0.0000	0.0000	0.0000	300.2171	521.4005	726.9938	(98)
Space heating												3800.9017	(98)
Space heating per m ²												40.7298	(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

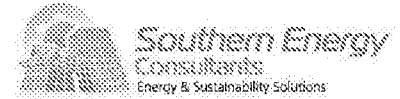
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4069.4879 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	715.3123	581.2181	506.4041	306.2379	143.1180	0.0000	0.0000	0.0000	0.0000	300.2171	521.4005	726.9938	(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)	765.8590	622.2892	542.1885	327.8778	153.2313	0.0000	0.0000	0.0000	0.0000	321.4316	558.2446	778.3659	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	210.1326	185.2418	194.3752	172.4010	166.9146	147.0091	140.8459	157.0102	158.7442	180.7619	191.2676	205.1102	(64)
Efficiency of water heater (217)m	87.8899	87.7330	87.3525	86.4820	84.6667	80.3000	80.3000	80.3000	80.3000	86.3197	87.4480	87.9653	(216)
Fuel for water heating, kWh/month	239.0862	211.1426	222.5182	199.3490	197.1432	183.0748	175.3996	195.5295	197.6889	209.4099	218.7214	233.1716	(219)
Water heating fuel used												2482.2348	(219)
Annual totals kWh/year													
Space heating fuel - main system												4069.4879	(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)												437.6809	(232)
Total delivered energy for all uses												7064.4036	(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	4069.4879	0.2160	879.0094 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2482.2348	0.2160	536.1627 (264)
Space and water heating			1415.1721 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	437.6809	0.5190	227.1564 (268)
Total CO2, kg/m2/year			1681.2535 (272)
Emissions per m2 for space and water heating			15.1647 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.4342 (272b)
Emissions per m2 for pumps and fans			0.4171 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1647 * 1.00) + 2.4342 + 0.4171, rounded to 2 d.p.			18.0200 (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	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1286 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3786 (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)	=	0.3218 (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	0.4103	0.4023	0.3942	0.3540	0.3459	0.3057	0.3057	0.2977	0.3218	0.3459	0.3620	0.3781 (22b)
Effective ac	0.5842	0.5809	0.5777	0.5627	0.5598	0.5467	0.5467	0.5443	0.5518	0.5598	0.5655	0.5715 (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)			10.1400	1.2357	12.5304		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1800	8.3988	75.0000	3499.5000 (28a)
Brick Cavity	96.8000	14.4400	82.3600	0.2500	20.5900	60.0000	4941.6000 (29a)
External Roof 1	46.6600		46.6600	0.1100	5.1326	9.0000	419.9400 (30)
Total net area of external elements Aum (A, m ²)			190.1200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	53.1018			(33)
Party Wall 1			45.2500	0.0000	0.0000	110.0000	4977.5000 (32)
Internal Wall 1			159.3600			9.0000	1434.2400 (32c)
Internal Wall 2			24.2000			75.0000	1815.0000 (32c)
Internal Floor 1			46.6600			18.0000	839.8800 (32d)
Internal Ceiling 1			46.6600			9.0000	419.9400 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =				18347.6000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							196.6095 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9937 (36)
Total fabric heat loss			(33) + (36) =				62.0955 (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	44.9748	44.7232	44.4765	43.3180	43.1012	42.0922	42.0922	41.9053	42.4808	43.1012	43.5397	43.9981 (38)
Heat transfer coeff	107.0703	106.8187	106.5720	105.4135	105.1967	104.1877	104.1877	104.0008	104.5763	105.1967	105.6352	106.0936 (39)
Average = Sum(39)m / 12 =												105.4124 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1473	1.1446	1.1420	1.1296	1.1273	1.1165	1.1165	1.1145	1.1206	1.1273	1.1320	1.1369 (40)
HLP (average)												1.1296 (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												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)

Regs Region: England

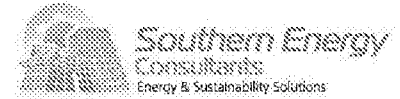
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1535.2611 (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	33.8244	29.5831	30.5271	26.6142	25.5370	22.0365	20.4200	23.4323	23.7121	27.6342	30.1649	32.7571 (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	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.7833	22.0123	17.9016	13.5527	10.1308	8.5528	9.2416	12.0126	16.1233	20.4723	23.8942	25.4721	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.0548	247.5977	241.1897	227.5478	210.3273	194.1424	183.3300	180.7871	187.1951	200.8370	218.0575	234.2424	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	(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)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	(71)
Water heating gains (Table 5)	45.4629	44.0224	41.0310	36.9642	34.3239	30.6062	27.4463	31.4950	32.9335	37.1428	41.8957	44.0284	(72)
Total internal gains	378.3284	376.6598	363.1497	341.0920	317.8093	296.3289	283.0453	287.3221	299.2793	321.4794	346.8748	366.7703	(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			2.1300		10.6334		0.4400		0.0000		0.7700		7.6735 (74)
East			3.4900		19.6403		0.4400		0.0000		0.7700		23.2229 (76)
West			4.5200		19.6403		0.4400		0.0000		0.7700		30.0766 (80)
Solar gains	60.9730	118.9296	196.6284	290.4542	360.8278	371.8976	352.9989	299.6849	229.6659	141.1756	75.9245	50.2280	(83)
Total gains	439.3015	495.5895	559.7781	631.5462	678.6371	668.2265	636.0441	587.0070	528.9452	462.6550	422.7993	416.9982	(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	47.6001	47.7122	47.8227	48.3482	48.4479	48.9171	48.9171	49.0050	48.7353	48.4479	48.2467	48.0383
alpha	4.1733	4.1808	4.1882	4.2232	4.2299	4.2611	4.2611	4.2670	4.2490	4.2299	4.2164	4.2026
util living area	0.9978	0.9961	0.9909	0.9734	0.9235	0.8091	0.6600	0.7195	0.9113	0.9847	0.9963	0.9983 (86)
MIT	19.3648	19.5136	19.7984	20.1963	20.5721	20.8461	20.9529	20.9316	20.7081	20.2231	19.7271	19.3412 (87)
Th 2	19.9624	19.9645	19.9667	19.9767	19.9786	19.9874	19.9874	19.9890	19.9840	19.9786	19.9748	19.9708 (88)
util rest of house	0.9972	0.9950	0.9881	0.9643	0.8945	0.7335	0.5339	0.5989	0.8653	0.9780	0.9950	0.9978 (89)
MIT 2	18.4614	18.6116	18.8968	19.2973	19.6576	19.9006	19.9711	19.9626	19.7919	19.3287	18.8329	18.4443 (90)
Living area fraction									fLA = Living area /	(4) =		0.2124 (91)
MIT	18.6533	18.8032	19.0883	19.4882	19.8518	20.1014	20.1796	20.1684	19.9865	19.5186	19.0228	18.6348 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6533	18.8032	19.0883	19.4882	19.8518	20.1014	20.1796	20.1684	19.9865	19.5186	19.0228	18.6348 (93)

8. Space heating requirement

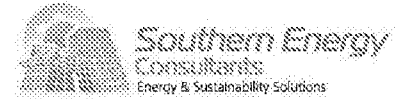
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9932	0.9849	0.9587	0.8901	0.7432	0.5598	0.6227	0.8654	0.9739	0.9933	0.9969	(94)
Useful gains	437.6129	492.2203	551.2986	605.4625	604.0861	496.6309	356.0717	365.5392	457.7624	450.5682	419.9735	415.7150	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1536.8118	1485.1184	1341.5597	1116.1440	857.5447	573.1815	372.9531	391.9153	615.5881	938.2102	1259.4719	1531.4417	(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	817.8040	667.2275	587.9542	367.6907	188.5731	0.0000	0.0000	0.0000	0.0000	362.8056	604.4388	830.1006	(98)
Space heating													4426.5947 (98)
Space heating per m2	(98) / (4) =												47.4346 (99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
Ext. temp.	Jan 4.3000	Feb 4.9000	Mar 6.5000	Apr 8.9000	May 11.7000	Jun 14.6000	Jul 16.6000	Aug 16.4000	Sep 14.1000	Oct 10.6000	Nov 7.1000	Dec 4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	979.3641	770.9888	790.4062	0.0000	0.0000	0.0000	0.0000 (100)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

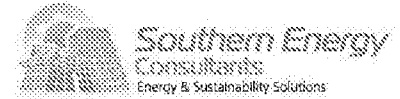


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7660	0.8446	0.8093	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	750.2339	651.1721	639.6411	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	883.4879	843.8225	788.6884	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	95.9429	143.3319	110.8912	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												350.1660 (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	23.9857	35.8330	27.7228	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												87.5415 (107)
Space cooling per m2												0.9381 (108)
Energy for space heating												47.4346 (99)
Energy for space cooling												0.9381 (108)
Total												48.3727 (109)
Dwelling Fabric Energy Efficiency (DFEE)												48.4 (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	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1286 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3786 (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) =	0.3218 (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	0.4103	0.4023	0.3942	0.3540	0.3459	0.3057	0.3057	0.2977	0.3218	0.3459	0.3620	0.3781 (22b)
Effective ac	0.5842	0.5809	0.5777	0.5627	0.5598	0.5467	0.5467	0.5443	0.5518	0.5598	0.5655	0.5715 (25)

3. Heat losses and heat loss parameter

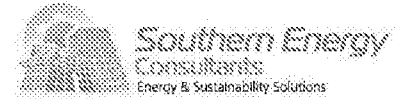
Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1500	1.0000	2.1500		(26)
TER Semi-glazed door			2.1500	1.2000	2.5800		(26a)
TER Opening Type (Uw = 1.40)			10.1400	1.3258	13.4432		(27)
Heat Loss Floor 1			46.6600	0.1300	6.0658		(28a)
Brick Cavity	96.8000	14.4400	82.3600	0.1800	14.8248		(29a)
External Roof 1	46.6600		46.6600	0.1300	6.0658		(30)
Total net area of external elements Aum(A, m ²)			190.1200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.1296		(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)							9.9943 (36)
Total fabric heat loss						(33) + (36) =	55.1239 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	44.9748	44.7232	44.4765	43.3180	43.1012	42.0922	42.0922
Heat transfer coeff	100.0987	99.8470	99.6004	98.4419	98.2251	97.2161	97.2161
Average = Sum(39)m / 12 =							
HLP	1.0726	1.0699	1.0673	1.0549	1.0526	1.0397	1.0397
HLP (average)							
Days in month	31	28	31	30	31	30	31
							31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)
Energy content (annual)												Total = Sum(45)m = 1535.2611 (45)
Distribution loss (46)m = 0.15 x (45)m												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	33.8244	29.5831	30.5271	26.6142	25.5370	22.0365	20.4200	23.4323	23.7121	27.6342	30.1649	32.7571 (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	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	133.4246	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.7833	22.0123	17.9016	13.5527	10.1308	8.5528	9.2416	12.0126	16.1233	20.4723	23.8942	25.4721	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.0548	247.5977	241.1897	227.5478	210.3273	194.1424	183.3300	180.7871	187.1951	200.8370	218.0575	234.2424	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	36.3425	(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)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	(71)
Water heating gains (Table 5)	45.4629	44.0224	41.0310	36.9642	34.3239	30.6062	27.4463	31.4950	32.9335	37.1428	41.6957	44.0284	(72)
Total internal gains	378.3284	376.6598	363.1497	341.0920	317.8093	296.3289	283.0453	287.3221	299.2793	321.4794	346.8748	366.7703	(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	2.1300	10.6334	0.6300	0.7000	0.7700	6.9219 (74)
East	3.4900	19.6403	0.6300	0.7000	0.7700	20.9481 (76)
West	4.5200	19.6403	0.6300	0.7000	0.7700	27.1305 (80)

Solar gains	55.0004	107.2799	177.3678	262.0029	325.4831	335.4685	318.4210	270.3294	207.1690	127.3468	68.4874	45.3079	(83)
Total gains	433.3289	483.9398	540.5175	603.0949	643.2924	631.7974	601.4663	557.6515	506.4484	448.8262	415.3621	412.0782	(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	64.7417	64.9048	65.0656	65.8313	65.9766	66.6614	66.6614	66.7897	66.3959	65.9766	65.6834	65.3796	
alpha	5.3161	5.3270	5.3377	5.3888	5.3984	5.4441	5.4441	5.4526	5.4264	5.3984	5.3789	5.3586	
util living area	0.9994	0.9988	0.9967	0.9872	0.9502	0.8383	0.6750	0.7381	0.9371	0.9934	0.9989	0.9996	(86)
MIT	19.7357	19.8519	20.0748	20.3899	20.6903	20.9050	20.9777	20.9644	20.7960	20.4102	20.0208	19.7181	(87)
Th 2	20.0232	20.0255	20.0276	20.0378	20.0398	20.0487	20.0487	20.0503	20.0452	20.0398	20.0359	20.0318	(88)
util rest of house	0.9992	0.9984	0.9954	0.9816	0.9260	0.7619	0.5469	0.6145	0.8957	0.9896	0.9984	0.9994	(89)
MIT 2	18.8587	18.9765	19.2007	19.5213	19.8108	19.9991	20.0422	20.0385	19.9153	19.5448	19.1539	18.8481	(90)
Living area fraction										fLA = Living area / (4) =		0.2124	(91)
MIT	19.0449	19.1625	19.3863	19.7057	19.9976	20.1915	20.2409	20.2352	20.1024	19.7286	19.3380	19.0329	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0449	19.1625	19.3863	19.7057	19.9976	20.1915	20.2409	20.2352	20.1024	19.7286	19.3380	19.0329	(93)

8. Space heating requirement

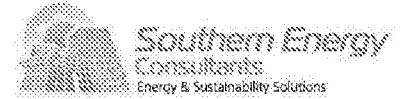
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9990	0.9979	0.9943	0.9791	0.9247	0.7750	0.5745	0.6409	0.8988	0.9879	0.9979	0.9992	(94)
Useful gains	432.8754	482.9213	537.4096	590.4886	594.8481	489.6484	345.5543	357.4005	455.2119	443.4151	414.4851	411.7530	(95)
Ext temp.	4.3000	4.9000	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	1475.9490	1424.0645	1283.4842	1063.7378	815.0315	543.5830	353.9536	372.1237	585.8591	896.6601	1207.4457	1470.2637	(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	776.0467	632.4482	555.0795	340.7394	163.8165	0.0000	0.0000	0.0000	0.0000	337.2143	570.9317	787.5319	(98)
Space heating												4163.8082	(98)
Space heating per m2										(98) / (4) =		44.6186	(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	913.8309	719.3988	737.4219	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8077	0.8874	0.8545	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	738.0559	638.4266	630.1013	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	840.9085	803.4069	754.3768	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	74.0538	122.7453	92.4609	0.0000	0.0000	0.0000	0.0000	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

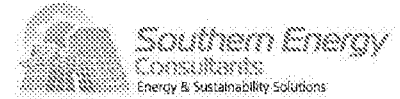


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												289.2601 (104)
Cooled fraction												1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)	
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	18.5135	30.6863	23.1152	0.0000	0.0000	0.0000	0.0000 (107)	
Space cooling												72.3150 (107)
Space cooling per m2												0.7749 (108)
Energy for space heating												44.6166 (99)
Energy for space cooling												0.7749 (108)
Total												45.3935 (109)
Target Fabric Energy Efficiency (TFEE)												52.2 (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	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					2 * 10 = 20.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					20.0000 / (5) = 0.0857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3357 (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) =	0.2854 (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	0.2996	0.2854	0.2854	0.2640	0.2640	0.2354	0.2426	0.2283	0.2354	0.2497	0.2497	0.2711 (22b)
Effective ac	0.5449	0.5407	0.5407	0.5348	0.5348	0.5277	0.5294	0.5261	0.5277	0.5312	0.5312	0.5367 (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)			10.1400	1.2357	12.5304		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1800	8.3988	75.0000	3499.5000 (28a)
Brick Cavity	96.8000	14.4400	82.3600	0.2500	20.5900	60.0000	4941.6000 (29a)
External Roof 1	46.6600		46.6600	0.1100	5.1326	9.0000	419.9400 (30)
Total net area of external elements Aum (A, m ²)			190.1200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	53.1018			(33)
Party Wall 1			45.2500	0.0000	0.0000	110.0000	4977.5000 (32)
Internal Wall 1			159.3600			9.0000	1434.2400 (32c)
Internal Wall 2			24.2000			75.0000	1815.0000 (32c)
Internal Floor 1			46.6600			18.0000	839.8800 (32d)
Internal Ceiling 1			46.6600			18.0000	839.8800 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =	18767.5400 (34)			
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							201.1095 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9937 (36)
Total fabric heat loss			(33) + (36) =	62.0955 (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	41.9506	41.6293	41.6293	41.1767	41.1767	40.6281	40.7594	40.5008	40.6281	40.8946	40.8946	41.3236 (38)
Heat transfer coeff	104.0461	103.7248	103.7248	103.2722	103.2722	102.7236	102.8549	102.5963	102.7236	102.9901	102.9901	103.4191 (39)
Average = Sum(39)m / 12 =												103.1948 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1149	1.1115	1.1115	1.1066	1.1066	1.1008	1.1022	1.0994	1.1008	1.1036	1.1036	1.1082 (40)
HLP (average)												1.1058 (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												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)

Regs Region: England

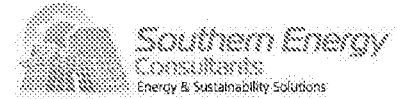
Elmhurst Energy Systems

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 = 1535.2611 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.8761	20.8822	21.5485	18.7865	18.0261	15.5552	14.4141	16.5404	16.7380	19.5065	21.2929	23.1227 (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	14.1386	12.7594	14.0997	13.6002	14.0211	13.5314	13.9591	13.9993	13.5689	14.0672	13.6535 (61)
Total heat required for water heating calculated for each month											
173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778 (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											
173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778 (64)
RHI water heating demand											
Heat gains from water heating, kWh/month											
56.4599	49.4786	51.2908	45.0435	43.4632	37.8634	35.4411	40.1645	40.4948	46.7562	50.6126	54.7869 (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	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	61.9583	55.0308	44.7540	33.8817	25.3270	21.3821	23.1041	30.0316	40.3083	51.1807	59.7354	63.6803 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	365.7535	369.5489	359.9846	339.6235	313.9213	289.7648	273.6268	269.8314	279.3956	299.7568	325.4590	349.6155 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794 (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)												
	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397 (71)
Water heating gains (Table 5)												
	75.8870	73.6289	68.9392	62.5604	58.4182	52.5881	47.6359	53.9845	56.2427	62.8444	70.2953	73.6383 (72)
Total internal gains	613.6480	608.2578	583.7272	546.1149	507.7157	473.7843	454.4161	463.8968	485.9960	523.8311	565.5389	596.9834 (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												2.1300	11.9814	0.4400	0.0000	0.7700	8.6463 (74)
East												3.4900	22.3313	0.4400	0.0000	0.7700	26.4048 (76)
West												4.5200	22.3313	0.4400	0.0000	0.7700	34.1976 (80)
Solar gains	69.2488	121.6396	198.6011	301.8125	364.6541	401.8926	377.4761	328.1827	251.3000	154.1811	88.3677	56.4737 (83)					
Total gains	682.8968	729.8974	782.3283	847.9274	872.3699	875.6769	831.8922	792.0795	737.2960	678.0122	653.9066	653.4571 (84)					

7. Mean internal temperature (heating season)

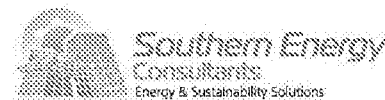
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	50.1048	50.2600	50.2600	50.4802	50.4802	50.7498	50.6851	50.8128	50.7498	50.6185	50.6185	50.4085
alpha	4.3403	4.3507	4.3507	4.3653	4.3653	4.3833	4.3790	4.3875	4.3833	4.3746	4.3746	4.3606
util living area	0.9873	0.9817	0.9642	0.9129	0.7908	0.5617	0.3797	0.4094	0.7188	0.9260	0.9773	0.9891 (86)
MIT	19.8243	19.9427	20.2122	20.5527	20.8362	20.9739	20.9964	20.9951	20.9208	20.5909	20.1585	19.8012 (87)
Th 2	19.9887	19.9915	19.9915	19.9954	19.9954	20.0002	19.9991	20.0013	20.0002	19.9979	19.9979	19.9941 (88)
util rest of house	0.9838	0.9768	0.9539	0.8870	0.7300	0.4601	0.2590	0.2843	0.6259	0.8979	0.9699	0.9862 (89)
MIT 2	18.4475	18.6204	19.0073	19.4841	19.8447	19.9860	19.9983	20.0002	19.9445	19.5469	18.9387	18.4179 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.7399	18.9013	19.2632	19.7111	20.0553	20.1958	20.2103	20.2115	20.1518	19.7686	19.1978	18.7117 (92)
Temperature adjustment												
adjusted MIT	18.5899	18.7513	19.1132	19.5611	19.9053	20.0458	20.0603	20.0615	20.0018	19.6186	19.0478	18.5617 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9770	0.9683	0.9420	0.8732	0.7238	0.4649	0.2665	0.2920	0.6261	0.8844	0.9603	0.9800 (94)
Useful gains	667.1848	706.7432	736.9847	740.4460	631.4123	407.1228	221.6928	231.2674	461.5860	599.6515	627.9292	640.4183 (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	1403.5707	1364.1128	1214.9466	997.7211	713.1227	415.6022	222.1957	232.0190	493.2605	825.8348	1137.8089	1392.1929 (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	547.8711	441.7524	355.6037	185.2381	60.7925	0.0000	0.0000	0.0000	0.0000	168.2804	367.1134	559.3203 (98)
Space heating												2685.9718 (98)
RHI space heating demand												2686 (98)

FULL SAP CALCULATION PRINTOUT

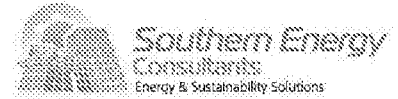
Calculation Type: New Build (As Designed)



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	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					2 * 10 = 20.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					20.0000 / (5) = 0.0857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3357 (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)	=	0.2854 (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	0.3638	0.3567	0.3496	0.3139	0.3068	0.2711	0.2711	0.2640	0.2854	0.3068	0.3210	0.3353 (22b)
Effective ac	0.5662	0.5636	0.5611	0.5493	0.5471	0.5367	0.5367	0.5348	0.5407	0.5471	0.5515	0.5562 (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)			10.1400	1.2357	12.5304		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1800	8.3988	75.0000	3499.5000 (28a)
Brick Cavity	96.8000	14.4400	82.3600	0.2500	20.5900	60.0000	4941.6000 (29a)
External Roof 1	46.6600		46.6600	0.1100	5.1326	9.0000	419.9400 (30)
Total net area of external elements Aum (A, m ²)			190.1200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	53.1018			(33)
Party Wall 1			45.2500	0.0000	0.0000	110.0000	4977.5000 (32)
Internal Wall 1			159.3600			9.0000	1434.2400 (32c)
Internal Wall 2			24.2000			75.0000	1815.0000 (32c)
Internal Floor 1			46.6600			18.0000	839.8800 (32d)
Internal Ceiling 1			46.6600			18.0000	839.8800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18767.5400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							201.1095 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9937 (36)
Total fabric heat loss						(33) + (36) =	62.0955 (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	43.5905	43.3926	43.1986	42.2876	42.1171	41.3236	41.3236	41.1767	41.6293	42.1171	42.4620	42.8225 (38)
Heat transfer coeff	105.6860	105.4881	105.2941	104.3831	104.2126	103.4191	103.4191	103.2722	103.7248	104.2126	104.5575	104.9180 (39)
Average = Sum(39)m / 12 =												104.3823 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1325	1.1304	1.1283	1.1186	1.1167	1.1082	1.1082	1.1066	1.1115	1.1167	1.1204	1.1243 (40)
HLP (average)												1.1185 (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												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)

Regs Region: England

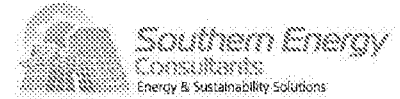
Elmhurst Energy Systems

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 = 1535.2611 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.8761	20.8822	21.5485	18.7865	18.0261	15.5552	14.4141	16.5404	16.7380	19.5065	21.2929	23.1227 (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	14.1386	12.7594	14.0997	13.6002	14.0211	13.5314	13.9591	13.9993	13.5689	14.0672	13.6535 (61)
Total heat required for water heating calculated for each month											
173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778 (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											
173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778 (64)
Heat gains from water heating, kWh/month											
56.4599	49.4786	51.2908	45.0435	43.4632	37.8634	35.4411	40.1645	40.4948	46.7562	50.6126	54.7869 (65)
Total per year (kWh/year) = Sum(64)m = 1700.7860 (64)											

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	61.9583	55.0308	44.7540	33.8817	25.3270	21.3821	23.1041	30.0316	40.3083	51.1807	59.7354	63.6803	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	365.7535	369.5489	359.9846	339.6235	313.9213	289.7648	273.6268	269.8314	279.3956	299.7568	325.4590	349.6155	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	(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)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	(71)
Water heating gains (Table 5)	75.8870	73.6289	68.9392	62.5604	58.4182	52.5881	47.6359	53.9845	56.2427	62.8444	70.2953	73.6383	(72)
Total internal gains	613.6480	608.2578	583.7272	546.1149	507.7157	473.7843	454.4161	463.8968	485.9960	523.8311	565.5389	596.9834	(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			2.1300		10.6334		0.4400		0.0000		0.7700		7.6735 (74)
East			3.4900		19.6403		0.4400		0.0000		0.7700		23.2229 (76)
West			4.5200		19.6403		0.4400		0.0000		0.7700		30.0766 (80)
Solar gains	60.9730	118.9296	196.6284	290.4542	360.8278	371.8976	352.9989	299.6849	229.6659	141.1756	75.9245	50.2280	(83)
Total gains	674.6210	727.1875	780.3556	836.5691	868.5435	845.6819	807.4150	763.5817	715.6618	665.0066	641.4634	647.2113	(84)

7. Mean internal temperature (heating season)

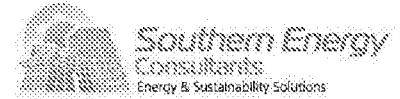
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	49.3273	49.4198	49.5109	49.9430	50.0247	50.4085	50.4085	50.4802	50.2600	50.0247	49.8597	49.6884
alpha	4.2885	4.2947	4.3007	4.3295	4.3350	4.3606	4.3606	4.3653	4.3507	4.3350	4.3240	4.3126
util living area	0.9899	0.9849	0.9719	0.9362	0.8542	0.7027	0.5424	0.5900	0.8131	0.9498	0.9835	0.9915 (86)
MIT	19.6890	19.8258	20.0811	20.4248	20.7275	20.9188	20.9795	20.9705	20.8394	20.4578	20.0146	19.6582 (87)
Th 2	19.9744	19.9761	19.9778	19.9857	19.9872	19.9941	19.9941	19.9954	19.9915	19.9872	19.9842	19.9811 (88)
util rest of house	0.9873	0.9809	0.9641	0.9173	0.8102	0.6187	0.4282	0.4753	0.7439	0.9311	0.9784	0.9893 (89)
MIT 2	18.2408	18.4404	18.8098	19.3015	19.7064	19.9331	19.9848	19.9807	19.8531	19.3566	18.7216	18.2008 (90)
Living area fraction	18.5484	18.7346	19.0798	19.5401	19.9233	20.1425	20.1960	20.1909	20.0626	19.5905	18.9962	18.5103 (91)
MIT	18.3984	18.5846	18.9298	19.3901	19.7733	19.9925	20.0460	20.0409	19.9126	19.4405	18.8462	18.3603 (93)
Temperature adjustment												-0.1500
adjusted MIT												18.3603 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9814	0.9732	0.9533	0.9034	0.7994	0.6185	0.4343	0.4808	0.7376	0.9179	0.9703	0.9841 (94)
Useful gains	662.0876	707.6840	743.9194	755.7677	694.3171	523.0587	350.6890	367.1440	527.8681	610.3875	622.3865	636.9408 (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	1490.0055	1443.5645	1308.7819	1094.9882	841.3368	557.6853	356.3870	376.0046	602.9057	921.2935	1228.1571	1485.6709 (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	615.9709	494.5117	420.2578	244.2388	109.3826	0.0000	0.0000	0.0000	0.0000	231.3141	436.1548	631.4552 (98)
Space heating												3183.2859 (98)
Space heating per m2												(98) / (4) = 34.1115 (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													3517.4430 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	615.9709	494.5117	420.2578	244.2388	109.3826	0.0000	0.0000	0.0000	0.0000	231.3141	436.1548	631.4552	(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)	680.6308	546.4218	464.3732	269.8771	120.8648	0.0000	0.0000	0.0000	0.0000	255.5957	481.9390	697.7406	(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	173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778	(64)
Efficiency of water heater (217)m	89.7774	89.7268	89.6036	89.3134	88.7086	87.3000	87.3000	87.3000	87.3000	89.2443	89.6360	89.8073	(217)
Fuel for water heating, kWh/month	193.0467	169.3738	176.0604	155.4566	151.2764	134.2869	126.0634	142.3470	143.3625	161.4788	173.5976	187.3765	(219)
Water heating fuel used												1913.7267	(219)
Annual totals kWh/year													
Space heating fuel - main system													3517.4430 (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)													437.6809 (232)
Total delivered energy for all uses													5943.8506 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3517.4430	3.4800	122.4070 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1913.7267	3.4800	66.5977 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	437.6809	13.1900	57.7301 (250)
Additional standing charges			120.0000 (251)
Total energy cost			376.6273 (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] =	1.1436 (257)
SAP value		84.0467
SAP rating (Section 12)		B (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	3517.4430	0.2160	759.7677 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1913.7267	0.2160	413.3650 (264)
Space and water heating			1173.1327 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	437.6809	0.5190	227.1564 (268)
Total kg/year			1439.2140 (272)
CO2 emissions per m2			15.4200 (273)
EI value			86.0574
EI rating			B (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	$3.48 / 0.8875 = 3.921$, stars = 4
Water heating environmental impact	$0.216 / 0.8875 = 0.2434$, stars = 4

Regs Region: England

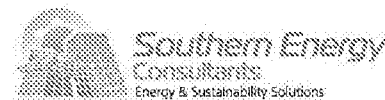
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

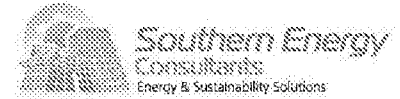
Calculation Type: New Build (As Designed)



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	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					2 * 10 = 20.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					20.0000 / (5) = 0.0857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3357 (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) =	0.2854 (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	0.2996	0.2854	0.2854	0.2640	0.2640	0.2354	0.2426	0.2283	0.2354	0.2497	0.2497	0.2711 (22b)
Effective ac	0.5449	0.5407	0.5407	0.5348	0.5348	0.5277	0.5294	0.5261	0.5277	0.5312	0.5312	0.5367 (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)			10.1400	1.2357	12.5304		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1800	8.3988	75.0000	3499.5000 (28a)
Brick Cavity	96.8000	14.4400	82.3600	0.2500	20.5900	60.0000	4941.6000 (29a)
External Roof 1	46.6600		46.6600	0.1100	5.1326	9.0000	419.9400 (30)
Total net area of external elements Aum (A, m ²)			190.1200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	53.1018			(33)
Party Wall 1			45.2500	0.0000	0.0000	110.0000	4977.5000 (32)
Internal Wall 1			159.3600			9.0000	1434.2400 (32c)
Internal Wall 2			24.2000			75.0000	1815.0000 (32c)
Internal Floor 1			46.6600			18.0000	839.8800 (32d)
Internal Ceiling 1			46.6600			18.0000	839.8800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18767.5400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							201.1095 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9937 (36)
Total fabric heat loss						(33) + (36) =	62.0955 (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	41.9506	41.6293	41.6293	41.1767	41.1767	40.6281	40.7594	40.5008	40.6281	40.8946	40.8946	41.3236 (38)
Heat transfer coeff	104.0461	103.7248	103.7248	103.2722	103.2722	102.7236	102.8549	102.5963	102.7236	102.9901	102.9901	103.4191 (39)
Average = Sum(39)m / 12 =												103.1948 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1149	1.1115	1.1115	1.1066	1.1066	1.1008	1.1022	1.0994	1.1008	1.1036	1.1036	1.1082 (40)
HLP (average)												1.1058 (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												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)

Regs Region: England

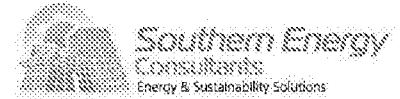
Elmhurst Energy Systems

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 = 1535.2611 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.8761 20.8822 21.5485 18.7865 18.0261 15.5552 14.4141 16.5404 16.7380 19.5065 21.2929 23.1227 (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 14.1386 12.7594 14.0997 13.6002 14.0211 13.5314 13.9591 13.9993 13.5689 14.0672 13.6535 14.1265 (61)											
Total heat required for water heating calculated for each month											
173.3123 151.9738 157.7565 138.8437 134.1952 117.2324 110.0534 124.2689 125.1555 144.1106 155.6060 168.2778 (62)											
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)											
Solar input (sum of months) = Sum(63)m = 0.0000 (63)											
Output from w/h											
173.3123 151.9738 157.7565 138.8437 134.1952 117.2324 110.0534 124.2689 125.1555 144.1106 155.6060 168.2778 (64)											
Total per year (kWh/year) = Sum(64)m = 1700.7860 (64)											
Heat gains from water heating, kWh/month											
56.4599 49.4786 51.2908 45.0435 43.4632 37.8634 35.4411 40.1645 40.4948 46.7562 50.6126 54.7869 (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	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	61.9583	55.0308	44.7540	33.8817	25.3270	21.3821	23.1041	30.0316	40.3083	51.1807	59.7354	63.6803	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	365.7535	369.5489	359.9846	339.6235	313.9213	289.7648	273.6268	269.8314	279.3956	299.7568	325.4590	349.6155	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	(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)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	(71)
Water heating gains (Table 5)	75.8870	73.6289	68.9392	62.5604	58.4182	52.5881	47.6359	53.9845	56.2427	62.8444	70.2953	73.6383	(72)
Total internal gains	613.6480	608.2578	583.7272	546.1149	507.7157	473.7843	454.4161	463.8968	485.9960	523.8311	565.5389	596.9834	(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					2.1300	11.9814	0.4400	0.0000			0.7700			8.6463 (74)
East					3.4900	22.3313	0.4400	0.0000			0.7700			26.4048 (76)
West					4.5200	22.3313	0.4400	0.0000			0.7700			34.1976 (80)
Solar gains	69.2488	121.6396	198.6011	301.8125	364.6541	401.8926	377.4761	328.1827	251.3000	154.1811	88.3677	56.4737 (83)		
Total gains	682.8968	729.8974	782.3283	847.9274	872.3699	875.6769	831.8922	792.0795	737.2960	678.0122	653.9066	653.4571 (84)		

7. Mean internal temperature (heating season)

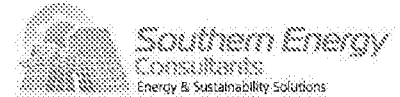
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	50.1048	50.2600	50.2600	50.4802	50.4802	50.7498	50.6851	50.8128	50.7498	50.6185	50.6185	50.4085
alpha	4.3403	4.3507	4.3507	4.3653	4.3653	4.3833	4.3790	4.3875	4.3833	4.3746	4.3746	4.3606
util living area	0.9873	0.9817	0.9642	0.9129	0.7908	0.5617	0.3797	0.4094	0.7188	0.9260	0.9773	0.9891 (86)
MIT	19.8243	19.9427	20.2122	20.5527	20.8362	20.9739	20.9964	20.9951	20.9208	20.5909	20.1585	19.8012 (87)
Th 2	19.9887	19.9915	19.9915	19.9954	19.9954	20.0002	19.9991	20.0013	20.0002	19.9979	19.9979	19.9941 (88)
util rest of house	0.9838	0.9768	0.9539	0.8870	0.7300	0.4601	0.2590	0.2843	0.6259	0.8979	0.9699	0.9862 (89)
MIT 2	18.4475	18.6204	19.0073	19.4841	19.8447	19.9860	19.9983	20.0002	19.9445	19.5469	18.9387	18.4179 (90)
Living area fraction	18.7399	18.9013	19.2632	19.7111	20.0553	20.1958	20.2103	20.2115	20.1518	19.7686	19.1978	18.7117 (91)
MIT	18.5899	18.7513	19.1132	19.5611	19.9053	20.0458	20.0603	20.0615	20.0018	19.6186	19.0478	18.5617 (93)
Temperature adjustment												-0.1500
adjusted MIT	18.5899	18.7513	19.1132	19.5611	19.9053	20.0458	20.0603	20.0615	20.0018	19.6186	19.0478	18.5617 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.9770	0.9683	0.9420	0.8732	0.7238	0.4649	0.2665	0.2920	0.6261	0.8844	0.9603	0.9800	0.9800	(94)
Useful gains	667.1848	706.7432	736.9847	740.4460	631.4123	407.1228	221.6928	231.2674	461.5860	599.6515	627.9292	640.4183	(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	1403.5707	1364.1128	1214.9466	997.7211	713.1227	415.6022	222.1957	232.0190	493.2605	825.8348	1137.8089	1392.1929	(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	547.8711	441.7524	355.6037	185.2381	60.7925	0.0000	0.0000	0.0000	0.0000	168.2804	367.1134	559.3203	(98)
Space heating												2685.9718	(98)
Space heating per m2												(98) / (4) =	28.7824 (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													2967.9246	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	547.8711	441.7524	355.6037	185.2381	60.7925	0.0000	0.0000	0.0000	0.0000	168.2804	367.1134	559.3203	(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)	605.3824	488.1242	392.9323	204.6829	67.1740	0.0000	0.0000	0.0000	0.0000	185.9452	405.6501	618.0334	(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	173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778	(64)	
Efficiency of water heater (217)m	89.7098	89.6588	89.4919	89.1008	88.2731	87.3000	87.3000	87.3000	87.3000	88.9951	89.5231	89.7392	(217)	
Fuel for water heating, kWh/month	193.1923	169.5024	176.2801	155.8277	152.0227	134.2869	126.0634	142.3470	143.3625	161.9309	173.8165	187.5186	(219)	
Water heating fuel used												1916.1509	(219)	
Annual totals kWh/year														
Space heating fuel - main system													2967.9246	(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)													437.6809	(232)
Total delivered energy for all uses													5396.7564	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2967.9246	3.8700	114.8587 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1916.1509	3.8700	74.1550 (247)
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)
Energy for lighting	437.6809	18.9000	82.7217 (250)
Additional standing charges			93.0000 (251)
Total energy cost			378.9104 (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	2967.9246	0.2160	641.0717 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1916.1509	0.2160	413.8886 (264)
Space and water heating			1054.9603 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	437.6809	0.5190	227.1564 (268)
Total kg/year			1321.0417 (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	2967.9246	1.2200	3620.8680 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1916.1509	1.2200	2337.7041 (264)
Space and water heating			5958.5721 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	437.6809	3.0700	1343.6803 (268)
Primary energy kWh/year			7532.5024 (272)
Primary energy kWh/m2/year			80.7169 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84
Current environmental impact rating: B 86

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	+ 1.2	-£ 29	-187 kg (14.2%)
U Solar photovoltaic panels	+ 9.7	-£ 345	-947 kg (83.5%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£29	2.01 kg/m²	B 85 B 88
Solar photovoltaic panels	£345	10.15 kg/m²	A 95 A 97
Total Savings	£374	12.15 kg/m²	

Potential energy efficiency rating: A 95
Potential environmental impact rating: A 97

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)

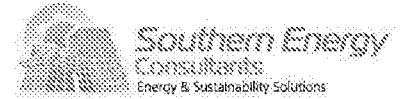
Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£97	£106	-£9
Mains gas	£282	£244	£38
Space heating	£222	£222	£0
Water heating	£74	£45	£29
Lighting	£83	£83	£0
Generated (PV)	-£0	-£345	£345

Total cost of fuels	£379	£5	£374
Total cost of uses	£379	£5	£374
Delivered energy	58 kWh/m²	28 kWh/m²	30 kWh/m²
Carbon dioxide emissions	1.3 tonnes	0.2 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	2 kg/m²	12 kg/m²
Primary energy	81 kWh/m²	9 kWh/m²	71 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	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					2 * 10 = 20.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					20.0000 / (5) = 0.0857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3357 (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) =	0.2854 (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	0.3638	0.3567	0.3496	0.3139	0.3068	0.2711	0.2711	0.2640	0.2854	0.3068	0.3210	0.3353 (22b)
Effective ac	0.5662	0.5636	0.5611	0.5493	0.5471	0.5367	0.5367	0.5348	0.5407	0.5471	0.5515	0.5562 (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)			10.1400	1.2357	12.5304		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1800	8.3988	75.0000	3499.5000 (28a)
Brick Cavity	96.8000	14.4400	82.3600	0.2500	20.5900	60.0000	4941.6000 (29a)
External Roof 1	46.6600		46.6600	0.1100	5.1326	9.0000	419.9400 (30)
Total net area of external elements Aum (A, m ²)			190.1200				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	53.1018			(33)
Party Wall 1			45.2500	0.0000	0.0000	110.0000	4977.5000 (32)
Internal Wall 1			159.3600			9.0000	1434.2400 (32c)
Internal Wall 2			24.2000			75.0000	1815.0000 (32c)
Internal Floor 1			46.6600			18.0000	839.8800 (32d)
Internal Ceiling 1			46.6600			18.0000	839.8800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18767.5400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							201.1095 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9937 (36)
Total fabric heat loss						(33) + (36) =	62.0955 (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	43.5905	43.3926	43.1986	42.2876	42.1171	41.3236	41.3236	41.1767	41.6293	42.1171	42.4620	42.8225 (38)
Heat transfer coeff	105.6860	105.4881	105.2941	104.3831	104.2126	103.4191	103.4191	103.2722	103.7248	104.2126	104.5575	104.9180 (39)
Average = Sum(39)m / 12 =												104.3823 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1325	1.1304	1.1283	1.1186	1.1167	1.1082	1.1082	1.1066	1.1115	1.1167	1.1204	1.1243 (40)
HLP (average)												1.1185 (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												2.6685 (42)
Average daily hot water use (litres/day)												97.5767 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (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 = 1535.2611 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.8761	20.8822	21.5485	18.7865	18.0261	15.5552	14.4141	16.5404	16.7380	19.5065	21.2929	23.1227 (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	14.1386	12.7594	14.0997	13.6002	14.0211	13.5314	13.9591	13.9993	13.5689	14.0672	13.6535 (61)
Total heat required for water heating calculated for each month											
173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778 (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	-25.0192	-41.7499	-71.1048	-95.2945	-117.7283	-115.7457	-114.2161	-99.7912	-78.1565	-53.3717	-29.6764 (63)
Output from w/h											
148.2931	110.2239	86.6516	43.5492	16.4668	1.4867	0.0000	24.4777	46.9990	90.7389	125.9296	147.3410 (64)
Heat gains from water heating, kWh/month											
56.4599	49.4786	51.2908	45.0435	43.4632	37.8634	35.4411	40.1645	40.4948	46.7562	50.6126	54.7869 (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	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	61.9583	55.0308	44.7540	33.8817	25.3270	21.3821	23.1041	30.0316	40.3083	51.1807	59.7354	63.6803	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	365.7535	369.5489	359.9846	339.6235	313.9213	289.7648	273.6268	269.8314	279.3956	299.7568	325.4590	349.6155	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	(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)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	(71)
Water heating gains (Table 5)	75.8870	73.6289	68.9392	62.5604	58.4182	52.5881	47.6359	53.9845	56.2427	62.8444	70.2953	73.6383	(72)
Total internal gains	613.6480	608.2578	583.7272	546.1149	507.7157	473.7843	454.4161	463.8968	485.9960	523.8311	565.5389	596.9834	(73)

6. Solar gains

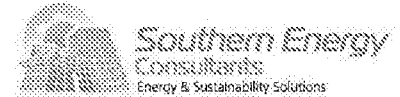
[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				2.1300	10.6334		0.4400		0.0000		0.7700		7.6735 (74)
East				3.4900	19.6403		0.4400		0.0000		0.7700		23.2229 (76)
West				4.5200	19.6403		0.4400		0.0000		0.7700		30.0766 (80)
Solar gains	60.9730	118.9296	196.6284	290.4542	360.8278	371.8976	352.9989	299.6849	229.6659	141.1756	75.9245	50.2280	(83)
Total gains	674.6210	727.1875	780.3556	836.5691	868.5435	845.6819	807.4150	763.5817	715.6618	665.0066	641.4634	647.2113	(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	49.3273	49.4198	49.5109	49.9430	50.0247	50.4085	50.4085	50.4802	50.2600	50.0247	49.8597	49.6884
alpha	4.2885	4.2947	4.3007	4.3295	4.3350	4.3606	4.3606	4.3653	4.3507	4.3350	4.3240	4.3126
util living area	0.9899	0.9849	0.9719	0.9362	0.8542	0.7027	0.5424	0.5900	0.8131	0.9498	0.9835	0.9915 (86)
MIT	19.6890	19.8258	20.0811	20.4248	20.7275	20.9188	20.9795	20.9705	20.8394	20.4578	20.0146	19.6582 (87)
Th 2	19.9744	19.9761	19.9778	19.9857	19.9872	19.9941	19.9941	19.9954	19.9915	19.9872	19.9842	19.9811 (88)
util rest of house	0.9873	0.9809	0.9641	0.9173	0.8102	0.6187	0.4282	0.4753	0.7439	0.9311	0.9784	0.9893 (89)
MIT 2	18.2408	18.4404	18.8098	19.3015	19.7064	19.9331	19.9848	19.9807	19.8531	19.3566	18.7216	18.2008 (90)
Living area fraction												
MIT	18.5484	18.7346	19.0798	19.5401	19.9233	20.1425	20.1960	20.1909	20.0626	19.5905	18.9962	18.5103 (92)
Temperature adjustment												
adjusted MIT	18.3984	18.5846	18.9298	19.3901	19.7733	19.9925	20.0460	20.0409	19.9126	19.4405	18.8462	18.3603 (93)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Calculation of Energy Ratings for Improved Dwelling 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9814	0.9732	0.9533	0.9034	0.7994	0.6185	0.4343	0.4808	0.7376	0.9179	0.9703	0.9841	(94)
Useful gains	662.0876	707.6840	743.9194	755.7677	694.3171	523.0587	350.6890	367.1440	527.8681	610.3875	622.3865	636.9408	(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	1490.0055	1443.5645	1308.7819	1094.9882	841.3368	557.6853	356.3870	376.0046	602.9057	921.2935	1228.1571	1485.6709	(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	615.9709	494.5117	420.2578	244.2388	109.3826	0.0000	0.0000	0.0000	0.0000	231.3141	436.1548	631.4552	(98)
Space heating												3183.2859	(98)
Space heating per m2											(98) / (4) =	34.1115	(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													3517.4430 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	615.9709	494.5117	420.2578	244.2388	109.3826	0.0000	0.0000	0.0000	0.0000	231.3141	436.1548	631.4552	(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)	680.6308	546.4218	464.3732	269.8771	120.8648	0.0000	0.0000	0.0000	0.0000	255.5957	481.9390	697.7406	(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	148.2931	110.2239	86.6516	43.5492	16.4668	1.4867	0.0000	24.4777	46.9990	90.7389	125.9296	147.3410	(64)
Efficiency of water heater	89.8609	89.8994	89.9365	90.0008	90.0680	87.3000	87.3000	87.3000	87.3000	89.5749	89.7628	89.8767	(217)
Fuel for water heating, kWh/month	165.0252	122.6080	96.3476	48.3875	18.2827	1.7030	0.0000	28.0386	53.8362	101.2995	140.2915	163.9367	(219)
Water heating fuel used												939.7565	(219)
Annual totals kWh/year													
Space heating fuel - main system												3517.4430	(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)													437.6809 (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												3292.6410	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3517.4430	3.4800	122.4070	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	939.7565	3.4800	32.7035	(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	437.6809	13.1900	57.7301	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			121.5053	(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] =	0.3689 (257)
SAP value		94.8532
SAP rating (Section 12)		95 (258)
SAP band		A

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

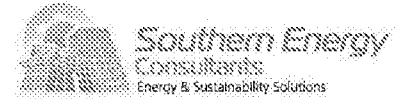


CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3517.4430	0.2160	759.7677 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	939.7565	0.2160	202.9874 (264)
Space and water heating			962.7551 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	437.6809	0.5190	227.1564 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			358.3492 (272)
CO2 emissions per m2			3.8400 (273)
EI value			96.5284
EI rating			97 (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	46.6600 (1b)	x 2.3400 (2b)	= 109.1844 (1b) - (3b)
First floor	46.6600 (1c)	x 2.6600 (2c)	= 124.1156 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 233.3000 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					2 * 10 = 20.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					20.0000 / (5) = 0.0857 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3357 (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) = 0.2854 (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	0.2996	0.2854	0.2854	0.2640	0.2640	0.2354	0.2426	0.2283	0.2354	0.2497	0.2497	0.2711 (22b)
Effective ac	0.5449	0.5407	0.5407	0.5348	0.5348	0.5277	0.5294	0.5261	0.5277	0.5312	0.5312	0.5367 (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)			10.1400	1.2357	12.5304		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1800	8.3988	75.0000	3499.5000 (28a)
Brick Cavity	96.8000	14.4400	82.3600	0.2500	20.5900	60.0000	4941.6000 (29a)
External Roof 1	46.6600		46.6600	0.1100	5.1326	9.0000	419.9400 (30)
Total net area of external elements Aum (A, m ²)			190.1200				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.1018		(33)
Party Wall 1			45.2500	0.0000	0.0000	110.0000	4977.5000 (32)
Internal Wall 1			159.3600			9.0000	1434.2400 (32c)
Internal Wall 2			24.2000			75.0000	1815.0000 (32c)
Internal Floor 1			46.6600			18.0000	839.8800 (32d)
Internal Ceiling 1			46.6600			18.0000	839.8800 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 18767.5400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							201.1095 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.9937 (36)
Total fabric heat loss							(33) + (36) = 62.0955 (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	41.9506	41.6293	41.6293	41.1767	41.1767	40.6281	40.7594	40.5008	40.6281	40.8946	40.8946	41.3236 (38)
Heat transfer coeff	104.0461	103.7248	103.7248	103.2722	103.2722	102.7236	102.8549	102.5963	102.7236	102.9901	102.9901	103.4191 (39)
Average = Sum(39)m / 12 =												103.1948 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1149	1.1115	1.1115	1.1066	1.1066	1.1008	1.1022	1.0994	1.1008	1.1036	1.1036	1.1082 (40)
HLP (average)												1.1058 (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	2.6685 (42)
Average daily hot water use (litres/day)	97.5767 (43)

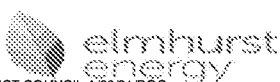
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	107.3343	103.4313	99.5282	95.6251	91.7221	87.8190	87.8190	91.7221	95.6251	99.5282	103.4313	107.3343 (44)
Energy conte	159.1737	139.2144	143.6568	125.2434	120.1741	103.7011	96.0943	110.2696	111.5866	130.0434	141.9525	154.1513 (45)

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 =	1535.2611 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.8761	20.8822	21.5485	18.7865	18.0261	15.5552	14.4141	16.5404	16.7380	19.5065	21.2929	23.1227 (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	14.1386	12.7594	14.0997	13.6002	14.0211	13.5314	13.9591	13.9993	13.5689	14.0672	13.6535	14.1265 (61)	
Total heat required for water heating calculated for each month													
	173.3123	151.9738	157.7565	138.8437	134.1952	117.2324	110.0534	124.2689	125.1555	144.1106	155.6060	168.2778 (62)	
Aperture area of solar collector													
Zero-loss collector efficiency													3.0000 (H1)
Collector heat loss coefficient													0.7000 (H2)
Collector 2nd order heat loss coefficient													1.8000 (H3)
Collector effective heat loss coefficient													0.0050 (H3a)
Collector performance ratio													1.8063 (H3b)
Annual solar radiation per m2													2.5804 (H4)
Overshading factor													1140.0998 (H5)
Solar energy available													0.8000 (H6)
Adjustment factor for showers													1915.3676 (H7)
Solar-to-load ratio													1.0000 (H7a)
Utilisation factor													1.2476 (H8)
Collector performance factor													0.5514 (H9)
Dedicated solar storage volume													0.8793 (H10)
Effective solar volume													75.0000 (H11)
Daily hot water demand													75.0000 (H13)
Volume ratio Veff/V													97.5767 (H14)
Solar storage volume factor													0.7686 (H15)
Solar input													0.9474 (H16)
Solar input	-27.0774	-40.6973	-68.5395	-94.7425	-114.1018	-120.0872	-117.2037	-104.6636	-81.6903	-55.5724	-32.9133	-879.7230 (H17)	
Output from w/h													-22.4338 (63)
												Solar input (sum of months) = Sum(63)m =	-879.7230 (63)
	146.2349	111.2764	89.2170	44.1012	20.0933	0.0000	0.0000	19.6053	43.4651	88.5382	122.6927	145.8440 (64)	
												Total per year (kWh/year) = Sum(64)m =	831.0680 (64)
Heat gains from water heating, kWh/month													
	56.4599	49.4786	51.2908	45.0435	43.4632	37.8634	35.4411	40.1645	40.4948	46.7562	50.6126	54.7869 (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	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	160.1095	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	61.9583	55.0308	44.7540	33.8817	25.3270	21.3821	23.1041	30.0316	40.3083	51.1807	59.7354	63.6803	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	365.7535	369.5489	359.9846	339.6235	313.9213	289.7648	273.6268	269.8314	279.3956	299.7568	325.4590	349.6155	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	53.6794	(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)	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	-106.7397	(71)
Water heating gains (Table 5)	75.8870	73.6289	68.9392	62.5604	58.4182	52.5881	47.6359	53.9845	56.2427	62.8444	70.2953	73.6383	(72)
Total internal gains	613.6480	608.2578	583.7272	546.1149	507.7157	473.7843	454.4161	463.8968	485.9960	523.8311	565.5389	596.9834	(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	2.1300	11.9814	0.4400	0.0000	0.7700	8.6463 (74)
East	3.4900	22.3313	0.4400	0.0000	0.7700	26.4048 (76)
West	4.5200	22.3313	0.4400	0.0000	0.7700	34.1976 (80)

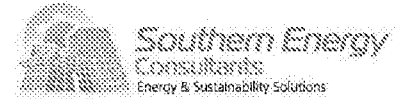
Solar gains	69.2488	121.6396	198.6011	301.8125	364.6541	401.8926	377.4761	328.1827	251.3000	154.1811	88.3677	56.4737 (83)
Total gains	682.8968	729.8974	782.3283	847.9274	872.3699	875.6769	831.8922	792.0795	737.2960	678.0122	653.9066	653.4571 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	50.1048	50.2600	50.2600	50.4802	50.4802	50.7498	50.6851	50.8128	50.7498	50.6185	50.6185	50.4085
util living area	4.3403	4.3507	4.3507	4.3653	4.3653	4.3833	4.3790	4.3875	4.3833	4.3746	4.3746	4.3606
	0.9873	0.9817	0.9642	0.9129	0.7908	0.5617	0.3797	0.4094	0.7188	0.9260	0.9773	0.9891 (86)
MIT	19.8243	19.9427	20.2122	20.5527	20.8362	20.9739	20.9964	20.9951	20.9208	20.5909	20.1585	19.8012 (87)
Th 2	19.9887	19.9915	19.9915	19.9954	19.9954	20.0002	19.9991	20.0013	20.0002	19.9979	19.9979	19.9941 (88)
util rest of house	0.9838	0.9768	0.9539	0.8870	0.7300	0.4601	0.2590	0.2843	0.6259	0.8979	0.9699	0.9862 (89)
MIT 2	18.4475	18.6204	19.0073	19.4841	19.8447	19.9860	19.9983	20.0002	19.9445	19.5469	18.9387	18.4179 (90)
Living area fraction	18.7399	18.9013	19.2632	19.7111	20.0553	20.1958	20.2103	20.2115	19.9445	19.5469	18.9387	18.4179 (91)
MIT	18.7399	18.9013	19.2632	19.7111	20.0553	20.1958	20.2103	20.2115	20.1518	19.7686	19.1978	18.7117 (92)
Temperature adjustment	18.5899	18.7513	19.1132	19.5611	19.9053	20.0458	20.0603	20.0615	20.0018	19.6186	19.0478	18.5617 (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	0.9770	0.9683	0.9420	0.8732	0.7238	0.4649	0.2665	0.2920	0.6261	0.8844	0.9603	0.9800	(94)
Useful gains	667.1848	706.7432	736.9847	740.4460	631.4123	407.1228	221.6928	231.2674	461.5860	599.6515	627.9292	640.4183	(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	1403.5707	1364.1128	1214.9466	997.7211	713.1227	415.6022	222.1957	232.0190	493.2605	825.8348	1137.8089	1392.1929	(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	547.8711	441.7524	355.6037	185.2381	60.7925	0.0000	0.0000	0.0000	0.0000	168.2804	367.1134	559.3203	(98)
Space heating												2685.9718	(98)
Space heating per m2												(98) / (4) =	28.7824 (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													2967.9246 (211)
Space heating requirement	547.8711	441.7524	355.6037	185.2381	60.7925	0.0000	0.0000	0.0000	0.0000	168.2804	367.1134	559.3203	(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)	605.3824	488.1242	392.9323	204.6829	67.1740	0.0000	0.0000	0.0000	0.0000	185.9452	405.6501	618.0334	(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	146.2349	111.2764	89.2170	44.1012	20.0933	0.0000	0.0000	19.6053	43.4651	88.5382	122.6927	145.8440	(64)
Efficiency of water heater	89.8065	89.8374	89.8395	89.8666	89.6834	87.3000	87.3000	87.3000	87.3000	89.3706	89.6766	89.8191	(217)
Fuel for water heating, kWh/month	162.8333	123.8642	99.3071	49.0740	22.4047	0.0000	0.0000	22.4574	49.7883	99.0685	136.8168	162.3753	(219)
Water heating fuel used												927.9897	(219)
Annual totals kWh/year													
Space heating fuel - main system													2967.9246 (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)													437.6809 (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													2634.4356 (238)

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

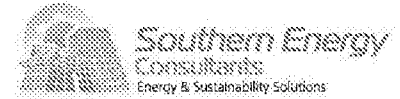
	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2967.9246	3.8700	114.8587 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	927.9897	3.8700	35.9132 (247)
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)
Pump for solar water heating	50.0000	18.9000	9.4500 (249)
Energy for lighting	437.6809	18.9000	82.7217 (250)
Additional standing charges			93.0000 (251)
Energy saving/generation technologies			
PV Unit	-1824.1596	18.9000	-344.7662 (252)
Total energy cost			5.3524 (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	2967.9246	0.2160	641.0717 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	927.9897	0.2160	200.4458 (264)
Space and water heating			841.5175 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	437.6809	0.5190	227.1564 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	0.5190	-946.7389 (269)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Total kg/year 186.8100 (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	2967.9246	1.2200	3620.8680 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	927.9897	1.2200	1132.1475 (264)
Space and water heating			4753.0155 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	437.6809	3.0700	1343.6803 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	3.0700	-5600.1701 (269)
Primary energy kWh/year			880.2757 (272)
Primary energy kWh/m2/year			9.4329 (273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	201.1 (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	307.96 (P1)
Transmission heat loss coefficient	62.10 (37)
Summer heat loss coefficient	370.05 (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	2.1300	81.1852	0.4400	0.0000	0.9000	68.4781
East	3.4900	117.5071	0.4400	0.0000	0.9000	162.3995
West	4.5200	117.5071	0.4400	0.0000	0.9000	210.3283

total: 441.2058

	Jun	Jul	Aug	
Solar gains	470	441	384	(P4)
Internal gains	471	451	461	
Total summer gains	941	893	844	(P5)

Summer gain/loss ratio	2.54	2.41	2.28	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 201.1)	0.59	0.59	0.59	
Threshold temperature	19.13	20.90	20.67	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight