

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	SECANG008			Issued on Date	04/02/2021
Assessment Reference	001	Prop Type Ref	End Bri Re Ga Ea		
Property	WP3520A+, Plot 4				
SAP Rating	84 B	DER	17.60	TET	18.16
Environmental	36 B	% DER<TER	3.07		
CO ₂ Emissions (t/year)	1.34	DPEE	49.09	TPEE	52.38
General Requirements Compliance	Pass	% DPEE<TPEE	6.29		
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

End-Terrace 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) 18.16 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.60 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)52.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)49.1 kWh/m²/yrOK

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	0.19 (max. 0.25)	0.19 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.37 (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: 0.60 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)			8.6100	1.2357	10.6397		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1900	8.8654	75.0000	3499.5000 (28a)
Brick/Render Cavity	101.9500	12.9100	89.0400	0.2500	22.2600	60.0000	5342.4000 (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)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	53.3477			(33)
Party Wall 1			40.3000	0.0000	0.0000	110.0000	4433.0000 (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) =	18623.8400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							199.5697 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.1002 (36)
Total fabric heat loss						(33) + (36) =	62.4479 (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	106.0384	105.8405	105.6465	104.7355	104.5650	103.7715	103.7715	103.6246	104.0772	104.5650	104.9099	105.2704 (39)
Average = Sum(39)m / 12 =												104.7347 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1363	1.1342	1.1321	1.1223	1.1205	1.1120	1.1120	1.1104	1.1153	1.1205	1.1242	1.1281 (40)
HLP (average)												1.1223 (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	25.6499	22.7821	18.5276	14.0266	10.4850	8.8519	9.5648	12.4327	16.6871	21.1882	24.7297	26.3628	(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	412.6191	410.0361	394.6839	370.1622	345.2579	321.6098	306.5581	313.2316	326.1523	350.8970	379.1099	400.2709	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W
North					0.6000	10.6334	0.4400	0.0000			0.7700			2.1616 (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	55.4611	108.3960	178.7292	261.7034	322.0978	330.4361	314.2892	268.9738	208.1452	128.6366	69.1248	45.6329	(83)	
Total gains	468.0802	518.4321	573.4131	631.8656	667.3557	652.0459	620.8473	582.2054	534.2975	479.5336	448.2347	445.9038	(84)	

7. Mean internal temperature (heating season)

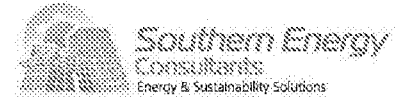
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	48.7869	48.8782	48.9679	49.3938	49.4744	49.8527	49.8527	49.9234	49.7063	49.4744	49.3117	49.1429
alpha	4.2525	4.2585	4.2645	4.2929	4.2983	4.3235	4.3235	4.3282	4.3138	4.2983	4.2874	4.2762
util living area	0.9974	0.9956	0.9905	0.9741	0.9280	0.8195	0.6714	0.7235	0.9098	0.9832	0.9956	0.9979 (86)
MIT	19.4341	19.5728	19.8414	20.2149	20.5745	20.8433	20.9520	20.9330	20.7201	20.2577	19.7815	19.4077 (87)
Th 2	19.9713	19.9730	19.9747	19.9826	19.9841	19.9910	19.9910	19.9923	19.9884	19.9841	19.9811	19.9780 (88)
util rest of house	0.9967	0.9944	0.9875	0.9651	0.9001	0.7453	0.5446	0.6027	0.8629	0.9759	0.9941	0.9974 (89)
MIT 2	17.8691	18.0729	18.4655	19.0107	19.5154	19.8611	19.9667	19.9546	19.7202	19.0782	18.3838	17.8349 (90)
Living area fraction	18.2015	18.3914	18.7577	19.2664	19.7404	20.0697	20.1760	20.1624	19.9326	19.3287	18.6806	18.1690 (92)
Temperature adjustment	18.0515	18.2414	18.6077	19.1164	19.5904	19.9197	20.0260	20.0124	19.7826	19.1787	18.5306	-0.1500 (93)
adjusted MIT	18.0515	18.2414	18.6077	19.1164	19.5904	19.9197	20.0260	20.0124	19.7826	19.1787	18.5306	18.0190 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9946	0.9911	0.9817	0.9545	0.8862	0.7391	0.5495	0.6055	0.8506	0.9673	0.9907	0.9956 (94)
Useful gains	465.5407	513.8074	562.9268	603.1341	591.4245	481.9184	341.1390	352.4990	454.4694	463.8447	444.0827	443.9308 (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	1458.1818	1412.0641	1279.1356	1070.0243	825.0564	552.0361	355.5194	374.3323	591.4246	897.0364	1199.1872	1454.7293 (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	738.5250	603.6285	532.8593	336.1610	173.8221	0.0000	0.0000	0.0000	0.0000	322.2946	543.6752	752.0341 (98)
Space heating												4002.9999 (98)
Space heating per m2												(98) / (4) = 42.8954 (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													4423.2043	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	738.5250	603.6285	532.8593	336.1610	173.8221	0.0000	0.0000	0.0000	0.0000	322.2946	543.6752	752.0341	(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)	816.0497	666.9928	588.7949	371.4486	192.0686	0.0000	0.0000	0.0000	0.0000	356.1266	600.7461	830.9769	(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	89.8738	89.8377	89.7485	89.5406	89.0775	87.3000	87.3000	87.3000	87.3000	89.4865	89.7678	89.8975	(217)	
Fuel for water heating, kWh/month	192.8395	169.1648	175.7761	155.0622	150.6500	134.2869	126.0634	142.3470	143.3625	161.0417	173.3428	187.1886	(219)	
Water heating fuel used												1911.1255	(219)	
Annual totals kWh/year														
Space heating fuel - main system													4423.2043	(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)													452.9861	(232)
Total delivered energy for all uses													6862.3159	(238)

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

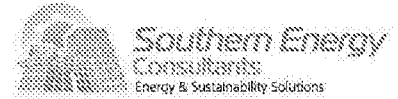
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4423.2043	0.2160	955.4121 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1911.1255	0.2160	412.8031 (264)
Space and water heating			1368.2152 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	452.9861	0.5190	235.0998 (268)
Total CO2, kg/year			1642.2400 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.6000 (273)

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

DER		17.6000	ZC1
Total Floor Area		93.3200	
Assumed number of occupants		2.6685	
CO2 emission factor in Table 12 for electricity displaced from grid		0.5190	
CO2 emissions from appliances, equation (L14)		15.5609	ZC2
CO2 emissions from cooking, equation (L16)		1.9615	ZC3
Total CO2 emissions		35.1224	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		35.1224	ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	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)			8.6100	1.3258	11.4148		(27)
Heat Loss Floor 1			46.6600	0.1300	6.0658		(28a)
Brick/Pender Cavity	101.9500	12.9100	89.0400	0.1800	16.0272		(29a)
External Roof 1	46.6600		46.6600	0.1300	6.0658		(30)
Total net area of external elements Aum(A, m ²)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.3036		(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)							10.2261 (36)
Total fabric heat loss						(33) + (36) =	54.5297 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	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)
Average = Sum(39)m / 12 =	99.5045	99.2528	99.0062	97.8476	97.6309	96.6218	96.6218	96.4350	97.0105	97.6309	98.0694	98.5278 (39)
	97.8466 (39)											

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.0663	1.0636	1.0609	1.0485	1.0462	1.0354	1.0354	1.0334	1.0395	1.0462	1.0509	1.0558 (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)
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	25.6499	22.7821	18.5276	14.0266	10.4850	8.8519	9.5648	12.4327	16.6871	21.1882	24.7297	26.3628	(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	424.9916	422.4126	406.9886	381.8140	356.2523	331.9489	316.9050	324.2334	337.8151	363.2126	391.4924	412.6474	(73)

6. Solar gains

[Jan]												Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North												0.6000	10.6334	0.6300	0.7000	0.7700	1.9498 (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	50.0284	97.7781	161.2218	236.0684	290.5469	298.0683	283.5032	242.6266	187.7564	116.0361	62.3537	41.1630	(83)				
Total gains	475.0200	520.1907	568.2105	617.8824	646.7992	630.0173	600.4082	566.8600	525.5715	479.2486	453.8461	453.8103	(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	65.1283	65.2934	65.4561	66.2311	66.3781	67.0713	67.0713	67.2013	66.8026	66.3781	66.0813	65.7739		
alpha	5.3419	5.3529	5.3637	5.4154	5.4252	5.4714	5.4714	5.4801	5.4535	5.4252	5.4054	5.3849		
util living area	0.9991	0.9983	0.9958	0.9857	0.9485	0.8375	0.6731	0.7268	0.9273	0.9909	0.9983	0.9993	(86)	
MIT	19.7868	19.8971	20.1102	20.4105	20.6979	20.9067	20.9784	20.9675	20.8131	20.4456	20.0672	19.7694	(87)	
Th 2	20.0285	20.0307	20.0329	20.0431	20.0450	20.0540	20.0540	20.0556	20.0505	20.0450	20.0411	20.0371	(88)	
util rest of house	0.9988	0.9978	0.9942	0.9795	0.9238	0.7613	0.5457	0.6036	0.8818	0.9860	0.9975	0.9991	(89)	
MIT 2	18.3960	18.5590	18.8718	19.3145	19.7186	19.9827	20.0448	20.0400	19.8793	19.3696	18.8156	18.3769	(90)	
Living area fraction	18.6914	18.8432	19.1348	19.5473	19.9266	20.1789	20.2431	20.2370	20.0776	19.5981	19.0815	18.6726	(92)	
Temperature adjustment												0.0000		
adjusted MIT	18.6914	18.8432	19.1348	19.5473	19.9266	20.1789	20.2431	20.2370	20.0776	19.5981	19.0815	18.6726	(93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9982	0.9967	0.9920	0.9751	0.9199	0.7728	0.5728	0.6294	0.8834	0.9827	0.9964	0.9986	(94)
Useful gains	474.1449	518.4624	563.6803	602.4928	595.0197	486.8660	343.9018	356.7796	464.2981	470.9461	452.2141	453.1599	(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	1432.0097	1383.8989	1250.9252	1041.8141	803.1737	539.0471	351.9992	370.0217	579.8914	878.4922	1175.0139	1425.9584	(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	712.6514	581.5733	511.3102	316.3113	154.8666	0.0000	0.0000	0.0000	0.0000	303.2143	520.4159	723.7621	(98)
Space heating												3824.1051	(98)
Space heating per m ²												40.9784	(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													4094.3310 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	712.6514	581.5733	511.3102	316.3113	154.8666	0.0000	0.0000	0.0000	0.0000	303.2143	520.4159	723.7621	(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)	763.0101	622.6695	547.4414	338.6631	165.8100	0.0000	0.0000	0.0000	0.0000	324.6406	557.1905	774.9059	(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	87.8829	87.7342	87.3730	86.5593	84.8632	80.3000	80.3000	80.3000	80.3000	86.3438	87.4441	87.9571	(217)
Fuel for water heating, kWh/month	239.1053	211.1397	222.4660	199.1709	196.6867	183.0748	175.3996	195.5295	197.6889	209.3513	218.7313	233.1934	(219)
Water heating fuel used												2481.5375	(219)
Annual totals kWh/year													
Space heating fuel - main system												4094.3310	(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)												452.9861	(232)
Total delivered energy for all uses												7103.8546	(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	4094.3310	0.2160	884.3755 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2481.5375	0.2160	536.0121 (264)
Space and water heating			1420.3876 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	452.9861	0.5190	235.0998 (268)
Total CO2, kg/m2/year			1694.4124 (272)
Emissions per m2 for space and water heating			15.2206 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.5193 (272b)
Emissions per m2 for pumps and fans			0.4171 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.2206 * 1.00) + 2.5193 + 0.4171, rounded to 2 d.p.			18.1600 (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)
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)			8.6100	1.2357	10.6397		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1900	8.8654	75.0000	3499.5000 (28a)
Brick/Render Cavity	101.9500	12.9100	89.0400	0.2500	22.2600	60.0000	5342.4000 (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)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	53.3477			(33)
Party Wall 1			40.3000	0.0000	0.0000	110.0000	4433.0000 (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) =	18203.9000			(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							195.0697 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.1002 (36)
Total fabric heat loss			(33) + (36) =	62.4479			(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	107.4227	107.1711	106.9244	105.7659	105.5491	104.5401	104.5401	104.3532	104.9287	105.5491	105.9876	106.4460 (39)
Average = Sum(39)m / 12 =												105.7648 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1511	1.1484	1.1458	1.1334	1.1310	1.1202	1.1202	1.1182	1.1244	1.1310	1.1357	1.1407 (40)
HLP (average)												1.1334 (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	25.6499	22.7821	18.5276	14.0266	10.4850	8.8519	9.5648	12.4327	16.6871	21.1882	24.7297	26.3628	(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	379.1951	377.4296	363.7757	341.5659	318.1636	296.6279	283.3684	287.7421	299.8431	322.1953	347.7103	367.6610	(73)

6. Solar gains

[Jan]			Area m2		Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North			0.6000		10.6334		0.4400		0.0000		0.7700		2.1616 (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	55.4611	108.3960	178.7292	261.7034	322.0978	330.4361	314.2892	268.9738	208.1452	128.6366	69.1248	45.6329	(83)
Total gains	434.6562	485.8256	542.5049	603.2693	640.2614	627.0640	597.6576	556.7159	507.9883	450.8319	416.8351	413.2939	(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	47.0724	47.1829	47.2917	47.8097	47.9079	48.3703	48.3703	48.4570	48.1912	47.9079	47.7097	47.5042	
alpha	4.1382	4.1455	4.1528	4.1873	4.1939	4.2247	4.2247	4.2305	4.2127	4.1939	4.1806	4.1669	
util living area	0.9979	0.9962	0.9917	0.9769	0.9350	0.8339	0.6909	0.7446	0.9204	0.9858	0.9963	0.9983	(86)
MIT	19.3437	19.4875	19.7658	20.1560	20.5316	20.8208	20.9423	20.9197	20.6859	20.2010	19.7075	19.3210	(87)
Th 2	19.9593	19.9615	19.9636	19.9737	19.9756	19.9843	19.9843	19.9860	19.9810	19.9756	19.9717	19.9678	(88)
util rest of house	0.9973	0.9952	0.9891	0.9689	0.9094	0.7626	0.5638	0.6252	0.8778	0.9795	0.9951	0.9978	(89)
MIT 2	18.4388	18.5839	18.8628	19.2564	19.6194	19.8805	19.9637	19.9539	19.7713	19.3053	18.8117	18.4226	(90)
Living area fraction	18.6310	18.7758	19.0546	19.4475	19.8131	20.0802	20.1715	20.1590	19.9655	19.4956	19.0020	18.6134	(91)
MIT	18.6310	18.7758	19.0546	19.4475	19.8131	20.0802	20.1715	20.1590	19.9655	19.4956	19.0020	18.6134	(92)
Temperature adjustment	18.6310	18.7758	19.0546	19.4475	19.8131	20.0802	20.1715	20.1590	19.9655	19.4956	19.0020	18.6134	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	432.9892	482.6491	534.9255	581.2465	579.0167	483.1035	352.3705	360.8948	445.4810	439.7814	414.1021	412.0151	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1539.4768	1487.0853	1342.3911	1115.5643	856.3313	572.9039	373.3695	392.2685	615.4623	938.9194	1261.4613	1534.2536	(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	823.2268	674.9811	600.7544	384.7088	206.3220	0.0000	0.0000	0.0000	0.0000	371.3587	610.0986	834.9454	(98)
Space heating												4506.3959	(98)
Space heating per m2												48.2897	(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	982.6767	773.5966	793.0844	0.0000	0.0000	0.0000	0.0000	(100)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

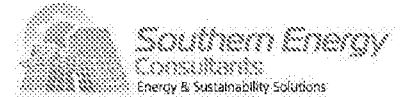


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7381	0.8216	0.7877	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	725.3448	635.6029	624.7515	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	835.7741	799.3854	753.8424	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	79.5091	121.8542	96.0436	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												297.4069 (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	19.8773	30.4635	24.0109	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												74.3517 (107)
Space cooling per m2												0.7967 (108)
Energy for space heating												48.2897 (99)
Energy for space cooling												0.7967 (108)
Total												49.0865 (109)
Dwelling Fabric Energy Efficiency (DFEE)												49.1 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	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)			8.6100	1.3258	11.4148		(27)
Heat Loss Floor 1			46.6600	0.1300	6.0658		(28a)
Brick/Pender Cavity	101.9500	12.9100	89.0400	0.1800	16.0272		(29a)
External Roof 1	46.6600		46.6600	0.1300	6.0658		(30)
Total net area of external elements Aum(A, m ²)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.3036		(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)							10.2261 (36)
Total fabric heat loss						(33) + (36) =	54.5297 (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	99.5045	99.2528	99.0062	97.8476	97.6309	96.6218	96.6218
Average = Sum(39)m / 12 =						96.4350	97.0105
HLP	1.0663	1.0636	1.0609	1.0485	1.0462	1.0354	1.0354
HLP (average)						1.0334	1.0395
Days in month	31	28	31	30	31	30	31
						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)
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	25.6499	22.7821	18.5276	14.0266	10.4850	8.8519	9.5648	12.4327	16.6871	21.1882	24.7297	26.3628	(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	379.1951	377.4296	363.7757	341.5659	318.1636	296.6279	283.3684	287.7421	299.8431	322.1953	347.7103	367.6610	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	0.6000	10.6334	0.6300	0.7000	0.7700	1.9498 (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	50.0284	97.7781	161.2218	236.0684	290.5469	298.0683	283.5032	242.6266	187.7564	116.0361	62.3537	41.1630	(83)
Total gains	429.2235	475.2077	524.9975	577.6343	608.7105	594.6963	566.8716	530.3687	487.5995	438.2314	410.0640	408.8240	(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	65.1283	65.2934	65.4561	66.2311	66.3781	67.0713	67.0713	67.2013	66.8026	66.3781	66.0813	65.7739	
alpha	5.3419	5.3529	5.3637	5.4154	5.4252	5.4714	5.4714	5.4801	5.4535	5.4252	5.4054	5.3849	
util living area	0.9995	0.9989	0.9971	0.9894	0.9592	0.8615	0.7040	0.7614	0.9446	0.9940	0.9989	0.9996	(86)
MIT	19.7402	19.8515	20.0669	20.3720	20.6676	20.8910	20.9732	20.9591	20.7856	20.4053	20.0227	19.7235	(87)
Th 2	20.0285	20.0307	20.0329	20.0431	20.0450	20.0540	20.0540	20.0556	20.0505	20.0450	20.0411	20.0371	(88)
util rest of house	0.9993	0.9986	0.9960	0.9847	0.9386	0.7902	0.5749	0.6391	0.9068	0.9907	0.9985	0.9995	(89)
MIT 2	18.8674	18.9804	19.1971	19.5083	19.7953	19.9953	20.0459	20.0417	19.9117	19.5444	19.1601	18.8577	(90)
Living area fraction									fLA = Living area / (4) =			0.2124	(91)
MIT	19.0527	19.1654	19.3819	19.6918	19.9806	20.1855	20.2429	20.2365	20.0973	19.7273	19.3433	19.0416	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0527	19.1654	19.3819	19.6918	19.9806	20.1855	20.2429	20.2365	20.0973	19.7273	19.3433	19.0416	(93)

8. Space heating requirement

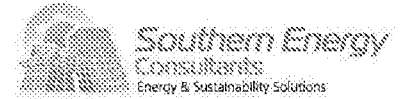
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9990	0.9981	0.9949	0.9824	0.9368	0.8017	0.6027	0.6651	0.9091	0.9891	0.9980	0.9992	(94)
Useful gains	428.7970	474.2921	522.3448	567.4462	570.2409	476.7528	341.6716	352.7580	443.3009	433.4436	409.2516	408.5159	(95)
Ext temp.	4.3000	4.9000	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	1467.9639	1415.8782	1275.3856	1055.9495	808.4395	539.6844	351.9802	369.9744	581.8033	891.1043	1200.6909	1462.3100	(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	773.1402	632.7459	560.2624	351.7224	177.2197	0.0000	0.0000	0.0000	0.0000	340.4996	569.8363	784.0228	(98)
Space heating												4189.4492	(98)
Space heating per m ²										(98) / (4) =		44.8934	(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	908.2453	715.0017	732.9059	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7860	0.8718	0.8399	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	713.8392	623.3124	615.5655	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	797.9417	763.4017	723.0469	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	60.5538	104.2264	79.9662	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												244.7464 (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	15.1384	26.0566	19.9916	0.0000	0.0000	0.0000	0.0000 (107)	
Space cooling												61.1866 (107)
Space cooling per m2												0.6557 (108)
Energy for space heating												44.8934 (99)
Energy for space cooling												0.6557 (108)
Total												45.5490 (109)
Target Fabric Energy Efficiency (TFEE)												52.4 (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)			8.6100	1.2357	10.6397		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1900	8.8654	75.0000	3499.5000 (28a)
Brick/Render Cavity	101.9500	12.9100	89.0400	0.2500	22.2600	60.0000	5342.4000 (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)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	53.3477			(33)
Party Wall 1			40.3000	0.0000	0.0000	110.0000	4433.0000 (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) = 18623.8400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							199.5697 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.1002 (36)
Total fabric heat loss							(33) + (36) = 62.4479 (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	104.3985	104.0772	104.0772	103.6246	103.6246	103.0760	103.2073	102.9487	103.0760	103.3425	103.3425	103.7715 (39)
Average = Sum(39)m / 12 =												103.5472 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1187	1.1153	1.1153	1.1104	1.1104	1.1045	1.1060	1.1032	1.1045	1.1074	1.1074	1.1120 (40)
HLP (average)												1.1096 (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 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	14.1386	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 (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 (64)
RHI water heating demand											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 (65)
											1701 (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	64.1249	56.9551	46.3190	35.0665	26.2126	22.1298	23.9120	31.0817	41.7179	52.9704	61.8243	65.9071	(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	615.8146	610.1822	585.2922	547.2997	508.6014	474.5320	455.2240	464.9469	487.4055	525.6208	567.6278	599.2102	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g	Specific data or Table 6b	FF	Specific data or Table 6c	Access factor Table 6d	Gains W	
North				0.6000	11.9814		0.4400	0.0000		0.7700	2.4356 (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	63.0380	110.8644	180.3284	271.4341	324.8426	356.3636	335.3926	293.9655	227.4225	140.4269	80.4983	51.3588 (83)
Total gains	678.8526	721.0466	765.6205	818.7338	833.4440	830.8956	790.6166	758.9124	714.8280	666.0477	648.1261	650.5690 (84)

7. Mean internal temperature (heating season)

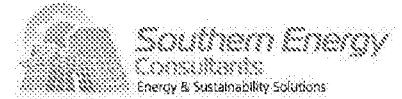
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	49.5533	49.7063	49.7063	49.9234	49.9234	50.1891	50.1252	50.2511	50.1891	50.0597	50.0597	49.8527
alpha	4.3036	4.3138	4.3138	4.3282	4.3282	4.3459	4.3417	4.3501	4.3459	4.3373	4.3373	4.3235
util living area	0.9873	0.9822	0.9663	0.9209	0.8101	0.5882	0.3999	0.4275	0.7340	0.9294	0.9776	0.9891 (86)
MIT	19.8069	19.9208	20.1849	20.5214	20.8143	20.9678	20.9954	20.9940	20.9116	20.5742	20.1422	19.7849 (87)
Th 2	19.9856	19.9884	19.9884	19.9923	19.9923	19.9971	19.9960	19.9982	19.9971	19.9948	19.9948	19.9910 (88)
util rest of house	0.9839	0.9774	0.9565	0.8967	0.7515	0.4837	0.2729	0.2971	0.6418	0.9024	0.9704	0.9861 (89)
MIT 2	18.4210	18.5876	18.9674	19.4411	19.8186	19.9793	19.9950	19.9968	19.9339	19.5231	18.9140	18.3931 (90)
Living area fraction	fLA = Living area / (4) =											0.2124 (91)
MIT	18.7153	18.8708	19.2260	19.6705	20.0300	20.1892	20.2075	20.2086	20.1415	19.7463	19.1749	18.6887 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.5653	18.7208	19.0760	19.5205	19.8800	20.0392	20.0575	20.0586	19.9915	19.5963	19.0249	18.5387 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9770	0.9689	0.9448	0.8827	0.7440	0.4884	0.2808	0.3051	0.6412	0.8887	0.9607	0.9799	(94)
Useful gains	663.2184	698.6436	723.3852	722.6949	620.1134	405.7717	222.0120	231.5755	458.3591	591.8850	622.6812	637.4985	(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	1405.7611	1365.5708	1215.2054	996.9241	712.9416	416.3457	222.6655	232.5164	493.8932	826.3573	1139.3355	1394.5508	(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	552.4518	448.1751	365.9142	197.4450	69.0641	0.0000	0.0000	0.0000	0.0000	174.4474	371.9911	563.2469	(98)
Space heating												2742.7357	(98)
RHI space heating demand												2743	(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	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)			8.6100	1.2357	10.6397		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1900	8.8654	75.0000	3499.5000 (28a)
Brick/Render Cavity	101.9500	12.9100	89.0400	0.2500	22.2600	60.0000	5342.4000 (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)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	53.3477			(33)
Party Wall 1			40.3000	0.0000	0.0000	110.0000	4433.0000 (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) =	18623.8400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							199.5697 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.1002 (36)
Total fabric heat loss						(33) + (36) =	62.4479 (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	106.0384	105.8405	105.6465	104.7355	104.5650	103.7715	103.7715	103.6246	104.0772	104.5650	104.9099	105.2704 (39)
Average = Sum(39)m / 12 =												104.7347 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1363	1.1342	1.1321	1.1223	1.1205	1.1120	1.1120	1.1104	1.1153	1.1205	1.1242	1.1281 (40)
HLP (average)												1.1223 (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

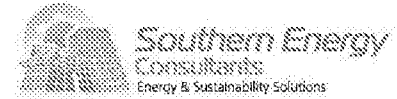
Elmhurst Energy Systems

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	64.1249	56.9551	46.3190	35.0665	26.2126	22.1298	23.9120	31.0817	41.7179	52.9704	61.8243	65.9071	(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	615.8146	610.1822	585.2922	547.2997	508.6014	474.5320	455.2240	464.9469	487.4055	525.6208	567.6278	599.2102	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					0.6000	10.6334	0.4400	0.0000	0.7700	2.1616 (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	55.4611	108.3960	178.7292	261.7034	322.0978	330.4361	314.2892	268.9738	208.1452	128.6366	69.1248	45.6329 (83)
Total gains	671.2757	718.5782	764.0214	809.0031	830.6992	804.9681	769.5132	733.9207	695.5507	654.2574	636.7526	644.8431 (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	48.7869	48.8782	48.9679	49.3938	49.4744	49.8527	49.8527	49.9234	49.7063	49.4744	49.3117	49.1429
alpha	4.2525	4.2585	4.2645	4.2929	4.2983	4.3235	4.3235	4.3282	4.3138	4.2983	4.2874	4.2762
util living area	0.9899	0.9852	0.9735	0.9419	0.8692	0.7270	0.5664	0.6104	0.8245	0.9519	0.9837	0.9915 (86)
MIT	19.6714	19.8033	20.0527	20.3914	20.6982	20.9047	20.9750	20.9654	20.8255	20.4400	19.9983	19.6415 (87)
Th 2	19.9713	19.9730	19.9747	19.9826	19.9841	19.9910	19.9910	19.9923	19.9884	19.9841	19.9811	19.9780 (88)
util rest of house	0.9873	0.9813	0.9661	0.9245	0.8278	0.6436	0.4487	0.4936	0.7572	0.9339	0.9786	0.9892 (89)
MIT 2	18.2141	18.4066	18.7680	19.2543	19.6690	19.9179	19.9794	19.9747	19.8361	19.3307	18.6969	18.1753 (90)
Living area fraction	18.5236	18.7032	19.0409	19.4958	19.8876	20.1275	20.1909	20.1851	20.0462	19.5663	18.9733	18.4867 (92)
Temperature adjustment	18.3736	18.5532	18.8909	19.3458	19.7376	19.9775	20.0409	20.0351	19.8962	19.4163	18.8233	-0.1500
adjusted MIT												18.3367 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9813	0.9737	0.9555	0.9106	0.8160	0.6424	0.4549	0.4989	0.7500	0.9206	0.9704	0.9839 (94)
Useful gains	658.7290	699.6599	730.0127	736.6781	677.8208	517.0943	350.0239	366.1612	521.6331	602.3168	617.9127	634.4921 (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	1492.3457	1445.0630	1309.0542	1094.0485	840.4527	558.0326	357.0623	376.6838	603.2542	921.8778	1229.8893	1488.1780 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	620.2108	500.9109	430.8069	257.3067	120.9982	0.0000	0.0000	0.0000	0.0000	237.7534	440.6231	635.1423 (98)
Space heating												3243.7522 (98)
Space heating per m2												(98) / (4) = 34.7595 (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													3584.2566 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	620.2108	500.9109	430.8069	257.3067	120.9982	0.0000	0.0000	0.0000	0.0000	237.7534	440.6231	635.1423	(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)	685.3158	553.4927	476.0297	284.3168	133.6996	0.0000	0.0000	0.0000	0.0000	262.7109	486.8764	701.8147	(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	89.7812	89.7344	89.6195	89.3521	88.7886	87.3000	87.3000	87.3000	87.3000	89.2652	89.6424	89.8105	(216)
(217)m	89.7812	89.7344	89.6195	89.3521	88.7886	87.3000	87.3000	87.3000	87.3000	89.2652	89.6424	89.8105	(217)
Fuel for water heating, kWh/month	193.0385	169.3596	176.0292	155.3894	151.1401	134.2869	126.0634	142.3470	143.3625	161.4410	173.5852	187.3699	(219)
Water heating fuel used												1913.4127	(219)
Annual totals kWh/year													
Space heating fuel - main system												3584.2566	(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)												452.9861	(232)
Total delivered energy for all uses												6025.6553	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3584.2566	3.4800	124.7321 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1913.4127	3.4800	66.5868 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	452.9861	13.1900	59.7489 (250)
Additional standing charges			120.0000 (251)
Total energy cost			380.9603 (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] =	1.1568 (257)
SAP value	83.8632	
SAP rating (Section 12)	84	(258)
SAP band	B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3584.2566	0.2160	774.1994 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1913.4127	0.2160	413.2971 (264)
Space and water heating			1187.4966 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	452.9861	0.5190	235.0998 (268)
Total kg/year			1461.5213 (272)
CO2 emissions per m2			15.6600 (273)
EI value			85.8412
EI rating			86 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$, 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	$3.48 / 0.8877 = 3.920$, stars = 4
Water heating environmental impact	$0.216 / 0.8877 = 0.2433$, stars = 4

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)			8.6100	1.2357	10.6397		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1900	8.8654	75.0000	3499.5000 (28a)
Brick/Render Cavity	101.9500	12.9100	89.0400	0.2500	22.2600	60.0000	5342.4000 (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)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	53.3477			(33)
Party Wall 1			40.3000	0.0000	0.0000	110.0000	4433.0000 (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) =	18623.8400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							199.5697 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.1002 (36)
Total fabric heat loss						(33) + (36) =	62.4479 (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	104.3985	104.0772	104.0772	103.6246	103.6246	103.0760	103.2073	102.9487	103.0760	103.3425	103.3425	103.7715 (39)
Average = Sum(39)m / 12 =												103.5472 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1187	1.1153	1.1153	1.1104	1.1104	1.1045	1.1060	1.1032	1.1045	1.1074	1.1074	1.1120 (40)
HLP (average)												1.1096 (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

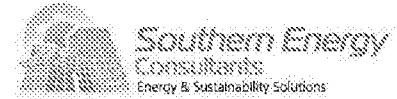
Elmhurst Energy Systems

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)											
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	64.1249	56.9551	46.3190	35.0665	26.2126	22.1298	23.9120	31.0817	41.7179	52.9704	61.8243	65.9071	(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	615.8146	610.1822	585.2922	547.2997	508.6014	474.5320	455.2240	464.9469	487.4055	525.6208	567.6278	599.2102	(73)

6. Solar gains

[Jan]														
	Area m2				Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W	
North	0.6000				11.9814		0.4400		0.0000		0.7700		2.4356 (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	63.0380	110.8644	180.3284	271.4341	324.8426	356.3636	335.3926	293.9655	227.4225	140.4269	80.4983	51.3588	(83)	
Total gains	678.8526	721.0466	765.6205	818.7338	833.4440	830.8956	790.6166	758.9124	714.8280	666.0477	648.1261	650.5690	(84)	

7. Mean internal temperature (heating season)

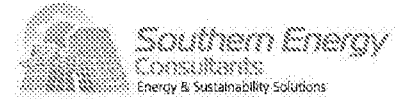
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	49.5533	49.7063	49.7063	49.9234	49.9234	50.1891	50.1252	50.2511	50.1891	50.0597	50.0597	49.8527
alpha	4.3036	4.3138	4.3138	4.3282	4.3282	4.3459	4.3417	4.3501	4.3459	4.3373	4.3373	4.3235
util living area	0.9873	0.9822	0.9663	0.9209	0.8101	0.5882	0.3999	0.4275	0.7340	0.9294	0.9776	0.9891 (86)
MIT	19.8069	19.9208	20.1849	20.5214	20.8143	20.9678	20.9954	20.9940	20.9116	20.5742	20.1422	19.7849 (87)
Th 2	19.9856	19.9884	19.9884	19.9923	19.9923	19.9971	19.9960	19.9982	19.9971	19.9948	19.9948	19.9910 (88)
util rest of house	0.9839	0.9774	0.9565	0.8967	0.7515	0.4837	0.2729	0.2971	0.6418	0.9024	0.9704	0.9861 (89)
MIT 2	18.4210	18.5876	18.9674	19.4411	19.8186	19.9793	19.9950	19.9968	19.9339	19.5231	18.9140	18.3931 (90)
Living area fraction	18.7153	18.8708	19.2260	19.6705	20.0300	20.1892	20.2075	20.2086	20.1415	19.7463	19.1749	18.6887 (92)
Ext temp.	1405.7611	1365.5708	1215.2054	996.9241	712.9416	416.3457	222.6655	232.5164	493.8932	826.3573	1139.3355	1394.5508 (97)
Temperature adjustment	18.5653	18.7208	19.0760	19.5205	19.8800	20.0392	20.0575	20.0586	19.9915	19.5963	19.0249	18.5387 (93)
adjusted MIT												

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9770	0.9689	0.9448	0.8827	0.7440	0.4884	0.2808	0.3051	0.6412	0.8887	0.9607	0.9799 (94)
Useful gains	663.2184	698.6436	723.3852	722.6949	620.1134	405.7717	222.0120	231.5755	458.3591	591.8850	622.6812	637.4985 (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	1405.7611	1365.5708	1215.2054	996.9241	712.9416	416.3457	222.6655	232.5164	493.8932	826.3573	1139.3355	1394.5508 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	552.4518	448.1751	365.9142	197.4450	69.0641	0.0000	0.0000	0.0000	0.0000	174.4474	371.9911	563.2469 (98)
Space heating												2742.7357 (98)
Space heating per m2												29.3907 (99)
										(98) / (4) =		

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													3030.6472 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	552.4518	448.1751	365.9142	197.4450	69.0641	0.0000	0.0000	0.0000	0.0000	174.4474	371.9911	563.2469	(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)	610.4440	495.2211	404.3251	218.1713	76.3140	0.0000	0.0000	0.0000	0.0000	192.7595	411.0399	622.3723	(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	89.7147	89.6677	89.5116	89.1508	88.3616	87.3000	87.3000	87.3000	87.3000	89.0238	89.5321	89.7433	(217)
Fuel for water heating, kWh/month	193.1816	169.4855	176.2414	155.7402	151.8704	134.2869	126.0634	142.3470	143.3625	161.8787	173.7992	187.5102	(219)
Water heating fuel used												1915.7671	(219)
Annual totals kWh/year													
Space heating fuel - main system												3030.6472	(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)												452.9861	(232)
Total delivered energy for all uses												5474.4003	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3030.6472	3.8700	117.2860 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1915.7671	3.8700	74.1402 (247)
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)
Energy for lighting	452.9861	18.9000	85.6144 (250)
Additional standing charges			93.0000 (251)
Total energy cost			384.2156 (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	3030.6472	0.2160	654.6198 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1915.7671	0.2160	413.8057 (264)
Space and water heating			1068.4255 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	452.9861	0.5190	235.0998 (268)
Total kg/year			1342.4502 (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	3030.6472	1.2200	3697.3896 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1915.7671	1.2200	2337.2358 (264)
Space and water heating			6034.6254 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	452.9861	3.0700	1390.6672 (268)
Primary energy kWh/year			7655.5426 (272)
Primary energy kWh/m2/year			82.0354 (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 (14.0%)
U Solar photovoltaic panels	+ 9.7	-£ 345	-947 kg (82.0%)

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 96
Total Savings	£374	12.15 kg/m²	

Potential energy efficiency rating: A 95
Potential environmental impact rating: A 96

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	£100	£109	-£9
Mains gas	£284	£246	£38
Space heating	£224	£224	£0
Water heating	£74	£45	£29
Lighting	£86	£86	£0
Generated (PV)	-£0	-£345	£345
Total cost of fuels	£384	£10	£374
Total cost of uses	£384	£10	£374
Delivered energy	59 kWh/m²	29 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	82 kWh/m²	11 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	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)			8.6100	1.2357	10.6397		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1900	8.8654	75.0000	3499.5000 (28a)
Brick/Render Cavity	101.9500	12.9100	89.0400	0.2500	22.2600	60.0000	5342.4000 (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)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	53.3477			(33)
Party Wall 1			40.3000	0.0000	0.0000	110.0000	4433.0000 (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) = 18623.8400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							199.5697 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.1002 (36)
Total fabric heat loss							(33) + (36) = 62.4479 (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	106.0384	105.8405	105.6465	104.7355	104.5650	103.7715	103.7715	103.6246	104.0772	104.5650	104.9099	105.2704 (39)
Average = Sum(39)m / 12 =												104.7347 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1363	1.1342	1.1321	1.1223	1.1205	1.1120	1.1120	1.1104	1.1153	1.1205	1.1242	1.1281 (40)
HLP (average)												1.1223 (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

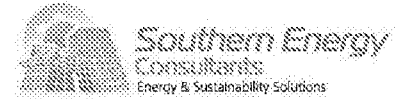
Elmhurst Energy Systems

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	64.1249	56.9551	46.3190	35.0665	26.2126	22.1298	23.9120	31.0817	41.7179	52.9704	61.8243	65.9071	(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	615.8146	610.1822	585.2922	547.2997	508.6014	474.5320	455.2240	464.9469	487.4055	525.6208	567.6278	599.2102	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	0.6000	10.6334	0.4400	0.0000	0.7700	2.1616 (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)

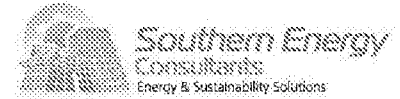
Solar gains	55.4611	108.3960	178.7292	261.7034	322.0978	330.4361	314.2892	268.9738	208.1452	128.6366	69.1248	45.6329 (83)
Total gains	671.2757	718.5782	764.0214	809.0031	830.6992	804.9681	769.5132	733.9207	695.5507	654.2574	636.7526	644.8431 (84)

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	48.7869	48.8782	48.9679	49.3938	49.4744	49.8527	49.8527	49.9234	49.7063	49.4744	49.3117	49.1429
alpha	4.2525	4.2585	4.2645	4.2929	4.2983	4.3235	4.3235	4.3282	4.3138	4.2983	4.2874	4.2762
util living area												
	0.9899	0.9852	0.9735	0.9419	0.8692	0.7270	0.5664	0.6104	0.8245	0.9519	0.9837	0.9915 (86)
MIT	19.6714	19.8033	20.0527	20.3914	20.6982	20.9047	20.9750	20.9654	20.8255	20.4400	19.9983	19.6415 (87)
Th 2	19.9713	19.9730	19.9747	19.9826	19.9841	19.9910	19.9910	19.9923	19.9884	19.9841	19.9811	19.9780 (88)
util rest of house												
	0.9873	0.9813	0.9661	0.9245	0.8278	0.6436	0.4487	0.4936	0.7572	0.9339	0.9786	0.9892 (89)
MIT 2	18.2141	18.4066	18.7680	19.2543	19.6690	19.9179	19.9794	19.9747	19.8361	19.3307	18.6969	18.1753 (90)
Living area fraction									fLA = Living area / (4) =			
MIT	18.5236	18.7032	19.0409	19.4958	19.8876	20.1275	20.1909	20.1851	20.0462	19.5663	18.9733	18.4867 (91)
Temperature adjustment												-0.1500
adjusted MIT	18.3736	18.5532	18.8909	19.3458	19.7376	19.9775	20.0409	20.0351	19.8962	19.4163	18.8233	18.3367 (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	0.9813	0.9737	0.9555	0.9106	0.8160	0.6424	0.4549	0.4989	0.7500	0.9206	0.9704	0.9839	(94)
Useful gains	658.7290	699.6599	730.0127	736.6781	677.8208	517.0943	350.0239	366.1612	521.6331	602.3168	617.9127	634.4921	(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	1492.3457	1445.0630	1309.0542	1094.0485	840.4527	558.0326	357.0623	376.6838	603.2542	921.8778	1229.8893	1488.1780	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	620.2108	500.9109	430.8069	257.3067	120.9982	0.0000	0.0000	0.0000	0.0000	237.7534	440.6231	635.1423	(98)
Space heating												3243.7522	(98)
Space heating per m2											(98) / (4) =	34.7595	(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													3584.2566	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	620.2108	500.9109	430.8069	257.3067	120.9982	0.0000	0.0000	0.0000	0.0000	237.7534	440.6231	635.1423	(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)	685.3158	553.4927	476.0297	284.3168	133.6996	0.0000	0.0000	0.0000	0.0000	262.7109	486.8764	701.8147	(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	89.8644	89.9056	89.9479	90.0224	90.1044	87.3000	87.3000	87.3000	87.3000	89.5929	89.7686	89.8796	(217)	
Fuel for water heating, kWh/month	165.0188	122.5995	96.3354	48.3759	18.2753	1.7030	0.0000	28.0386	53.8362	101.2792	140.2825	163.9314	(219)	
Water heating fuel used												939.6757	(219)	
Annual totals kWh/year														
Space heating fuel - main system													3584.2566	(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)													452.9861	(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													3374.6790	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3584.2566	3.4800	124.7321	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	939.6757	3.4800	32.7007	(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	452.9861	13.1900	59.7489	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			125.8463	(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] =	0.3821	(257)
SAP value		94.6694	
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)

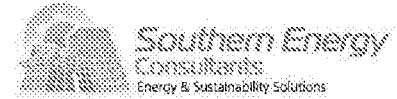


CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3584.2566	0.2160	774.1994 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	939.6757	0.2160	202.9700 (264)
Space and water heating			977.1694 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	452.9861	0.5190	235.0998 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			380.7069 (272)
CO2 emissions per m2			4.0800 (273)
EI value			96.3118
EI rating			96 (274)
EI band			A

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	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												
Effective ac	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)
	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)			8.6100	1.2357	10.6397		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			46.6600	0.1900	8.8654	75.0000	3499.5000 (28a)
Brick/Render Cavity	101.9500	12.9100	89.0400	0.2500	22.2600	60.0000	5342.4000 (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)			195.2700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	53.3477		(33)
Party Wall 1			40.3000	0.0000	0.0000	110.0000	4433.0000 (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) =	18623.8400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							199.5697 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.1002 (36)
Total fabric heat loss						(33) + (36) =	62.4479 (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	104.3985	104.0772	104.0772	103.6246	103.6246	103.0760	103.2073	102.9487	103.0760	103.3425	103.3425	103.7715 (39)
Average = Sum(39)m / 12 =												103.5472 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1187	1.1153	1.1153	1.1104	1.1104	1.1045	1.1060	1.1032	1.1045	1.1074	1.1074	1.1120 (40)
HLP (average)												1.1096 (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 (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	-27.0774	-40.6973	-68.5395	-94.7425	-114.1018	-120.0872	-117.2037	-104.6636	-81.6903	-55.5724	-32.9133
Output from w/h											
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)
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	64.1249	56.9551	46.3190	35.0665	26.2126	22.1298	23.9120	31.0817	41.7179	52.9704	61.8243	65.9071	(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	615.8146	610.1822	585.2922	547.2997	508.6014	474.5320	455.2240	464.9469	487.4055	525.6208	567.6278	599.2102	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	0.6000	11.9814	0.4400	0.0000	0.7700	2.4356 (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	63.0380	110.8644	180.3284	271.4341	324.8426	356.3636	335.3926	293.9655	227.4225	140.4269	80.4983	51.3588 (83)
Total gains	678.8526	721.0466	765.6205	818.7338	833.4440	830.8956	790.6166	758.9124	714.8280	666.0477	648.1261	650.5690 (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	49.5533	49.7063	49.7063	49.9234	49.9234	50.1891	50.1252	50.2511	50.1891	50.0597	50.0597	49.8527
alpha	4.3036	4.3138	4.3138	4.3282	4.3282	4.3459	4.3417	4.3501	4.3459	4.3373	4.3373	4.3235
util living area	0.9873	0.9822	0.9663	0.9209	0.8101	0.5882	0.3999	0.4275	0.7340	0.9294	0.9776	0.9891 (86)
MIT	19.8069	19.9208	20.1849	20.5214	20.8143	20.9678	20.9954	20.9940	20.9116	20.5742	20.1422	19.7849 (87)
Th 2	19.9856	19.9884	19.9884	19.9923	19.9923	19.9971	19.9960	19.9982	19.9971	19.9948	19.9948	19.9910 (88)
util rest of house	0.9839	0.9774	0.9565	0.8967	0.7515	0.4837	0.2729	0.2971	0.6418	0.9024	0.9704	0.9861 (89)
MIT 2	18.4210	18.5876	18.9674	19.4411	19.8186	19.9793	19.9950	19.9968	19.9339	19.5231	18.9140	18.3931 (90)
Living area fraction												
MIT	18.7153	18.8708	19.2260	19.6705	20.0300	20.1892	20.2075	20.2086	20.1415	19.7463	19.1749	18.6887 (92)
Temperature adjustment												
adjusted MIT	18.5653	18.7208	19.0760	19.5205	19.8800	20.0392	20.0575	20.0586	19.9915	19.5963	19.0249	18.5387 (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	0.9689	0.9448	0.8827	0.7440	0.4884	0.2808	0.3051	0.6412	0.8887	0.9607	0.9799	(94)
Useful gains	663.2184	698.6436	723.3852	722.6949	620.1134	405.7717	222.0120	231.5755	458.3591	591.8850	622.6812	637.4985	(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	1405.7611	1365.5708	1215.2054	996.9241	712.9416	416.3457	222.6655	232.5164	493.8932	826.3573	1139.3355	1394.5508	(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	552.4518	448.1751	365.9142	197.4450	69.0641	0.0000	0.0000	0.0000	0.0000	174.4474	371.9911	563.2469	(98)
Space heating													(98)
Space heating per m2													(98) / (4) = 29.3907 (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													3030.6472 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	552.4518	448.1751	365.9142	197.4450	69.0641	0.0000	0.0000	0.0000	0.0000	174.4474	371.9911	563.2469	(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)	610.4440	495.2211	404.3251	218.1713	76.3140	0.0000	0.0000	0.0000	0.0000	192.7595	411.0399	622.3723	(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	89.8110	89.8450	89.8544	89.8984	89.7585	87.3000	87.3000	87.3000	87.3000	89.3968	89.6846	89.8228	(217)
Fuel for water heating, kWh/month	162.8252	123.8538	99.2907	49.0567	22.3860	0.0000	0.0000	22.4574	49.7883	99.0395	136.8046	162.3685	(219)
Water heating fuel used													(219)
Annual totals kWh/year													
Space heating fuel - main system													3030.6472 (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)													452.9861 (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													2712.3442 (238)

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

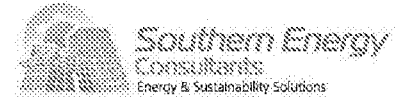
	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3030.6472	3.8700	117.2860	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	927.8706	3.8700	35.9086	(247)
Pumps and fans for heating	75.0000	18.9000	14.1750	(249)
Pump for solar water heating	50.0000	18.9000	9.4500	(249)
Energy for lighting	452.9861	18.9000	85.6144	(250)
Additional standing charges			93.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	18.9000	-344.7662	(252)
Total energy cost			10.6678	(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	3030.6472	0.2160	654.6198	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	927.8706	0.2160	200.4200	(264)
Space and water heating			855.0398	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	452.9861	0.5190	235.0998	(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

208.2757 (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	3030.6472	1.2200	3697.3896 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	927.8706	1.2200	1132.0021 (264)
Space and water heating			4829.3917 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	452.9861	3.0700	1390.6672 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	3.0700	-5600.1701 (269)
Primary energy kWh/year			1003.6388 (272)
Primary energy kWh/m2/year			10.7548 (273)

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

Overheating Calculation Input Data

Dwelling type	EndTerrace House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	199.6 (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	62.45 (37)
Summer heat loss coefficient	370.40 (P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	0.6000	81.1852	0.4400	0.0000	0.9000	19.2896
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: 392.0173

	Jun	Jul	Aug	
Solar gains	417	392	344	(P4)
Internal gains	472	452	462	
Total summer gains	888	844	806	(P5)

Summer gain/loss ratio	2.40	2.28	2.17	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 199.6)	0.60	0.60	0.60	
Threshold temperature	19.00	20.78	20.58	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight