

FULL SAP CALCULATION PRINTOUT

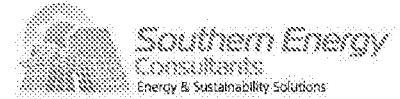
Calculation Type: New Build (As Designed)



Property Reference	SECANG007b			Issued on Date	04/02/2021
Assessment Reference	001	Prop Type Ref	End Bri Ga Ea		
Property	2B3P, Plot 6,15				
SAP Rating	83 B	DER	19.02	TET	19.47
Environmental	36 B	% DER<TER	2.32		
CO ₂ Emissions (t/year)	1.14	DPEE	50.42	TPEE	53.27
General Requirements Compliance	Pass	% DPEE<TPEE	5.35		
Assessor Details	Mr. Stuart Harvey, Stuart Harvey, [REDACTED]			Assessor ID	T555-0001
Client	Persimon Homes Thames Valley				

FULL SAP CALCULATION PRINTOUT

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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 73 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) 19.47 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 19.02 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)53.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)50.4 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	1.38 (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:

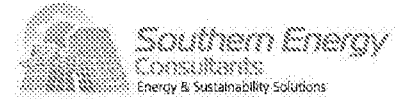
Overshading: Average
Windows facing East: 3.58 m², No overhang
Windows facing West: 3.24 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

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

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Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	36.6200 (1b)	x 2.3500 (2b)	= 86.0570 (1b) - (3b)
First floor	36.6200 (1c)	x 2.6600 (2c)	= 97.4092 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.2400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.4662 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1635 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4135 (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) =		0.3515 (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	0.4481	0.4394	0.4306	0.3866	0.3779	0.3339	0.3339	0.3251	0.3515	0.3779	0.3954	0.4130 (22b)
Effective ac	0.6004	0.5965	0.5927	0.5747	0.5714	0.5557	0.5557	0.5529	0.5618	0.5714	0.5782	0.5853 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			6.8200	1.2357	8.4278		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			36.6200	0.1900	6.9578	75.0000	2746.5000 (28a)
Brick Cavity	85.6700	11.1200	74.5500	0.2500	18.6375	60.0000	4473.0000 (29a)
External Roof 1	36.6200		36.6200	0.1100	4.0282	9.0000	329.5800 (30)
Total net area of external elements Aum (A, m ²)			158.9100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		44.5013		(33)
Party Wall 1			39.9700	0.0000	0.0000	110.0000	4396.7000 (32)
Internal Wall 1			119.6100			9.0000	1076.4900 (32c)
Internal Wall 2			21.5300			75.0000	1614.7500 (32c)
Internal Floor 1			36.6200			18.0000	659.1600 (32d)
Internal Ceiling 1			36.6200			18.0000	659.1600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15955.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							217.8501 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.5415 (36)
Total fabric heat loss						(33) + (36) =	52.0427 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	36.3517	36.1156	35.8842	34.7973	34.5939	33.6472	33.6472	33.4719	34.0119	34.5939	35.0053	35.4354 (38)
Heat transfer coeff	88.3944	88.1583	87.9269	86.8400	86.6366	85.6900	85.6900	85.5146	86.0546	86.6366	87.0480	87.4781 (39)
Average = Sum(39)m / 12 =												86.8390 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2069	1.2037	1.2005	1.1857	1.1829	1.1700	1.1700	1.1676	1.1750	1.1829	1.1885	1.1944 (40)
HLP (average)												1.1857 (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												2.3221 (42)
Average daily hot water use (litres/day)												89.3510 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	98.2861	94.7120	91.1380	87.5640	83.9899	80.4159	80.4159	83.9899	87.5640	91.1380	94.7120	98.2861 (44)
Energy conte	145.7554	127.4786	131.5465	114.6854	110.0434	94.9591	87.9936	100.9739	102.1798	119.0808	129.9860	141.1563 (45)

Regs Region: England

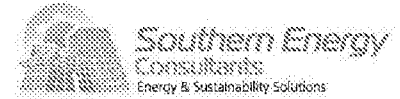
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

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Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1405.8389 (45)										
Distribution loss (46)m = 0.15 x (45)m											
21.8633	19.1218	19.7320	17.2028	16.5065	14.2439	13.1990	15.1461	15.3270	17.8621	19.4979	21.1735 (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	14.1004	12.7151	14.0443	13.5538	13.9784	13.4961	13.9264	13.9601	13.5275	14.0170	13.6083 (61)
Total heat required for water heating calculated for each month											
159.8558	140.1937	145.5908	128.2393	124.0218	108.4552	101.9199	114.9340	115.7074	133.0978	143.5942	155.2459 (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											
159.8558	140.1937	145.5908	128.2393	124.0218	108.4552	101.9199	114.9340	115.7074	133.0978	143.5942	155.2459 (64)
Heat gains from water heating, kWh/month											
51.9888	45.5654	47.2503	41.5214	40.0840	34.9479	32.7395	37.0638	37.3567	43.0986	46.6224	50.4569 (65)
Total per year (kWh/year) = Sum(64)m =	1570.8557 (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	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.3899	18.9983	15.4505	11.6970	8.7436	7.3817	7.9762	10.3678	13.9157	17.6691	20.6225	21.9844	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	204.7379	206.8624	201.5087	190.1111	175.7238	162.2017	153.1681	151.0436	156.3973	167.7949	182.1822	195.7043	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	(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)	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	(71)
Water heating gains (Table 5)	69.8774	67.8057	63.5085	57.6686	53.8764	48.5388	44.0046	49.8170	51.8843	57.9282	64.7533	67.8184	(72)
Total internal gains	356.8373	354.4986	341.2998	320.3089	299.1760	278.9544	265.9812	272.0606	283.0295	304.2244	328.3902	346.3392	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W
East					3.5800	19.6403	0.4400	0.0000			0.7700	23.8218
West					3.2400	19.6403	0.4400	0.0000			0.7700	21.5594 (80)

Solar gains	45.3811	88.7751	146.1999	213.2238	261.3138	267.5012	254.6720	218.7595	170.0365	105.3391	56.5849	37.3192 (83)
Total gains	402.2185	443.2737	487.4997	533.5327	560.4898	546.4556	520.6532	490.8201	453.0660	409.5636	384.9752	383.6585 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	50.1394	50.2736	50.4059	51.0368	51.1566	51.7218	51.7218	51.8278	51.5026	51.1566	50.9149	50.6645
alpha	4.3426	4.3516	4.3604	4.4025	4.4104	4.4481	4.4481	4.4552	4.4335	4.4104	4.3943	4.3776
util living area	0.9974	0.9956	0.9906	0.9744	0.9286	0.8179	0.6667	0.7168	0.9072	0.9829	0.9955	0.9979 (86)
MIT	19.4830	19.6190	19.8809	20.2477	20.5955	20.8558	20.9575	20.9409	20.7405	20.2932	19.8291	19.4626 (87)
Th 2	19.9145	19.9170	19.9196	19.9315	19.9337	19.9441	19.9441	19.9460	19.9401	19.9337	19.9292	19.9245 (88)
util rest of house	0.9966	0.9943	0.9875	0.9648	0.8985	0.7380	0.5323	0.5880	0.8556	0.9748	0.9939	0.9973 (89)
MIT 2	17.8903	18.0906	18.4739	19.0115	19.4981	19.8302	19.9245	19.9156	19.7010	19.0835	18.4063	17.8671 (90)
Living area fraction	18.1774	18.3661	18.7275	19.2343	19.6959	20.0151	20.1107	20.1004	19.8884	19.3015	18.6627	18.1547 (91)
MIT	18.0274	18.2161	18.5775	19.0843	19.5459	19.8651	19.9607	19.9504	19.7384	19.1515	18.5127	18.0047 (93)
Temperature adjustment												-0.1500
adjusted MIT												18.0047 (93)

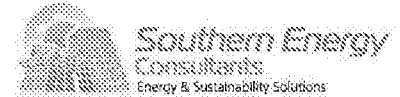
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9945	0.9910	0.9816	0.9541	0.8843	0.7309	0.5346	0.5886	0.8428	0.9659	0.9904	0.9955	(94)
Useful gains	399.9886	439.2692	478.5151	509.0623	495.6668	399.3889	278.3565	288.9131	381.8338	395.5866	381.2944	381.9252	(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	1213.4222	1173.9214	1061.9387	884.4061	679.7408	451.1636	287.9754	303.6072	485.2070	740.8721	993.4530	1207.6069	(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	605.1946	493.6863	434.0672	270.2475	136.9511	0.0000	0.0000	0.0000	0.0000	256.8924	440.7542	614.3072	(98)
Space heating												3252.1004	(98)
Space heating per m2												(98) / (4) =	44.4033 (99)

8c. Space cooling requirement

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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													3593.4811 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	605.1946	493.6863	434.0672	270.2475	136.9511	0.0000	0.0000	0.0000	0.0000	256.8924	440.7542	614.3072	(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)	668.7233	545.5097	479.6323	298.6160	151.3272	0.0000	0.0000	0.0000	0.0000	283.8590	487.0212	678.7924	(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	159.8558	140.1937	145.5908	128.2393	124.0218	108.4552	101.9199	114.9340	115.7074	133.0978	143.5942	155.2459	(64)
Efficiency of water heater (217)m	89.8121	89.7722	89.6744	89.4449	88.9505	87.3000	87.3000	87.3000	87.3000	89.3818	89.6921	87.3000	(216)
Fuel for water heating, kWh/month	177.9891	156.1660	162.3549	143.3724	139.4278	124.2327	116.7468	131.6541	132.5400	148.9092	160.0968	172.8109	(219)
Water heating fuel used													1766.3007 (219)
Annual totals kWh/year													
Space heating fuel - main system													3593.4811 (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)													377.7519 (232)
Total delivered energy for all uses													5812.5337 (238)

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

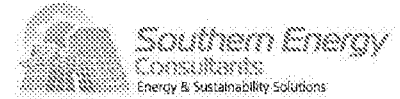
	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year	
Space heating - main system 1	3593.4811	0.2160	776.1919	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1766.3007	0.2160	381.5210	(264)
Space and water heating			1157.7129	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	377.7519	0.5190	196.0533	(268)
Total CO ₂ , kg/year			1392.6911	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			19.0200	(273)

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

DER			19.0200	ZC1
Total Floor Area		TFA	73.2400	
Assumed number of occupants		N	2.3221	
CO ₂ emission factor in Table 12 for electricity displaced from grid		EF	0.5190	
CO ₂ emissions from appliances, equation (L14)			16.5652	ZC2
CO ₂ emissions from cooking, equation (L16)			2.3857	ZC3
Total CO ₂ emissions			37.9709	ZC4
Residual CO ₂ emissions offset from biofuel CHP			0.0000	ZC5
Additional allowable electricity generation, kWh/m ² /year			0.0000	ZC6
Resulting CO ₂ emissions offset from additional allowable electricity generation			0.0000	ZC7
Net CO ₂ emissions			37.9709	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	36.6200 (1b)	x 2.3500 (2b)	= 86.0570 (1b) - (3b)
First floor	36.6200 (1c)	x 2.6600 (2c)	= 97.4092 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.2400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.4662 (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) = 0.1635 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4135 (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) =	0.3515 (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	0.4481	0.4394	0.4306	0.3866	0.3779	0.3339	0.3339	0.3251	0.3515	0.3779	0.3954	0.4139 (22b)
Effective ac	0.6004	0.5965	0.5927	0.5747	0.5714	0.5557	0.5557	0.5529	0.5618	0.5714	0.5782	0.5853 (25)

3. Heat losses and heat loss parameter

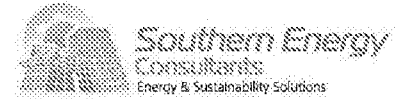
Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			2.1500	1.0000	2.1500		(26)					
TER Semi-glazed door			2.1500	1.2000	2.5800		(26a)					
TER Opening Type (Uw = 1.40)			6.8200	1.3258	9.0417		(27)					
Heat Loss Floor 1			36.6200	0.1300	4.7606		(28a)					
Brick Cavity	85.6700	11.1200	74.5500	0.1800	13.4190		(29a)					
External Roof 1	36.6200		36.6200	0.1300	4.7606		(30)					
Total net area of external elements Aum(A, m2)			158.9100				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	36.7119		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.6679 (36)					
Total fabric heat loss						(33) + (36) =	45.3798 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 36.3517	Feb 36.1156	Mar 35.8842	Apr 34.7973	May 34.5939	Jun 33.6472	Jul 33.6472	Aug 33.4719	Sep 34.0119	Oct 34.5939	Nov 35.0053	Dec 35.4354 (38)
Heat transfer coeff	81.7315	81.4954	81.2640	80.1770	79.9737	79.0270	79.0270	78.8517	79.3916	79.9737	80.3851	80.8152 (39)
Average = Sum(39)m / 12 =												80.1761 (39)
HLP	Jan 1.1159	Feb 1.1127	Mar 1.1096	Apr 1.0947	May 1.0919	Jun 1.0790	Jul 1.0790	Aug 1.0766	Sep 1.0840	Oct 1.0919	Nov 1.0976	Dec 1.1034 (40)
HLP (average)												1.0947 (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												2.3221 (42)
Average daily hot water use (litres/day)												89.3510 (43)
Daily hot water use	98.2861	94.7120	91.1380	87.5640	83.9899	80.4159	80.4159	83.9899	87.5640	91.1380	94.7120	98.2861 (44)
Energy conte	145.7554	127.4786	131.5465	114.6854	110.0434	94.9591	87.9936	100.9739	102.1798	119.0808	129.9860	141.1563 (45)
Energy content (annual)										Total = Sum(45)m =		1405.8389 (45)
Distribution loss (46)m = 0.15 x (45)m	21.8633	19.1218	19.7320	17.2028	16.5065	14.2439	13.1990	15.1461	15.3270	17.8621	19.4979	21.1735 (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	0.0000	0.0000	(57)
Combi loss	50.0855	43.5935	46.4429	43.1822	42.8003	39.6571	40.9791	42.8003	43.1822	46.4429	46.7073	50.0855	50.0855	50.0855	(61)
Total heat required for water heating calculated for each month	195.8409	171.0721	177.9894	157.8677	152.8438	134.6162	128.9726	143.7742	145.3621	165.5237	176.6933	191.2419	191.2419	191.2419	(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	0.0000	0.0000	(63)
Output from w/h	195.8409	171.0721	177.9894	157.8677	152.8438	134.6162	128.9726	143.7742	145.3621	165.5237	176.6933	191.2419	191.2419	191.2419	(64)
Heat gains from water heating, kWh/month	60.9851	53.2850	55.3499	48.9285	47.2895	41.4882	39.5026	44.2739	44.7704	51.2051	54.8972	59.4559	59.4559	59.4559	(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	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.3899	18.9983	15.4505	11.6970	8.7436	7.3817	7.9762	10.3678	13.9157	17.6691	20.6225	21.9844	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	204.7379	206.8624	201.5087	190.1111	175.7238	162.2017	153.1681	151.0436	156.3973	167.7949	182.1822	195.7043	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	(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)	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	(71)
Water heating gains (Table 5)	81.9692	79.2932	74.3951	67.9562	63.5612	57.6225	53.0949	59.5079	62.1811	68.8240	76.2461	79.9138	(72)
Total internal gains	368.9291	365.9861	352.1864	330.5965	308.8608	288.0381	275.0715	281.7515	293.3263	315.1202	339.8830	358.4347	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
East					3.5800	19.6403	0.6300	0.7000	0.7700		21.4883 (76)	
West					3.2400	19.6403	0.6300	0.7000	0.7700		19.4475 (80)	
Solar gains	40.9358	80.0792	131.8790	192.3376	235.7169	241.2982	229.7258	197.3310	153.3807	95.0207	51.0422	33.6636 (83)
Total gains	409.8649	446.0653	484.0654	522.9341	544.5777	529.3364	504.7972	479.0826	446.7069	410.1409	390.9251	392.0983 (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	62.2295	62.4098	62.5875	63.4360	63.5973	64.3592	64.3592	64.5022	64.0636	63.5973	63.2718	62.9351	
alpha	5.1486	5.1607	5.1725	5.2291	5.2398	5.2906	5.2906	5.3001	5.2709	5.2398	5.2181	5.1957	
util living area	0.9986	0.9975	0.9941	0.9814	0.9390	0.8213	0.6558	0.7062	0.9128	0.9874	0.9973	0.9989	(86)
MIT	19.7669	19.8805	20.0994	20.4081	20.6988	20.9077	20.9784	20.9683	20.8182	20.4469	20.0581	19.7506	(87)
Th 2	19.9878	19.9905	19.9930	20.0052	20.0074	20.0180	20.0180	20.0200	20.0139	20.0074	20.0028	19.9980	(88)
util rest of house	0.9981	0.9966	0.9918	0.9735	0.9105	0.7406	0.5258	0.5797	0.8607	0.9806	0.9962	0.9985	(89)
MIT 2	18.3378	18.5056	18.8268	19.2817	19.6875	19.9492	20.0091	20.0053	19.8523	19.3428	18.7745	18.3213	(90)
Living area fraction	18.5954	18.7534	19.0561	19.4847	19.8698	20.1219	20.1838	20.1789	20.0264	19.5418	19.0059	0.1802	(91)
MIT	18.5954	18.7534	19.0561	19.4847	19.8698	20.1219	20.1838	20.1789	20.0264	19.5418	19.0059	18.5789	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5954	18.7534	19.0561	19.4847	19.8698	20.1219	20.1838	20.1789	20.0264	19.5418	19.0059	18.5789	(93)

8. Space heating requirement

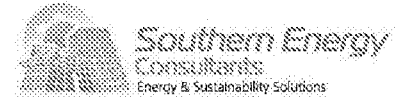
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9970	0.9950	0.9888	0.9679	0.9056	0.7503	0.5492	0.6020	0.8615	0.9761	0.9944	0.9977	(94)
Useful gains	408.6533	443.8200	478.6352	506.1542	493.1572	397.1525	277.2151	288.3978	384.8453	400.3354	388.7539	391.1785	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1168.3809	1128.9851	1020.3623	848.6536	653.3668	436.3829	283.2158	297.9693	470.5039	715.1057	957.0528	1162.0323	(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	565.2373	460.4310	403.0450	246.5996	119.1959	0.0000	0.0000	0.0000	0.0000	234.1891	409.1752	573.5153	(98)
Space heating												3011.3883	(98)
Space heating per m2												(98) / (4) =	41.1167 (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

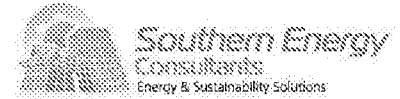
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3224.1845 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	565.2373	460.4310	403.0450	246.5996	119.1959	0.0000	0.0000	0.0000	0.0000	234.1891	409.1752	573.5153	(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)	605.1791	492.9668	431.5256	264.0253	127.6187	0.0000	0.0000	0.0000	0.0000	250.7378	438.0891	614.0420	(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	195.8409	171.0721	177.9894	157.8677	152.8438	134.6162	128.9726	143.7742	145.3621	165.5237	176.6933	191.2419	(64)
Efficiency of water heater (217)m	87.5659	87.4213	87.0461	86.1697	84.4333	80.3000	80.3000	80.3000	80.3000	85.9246	87.0961	80.3000	(216)
Fuel for water heating, kWh/month	223.6498	195.6870	204.4772	183.2055	181.0231	167.6417	160.6135	179.0464	181.0238	192.6384	202.6716	218.2047	(219)
Water heating fuel used												2290.0824	(219)
Annual totals kWh/year													
Space heating fuel - main system												3224.1845	(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)												377.7519	(232)
Total delivered energy for all uses												5967.0189	(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	3224.1845	0.2160	696.4238 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2290.0824	0.2160	494.6578 (264)
Space and water heating			1191.0817 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	377.7519	0.5190	196.0533 (268)
Total CO2, kg/m2/year			1426.0599 (272)
Emissions per m2 for space and water heating			16.2627 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.6769 (272b)
Emissions per m2 for pumps and fans			0.5315 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.2627 * 1.00) + 2.6769 + 0.5315, rounded to 2 d.p.			19.4700 (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	36.6200 (1b)	x 2.3500 (2b)	= 86.0570 (1b) - (3b)
First floor	36.6200 (1c)	x 2.6600 (2c)	= 97.4092 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.2400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.4662 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1635 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4135 (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) =	0.3515 (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	0.4481	0.4394	0.4306	0.3866	0.3779	0.3339	0.3339	0.3251	0.3515	0.3779	0.3954	0.4139 (22b)
Effective ac	0.6004	0.5965	0.5927	0.5747	0.5714	0.5557	0.5557	0.5529	0.5618	0.5714	0.5782	0.5853 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			6.8200	1.2357	8.4278		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			36.6200	0.1900	6.9578	75.0000	2746.5000 (28a)
Brick Cavity	85.6700	11.1200	74.5500	0.2500	18.6375	60.0000	4473.0000 (29a)
External Roof 1	36.6200		36.6200	0.1100	4.0282	9.0000	329.5800 (30)
Total net area of external elements Aum (A, m ²)			158.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.5013		(33)
Party Wall 1			39.9700	0.0000	0.0000	110.0000	4396.7000 (32)
Internal Wall 1			119.6100			9.0000	1076.4900 (32c)
Internal Wall 2			21.5300			75.0000	1614.7500 (32c)
Internal Floor 1			36.6200			18.0000	659.1600 (32d)
Internal Ceiling 1			36.6200			9.0000	329.5800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15625.7600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							213.3501 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.5415 (36)
Total fabric heat loss						(33) + (36) =	52.0427 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	36.3517	36.1156	35.8842	34.7973	34.5939	33.6472	33.6472	33.4719	34.0119	34.5939	35.0053	35.4354 (38)
Heat transfer coeff	88.3944	88.1583	87.9269	86.8400	86.6366	85.6900	85.6900	85.5146	86.0546	86.6366	87.0480	87.4781 (39)
Average = Sum(39)m / 12 =												86.8390 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2069	1.2037	1.2005	1.1857	1.1829	1.1700	1.1700	1.1676	1.1750	1.1829	1.1885	1.1944 (40)
HLP (average)												1.1857 (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												2.3221 (42)
Average daily hot water use (litres/day)												89.3510 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	98.2861	94.7120	91.1380	87.5640	83.9899	80.4159	80.4159	83.9899	87.5640	91.1380	94.7120	98.2861 (44)
Energy conte	145.7554	127.4786	131.5465	114.6854	110.0434	94.9591	87.9936	100.9739	102.1798	119.0808	129.9860	141.1563 (45)

Regs Region: England

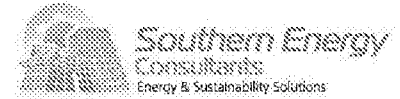
Elmhurst Energy Systems

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 = 1405.8389 (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 (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)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	30.9730	27.0892	27.9536	24.3707	23.3842	20.1788	18.6986	21.4570	21.7132	25.3047	27.6220 29.9957 (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	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.3899	18.9983	15.4505	11.6970	8.7436	7.3817	7.9762	10.3678	13.9157	17.6691	20.6225	21.9844	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	204.7379	206.8624	201.5087	190.1111	175.7238	162.2017	153.1681	151.0436	156.3973	167.7949	182.1822	195.7043	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	(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)	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	(71)
Water heating gains (Table 5)	41.6304	40.3113	37.5721	33.8481	31.4304	28.0261	25.1326	28.8400	30.1572	34.0116	38.3639	40.3168	(72)
Total internal gains	325.5904	324.0042	312.3634	293.4884	273.7300	255.4418	244.1091	248.0836	258.3025	277.3079	299.0008	315.8377	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.5800	19.6403	0.4400	0.0000	0.7700	23.8218	(76)
West	3.2400	19.6403	0.4400	0.0000	0.7700	21.5594	(80)
Solar gains	45.3811	88.7751	146.1999	213.2238	261.3138	267.5012	254.6720 218.7595 170.0365 105.3391 56.5849 37.3192 (83)
Total gains	370.9715	412.7793	458.5633	506.7123	535.0438	522.9430	498.7812 466.8431 428.3390 382.6470 355.5857 353.1569 (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	49.1037	49.2352	49.3647	49.9826	50.0999	50.6534	50.6534	50.7573	50.4388	50.0999	49.8631	49.6180
alpha	4.2736	4.2823	4.2910	4.3322	4.3400	4.3769	4.3769	4.3838	4.3626	4.3400	4.3242	4.3079
util living area	0.9980	0.9964	0.9920	0.9776	0.9360	0.8328	0.6862	0.7387	0.9189	0.9859	0.9965	0.9984 (86)
MIT	19.4145	19.5539	19.8229	20.2003	20.5607	20.8369	20.9498	20.9299	20.7112	20.2454	19.7688	19.3945 (87)
Th 2	19.9145	19.9170	19.9196	19.9315	19.9337	19.9441	19.9441	19.9460	19.9401	19.9337	19.9292	19.9245 (88)
util rest of house	0.9973	0.9953	0.9893	0.9691	0.9086	0.7563	0.5517	0.6115	0.8722	0.9791	0.9952	0.9979 (89)
MIT 2	18.4662	18.6073	18.8771	19.2592	19.6064	19.8539	19.9277	19.9203	19.7540	19.3085	18.8314	18.4540 (90)
Living area fraction	fLA = Living area / (4) =											0.1802 (91)
MIT	18.6371	18.7779	19.0475	19.4288	19.7784	20.0311	20.1119	20.1023	19.9265	19.4774	19.0003	18.6235 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6371	18.7779	19.0475	19.4288	19.7784	20.0311	20.1119	20.1023	19.9265	19.4774	19.0003	18.6235 (93)

8. Space heating requirement

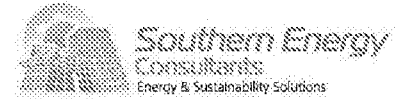
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9963	0.9937	0.9864	0.9639	0.9036	0.7637	0.5753	0.6328	0.8715	0.9751	0.9935	0.9970	(94)
Ext temp.	369.5928	410.1631	452.3086	488.4111	483.4672	399.3782	286.9343	295.4133	373.2779	373.1266	353.2856	352.1011	(95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Month fracti	1267.3199	1223.4515	1103.2643	914.3229	699.8827	465.3911	300.9342	316.5992	501.3970	769.1044	1035.9014	1261.7395	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating	667.9089	546.5298	484.3110	306.6565	161.0132	0.0000	0.0000	0.0000	0.0000	294.6075	491.4833	676.7710	(98)
Space heating per m2	(98) / (4) =											49.5533	(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	805.4856	634.1057	649.9113	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7521	0.8352	0.8038	0.0000	0.0000	0.0000	0.0000	(101)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

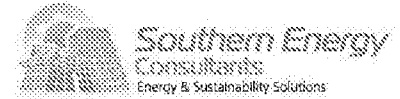


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	605.8381	529.5866	522.3704	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	698.9343	669.0489	633.5886	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	67.0293	103.7599	82.7464	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fC = cooled area / (4) =			253.5355 (104)
Intermittency factor (Table 10b)												1.0000 (105)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	16.7573	25.9400	20.6866	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												63.3839 (107)
Energy for space heating												0.8654 (108)
Energy for space cooling												49.5533 (99)
Total												0.8654 (108)
Dwelling Fabric Energy Efficiency (DFEE)												50.4187 (109)
												50.4 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	36.6200 (1b)	x 2.3500 (2b)	= 86.0570 (1b) - (3b)
First floor	36.6200 (1c)	x 2.6600 (2c)	= 97.4092 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.2400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.4662 (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) = 0.1635 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4135 (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) =	0.3515 (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	0.4481	0.4394	0.4306	0.3866	0.3779	0.3339	0.3339	0.3251	0.3515	0.3779	0.3954	0.4139 (22b)
Effective ac	0.6004	0.5965	0.5927	0.5747	0.5714	0.5557	0.5557	0.5529	0.5618	0.5714	0.5782	0.5853 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
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)			6.8200	1.3258	9.0417		(27)
Heat Loss Floor 1			36.6200	0.1300	4.7606		(28a)
Brick Cavity	85.6700	11.1200	74.5500	0.1800	13.4190		(29a)
External Roof 1	36.6200		36.6200	0.1300	4.7606		(30)
Total net area of external elements Aum(A, m ²)			158.9100				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	36.7119	(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)							8.6679 (36)
Total fabric heat loss						(33) + (36) =	45.3798 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	36.3517	36.1156	35.8842	34.7973	34.5939	33.6472	33.6472
Heat transfer coeff	81.7315	81.4954	81.2640	80.1770	79.9737	79.0270	79.0270
Average = Sum(39)m / 12 =							80.8152 (39)
							80.1761 (39)
HLP	1.1159	1.1127	1.1096	1.0947	1.0919	1.0790	1.0790
HLP (average)							1.1034 (40)
Days in month	31	28	31	30	31	30	31
							31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.3221 (42)
Average daily hot water use (litres/day)												89.3510 (43)
Daily hot water use	98.2861	94.7120	91.1380	87.5640	83.9899	80.4159	80.4159	83.9899	87.5640	91.1380	94.7120	98.2861 (44)
Energy conte	145.7554	127.4786	131.5465	114.6854	110.0434	94.9591	87.9936	100.9739	102.1798	119.0808	129.9860	141.1563 (45)
Energy content (annual)										Total = Sum(45)m =		1405.8389 (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)

Regs Region: England

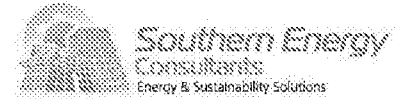
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF 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	30.9730	27.0892	27.9536	24.3707	23.3842	20.1788	18.6986	21.4570	21.7132	25.3047	27.6220	29.9957 (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	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	116.1073	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.3899	18.9983	15.4505	11.6970	8.7436	7.3817	7.9762	10.3678	13.9157	17.6691	20.6225	21.9844	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	204.7379	206.8624	201.5087	190.1111	175.7238	162.2017	153.1681	151.0436	156.3973	167.7949	182.1822	195.7043	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	34.6107	(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)	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	(71)
Water heating gains (Table 5)	41.6304	40.3113	37.5721	33.8461	31.4304	28.0261	25.1326	28.8400	30.1572	34.0116	38.3639	40.3168	(72)
Total internal gains	325.5904	324.0042	312.3634	293.4884	273.7300	255.4418	244.1091	248.0836	258.3025	277.3079	299.0008	315.8377	(73)

6. Solar gains

[Jan]											Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East											3.5800	19.6403	0.6300	0.7000	0.7700	21.4883 (76)
West											3.2400	19.6403	0.6300	0.7000	0.7700	19.4475 (80)
Solar gains	40.9358	80.0792	131.8790	192.3376	235.7169	241.2982	229.7258	197.3310	153.3807	95.0207	51.0422	33.6636 (83)				
Total gains	366.5262	404.0834	444.2424	485.8260	509.4470	496.7400	473.8349	445.4146	411.6831	372.3285	350.0430	349.5013 (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	62.2295	62.4098	62.5875	63.4360	63.5973	64.3592	64.3592	64.5022	64.0636	63.5973	63.2718	62.9351	
alpha	5.1486	5.1607	5.1725	5.2291	5.2398	5.2906	5.2906	5.3001	5.2709	5.2398	5.2181	5.1957	
util living area	0.9992	0.9984	0.9960	0.9864	0.9521	0.8485	0.6895	0.7442	0.9338	0.9918	0.9984	0.9994	(86)
MIT	19.7114	19.8269	20.0494	20.3641	20.6647	20.8905	20.9727	20.9594	20.7880	20.4006	20.0059	19.6958	(87)
Th 2	19.9878	19.9905	19.9930	20.0052	20.0074	20.0180	20.0180	20.0200	20.0139	20.0074	20.0028	19.9980	(88)
util rest of house	0.9989	0.9978	0.9944	0.9804	0.9283	0.7727	0.5572	0.6177	0.8903	0.9872	0.9977	0.9991	(89)
MIT 2	18.8058	18.9233	19.1472	19.4688	19.7593	19.9604	20.0101	20.0066	19.8802	19.5087	19.1122	18.7985	(90)
Living area fraction									fLA = Living area / (4) =			0.1802	(91)
MIT	18.9690	19.0861	19.3098	19.6302	19.9225	20.1280	20.1836	20.1783	20.0438	19.6695	19.2732	18.9602	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9690	19.0861	19.3098	19.6302	19.9225	20.1280	20.1836	20.1783	20.0438	19.6695	19.2732	18.9602	(93)

8. Space heating requirement

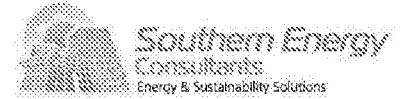
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9984	0.9971	0.9930	0.9774	0.9258	0.7825	0.5812	0.6403	0.8920	0.9850	0.9970	0.9988	(94)
Useful gains	365.9560	402.9235	441.1139	474.8594	471.6274	388.7086	275.4104	285.2098	367.2030	366.7371	348.9889	349.0815	(95)
Ext temp.	4.3000	4.9000	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	1198.9204	1156.1041	1040.9777	860.3117	657.5824	436.8627	283.1981	297.9244	471.8911	725.3192	978.5456	1192.8496	(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	619.7255	506.1373	446.2986	277.5256	138.3505	0.0000	0.0000	0.0000	0.0000	266.7850	453.2809	627.7635	(98)
Space heating												3335.8670	(98)
Space heating per m ²												45.5471	(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	742.8538	584.7998	599.2728	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7935	0.8763	0.8477	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	589.4185	512.4821	507.9787	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	668.3074	639.8909	608.5423	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	56.8000	94.7921	74.8193	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												226.4115	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

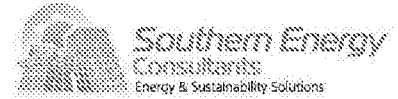


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction	FC = cooled area / (4) =										1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	14.2000	23.6980	18.7048	0.0000	0.0000	0.0000 (107)
Space cooling											56.6029 (107)
Space cooling per m2											0.7728 (108)
Energy for space heating											45.5471 (99)
Energy for space cooling											0.7728 (108)
Total											46.3199 (109)
Target Fabric Energy Efficiency (TFEE)											53.3 (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	36.6200 (1b)	x 2.3500 (2b)	= 86.0570 (1b) - (3b)
First floor	36.6200 (1c)	x 2.6600 (2c)	= 97.4092 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.2400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.4662 (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) = 0.1635 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4135 (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)	=	0.3515 (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	0.3691	0.3515	0.3515	0.3251	0.3251	0.2900	0.2988	0.2812	0.2900	0.3076	0.3076	0.3339 (22b)
Effective ac	0.5681	0.5618	0.5618	0.5529	0.5529	0.5420	0.5446	0.5395	0.5420	0.5473	0.5473	0.5557 (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)			6.8200	1.2357	8.4278		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			36.6200	0.1900	6.9578	75.0000	2746.5000 (28a)
Brick Cavity	85.6700	11.1200	74.5500	0.2500	18.6375	60.0000	4473.0000 (29a)
External Roof 1	36.6200		36.6200	0.1100	4.0282	9.0000	329.5800 (30)
Total net area of external elements Aum (A, m ²)			158.9100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	44.5013			(33)
Party Wall 1			39.9700	0.0000	0.0000	110.0000	4396.7000 (32)
Internal Wall 1			119.6100			9.0000	1076.4900 (32c)
Internal Wall 2			21.5300			75.0000	1614.7500 (32c)
Internal Floor 1			36.6200			18.0000	659.1600 (32d)
Internal Ceiling 1			36.6200			18.0000	659.1600 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =	15955.3400			(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							217.8501 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.5415 (36)
Total fabric heat loss			(33) + (36) =	52.0427			(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	34.3952	34.0119	34.0119	33.4719	33.4719	32.8174	32.9740	32.6655	32.8174	33.1353	33.1353	33.6472 (38)
Heat transfer coeff	86.4380	86.0546	86.0546	85.5146	85.5146	84.8602	85.0168	84.7082	84.8602	85.1781	85.1781	85.6900 (39)
Average = Sum(39)m / 12 =												85.4223 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1802	1.1750	1.1750	1.1676	1.1676	1.1587	1.1608	1.1566	1.1587	1.1630	1.1630	1.1700 (40)
HLP (average)												1.1663 (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												2.3221 (42)
Average daily hot water use (litres/day)												89.3510 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	98.2861	94.7120	91.1380	87.5640	83.9899	80.4159	80.4159	83.9899	87.5640	91.1380	94.7120	98.2861 (44)
Energy conte	145.7554	127.4786	131.5465	114.6854	110.0434	94.9591	87.9936	100.9739	102.1798	119.0808	129.9860	141.1563 (45)

Regs Region: England

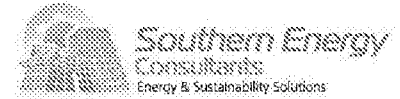
Elmhurst Energy Systems

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 = 1405.8389 (45)										
Distribution loss (46)m = 0.15 x (45)m											
21.8633	19.1218	19.7320	17.2028	16.5065	14.2439	13.1990	15.1461	15.3270	17.8621	19.4979	21.1735 (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	14.1004	12.7151	14.0443	13.5538	13.9784	13.4961	13.9264	13.9601	13.5275	14.0170	13.6083 (61)
Total heat required for water heating calculated for each month											
159.8558	140.1937	145.5908	128.2393	124.0218	108.4552	101.9199	114.9340	115.7074	133.0978	143.5942	155.2459 (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											
159.8558	140.1937	145.5908	128.2393	124.0218	108.4552	101.9199	114.9340	115.7074	133.0978	143.5942	155.2459 (64)
RHI water heating demand											
Heat gains from water heating, kWh/month											
51.9888	45.5654	47.2503	41.5214	40.0840	34.9479	32.7395	37.0638	37.3567	43.0986	46.6224	50.4569 (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	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	53.4747	47.4958	38.6261	29.2425	21.8591	18.4544	19.9406	25.9195	34.7891	44.1728	51.5562	54.9609 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	305.5789	308.7499	300.7592	283.7479	262.2743	242.0921	228.6091	225.4382	233.4289	250.4401	271.9138	292.0960 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550 (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)												
	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859 (71)
Water heating gains (Table 5)												
	69.8774	67.8057	63.5085	57.6686	53.8764	48.5388	44.0046	49.8170	51.8843	57.9282	64.7533	67.8184 (72)
Total internal gains												
	529.6290	524.7493	503.5917	471.3569	438.7077	409.7832	393.2523	401.8727	420.8003	453.2391	488.9213	515.5732 (73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W
East					3.5800	22.3313	0.4400	0.0000			0.7700	27.0857 (76)
West					3.2400	22.3313	0.4400	0.0000			0.7700	24.5134 (80)

Solar gains	51.5991	90.7961	147.4368	220.9655	263.2897	288.2187	271.5137	238.8677	185.6630	114.9720	65.9115	42.0209 (83)
Total gains	581.2281	615.5453	651.0285	692.3224	701.9974	698.0019	664.7660	640.7404	606.4633	568.2111	554.8328	557.5941 (84)

7. Mean internal temperature (heating season)

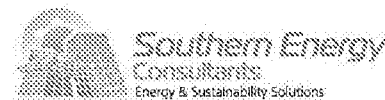
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	51.2742	51.5026	51.5026	51.8278	51.8278	52.2276	52.1314	52.3212	52.2276	52.0326	52.0326	51.7218
util living area	4.4183	4.4335	4.4335	4.4552	4.4552	4.4818	4.4754	4.4881	4.4818	4.4688	4.4688	4.4481
0.9870	0.9818	0.9656	0.9192	0.8060	0.5805	0.3926	0.4179	0.7236	0.9259	0.9767	0.9888	(86)
MIT	19.8640	19.9762	20.2307	20.5551	20.8317	20.9728	20.9964	20.9953	20.9239	20.6091	20.1951	19.8469 (87)
Th 2	19.9359	19.9401	19.9401	19.9460	19.9460	19.9532	19.9515	19.9549	19.9532	19.9497	19.9497	19.9441 (88)
util rest of house	0.9832	0.9765	0.9549	0.8927	0.7427	0.4711	0.2619	0.2842	0.6250	0.8957	0.9686	0.9855 (89)
MIT 2	18.4586	18.6235	18.9885	19.4439	19.7948	19.9393	19.9508	19.9539	19.9025	19.5280	18.9480	18.4397 (90)
Living area fraction	18.7119	18.8673	19.2124	19.6442	19.9817	20.1256	20.1393	20.1416	20.0866	19.7228	19.1727	18.6933 (92)
MIT	18.5619	18.7173	19.0624	19.4942	19.8317	19.9756	19.9893	19.9916	19.9366	19.5728	19.0227	-0.1500 (93)
adjusted MIT	18.5619	18.7173	19.0624	19.4942	19.8317	19.9756	19.9893	19.9916	19.9366	19.5728	19.0227	18.5433 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9761	0.9679	0.9430	0.8787	0.7349	0.4736	0.2667	0.2889	0.6233	0.8818	0.9587	0.9791 (94)
Useful gains	567.3600	595.7855	613.9248	608.3101	515.8701	330.5406	177.2674	185.1382	377.9796	501.0515	531.9140	545.9618 (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	1163.6205	1128.8018	1003.5998	820.4424	584.2076	337.3689	177.6218	185.6464	401.9456	679.1099	938.8945	1151.9586 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	443.6178	358.1870	289.9182	152.7352	50.8431	0.0000	0.0000	0.0000	0.0000	132.4754	293.0259	450.8616 (98)
Space heating												2171.6641 (98)
RHI space heating demand												2172 (98)

FULL SAP CALCULATION PRINTOUT

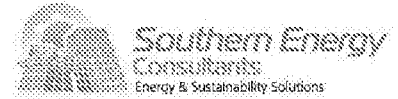
Calculation Type: New Build (As Designed)



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	36.6200 (1b)	x 2.3500 (2b)	= 86.0570 (1b) - (3b)
First floor	36.6200 (1c)	x 2.6600 (2c)	= 97.4092 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.2400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.4662 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1635 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4135 (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)	=	0.3515 (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	0.4481	0.4394	0.4306	0.3866	0.3779	0.3339	0.3339	0.3251	0.3515	0.3779	0.3954	0.4139 (22b)
Effective ac	0.6004	0.5965	0.5927	0.5747	0.5714	0.5557	0.5557	0.5529	0.5618	0.5714	0.5782	0.5853 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			6.8200	1.2357	8.4278		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			36.6200	0.1900	6.9578	75.0000	2746.5000 (28a)
Brick Cavity	85.6700	11.1200	74.5500	0.2500	18.6375	60.0000	4473.0000 (29a)
External Roof 1	36.6200		36.6200	0.1100	4.0282	9.0000	329.5800 (30)
Total net area of external elements Aum (A, m ²)			158.9100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	44.5013			(33)
Party Wall 1			39.9700	0.0000	0.0000	110.0000	4396.7000 (32)
Internal Wall 1			119.6100			9.0000	1076.4900 (32c)
Internal Wall 2			21.5300			75.0000	1614.7500 (32c)
Internal Floor 1			36.6200			18.0000	659.1600 (32d)
Internal Ceiling 1			36.6200			18.0000	659.1600 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =	15955.3400			(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							217.8501 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.5415 (36)
Total fabric heat loss			(33) + (36) =	52.0427			(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	36.3517	36.1156	35.8842	34.7973	34.5939	33.6472	33.6472	33.4719	34.0119	34.5939	35.0053	35.4354 (38)
Heat transfer coeff	88.3944	88.1583	87.9269	86.8400	86.6366	85.6900	85.6900	85.5146	86.0546	86.6366	87.0480	87.4781 (39)
Average = Sum(39)m / 12 =												86.8390 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2069	1.2037	1.2005	1.1857	1.1829	1.1700	1.1700	1.1676	1.1750	1.1829	1.1885	1.1944 (40)
HLP (average)												1.1857 (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												2.3221 (42)
Average daily hot water use (litres/day)												89.3510 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	98.2861	94.7120	91.1380	87.5640	83.9899	80.4159	80.4159	83.9899	87.5640	91.1380	94.7120	98.2861 (44)
Energy conte	145.7554	127.4786	131.5465	114.6854	110.0434	94.9591	87.9936	100.9739	102.1798	119.0808	129.9860	141.1563 (45)

Regs Region: England

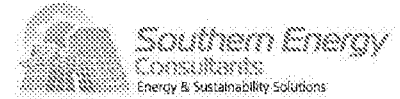
Elmhurst Energy Systems

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 = 1405.8389 (45)										
Distribution loss (46)m = 0.15 x (45)m											
21.8633	19.1218	19.7320	17.2028	16.5065	14.2439	13.1990	15.1461	15.3270	17.8621	19.4979	21.1735 (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	14.1004	12.7151	14.0443	13.5538	13.9784	13.4961	13.9264	13.9601	13.5275	14.0170	13.6083 (61)
Total heat required for water heating calculated for each month											
159.8558	140.1937	145.5908	128.2393	124.0218	108.4552	101.9199	114.9340	115.7074	133.0978	143.5942	155.2459 (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											
159.8558	140.1937	145.5908	128.2393	124.0218	108.4552	101.9199	114.9340	115.7074	133.0978	143.5942	155.2459 (64)
Heat gains from water heating, kWh/month											
51.9888	45.5654	47.2503	41.5214	40.0840	34.9479	32.7395	37.0638	37.3567	43.0986	46.6224	50.4569 (65)
Total per year (kWh/year) = Sum(64)m =	1570.8557 (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	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	53.4747	47.4958	38.6261	29.2425	21.8591	18.4544	19.9406	25.9195	34.7891	44.1728	51.5562	54.9609	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	305.5789	308.7499	300.7592	283.7479	262.2743	242.0921	228.6091	225.4382	233.4289	250.4401	271.9138	292.0960	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	(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)	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	(71)
Water heating gains (Table 5)	69.8774	67.8057	63.5085	57.6686	53.8764	48.5388	44.0046	49.8170	51.8843	57.9282	64.7533	67.8184	(72)
Total internal gains	529.6290	524.7493	503.5917	471.3569	438.7077	409.7832	393.2523	401.8727	420.8003	453.2391	488.9213	515.5732	(73)

6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W	
East			3.5800	19.6403		0.4400		0.0000		0.7700		23.8218	
West			3.2400	19.6403		0.4400		0.0000		0.7700		21.5594 (80)	
Solar gains	45.3811	88.7751	146.1999	213.2238	261.3138	267.5012	254.6720	218.7595	170.0365	105.3391	56.5849	37.3192	(83)
Total gains	575.0101	613.5243	649.7916	684.5808	700.0215	677.2844	647.9244	620.6322	590.8368	558.5782	545.5062	552.8924	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	21.0000 (85)											
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	50.1394	50.2736	50.4059	51.0368	51.1566	51.7218	51.7218	51.8278	51.5026	51.1566	50.9149	50.6645
alpha	4.3426	4.3516	4.3604	4.4025	4.4104	4.4481	4.4481	4.4552	4.4335	4.4104	4.3943	4.3776
util living area	0.9898	0.9851	0.9733	0.9414	0.8676	0.7215	0.5588	0.6006	0.8180	0.9501	0.9832	0.9913 (86)
MIT	19.7200	19.8492	20.0922	20.4242	20.7187	20.9151	20.9787	20.9707	20.8431	20.4749	20.0459	19.6963 (87)
Th 2	19.9145	19.9170	19.9196	19.9315	19.9337	19.9441	19.9441	19.9460	19.9401	19.9337	19.9292	19.9245 (88)
util rest of house	0.9869	0.9808	0.9653	0.9223	0.8228	0.6326	0.4356	0.4781	0.7446	0.9301	0.9776	0.9889 (89)
MIT 2	18.2346	18.4236	18.7757	19.2537	19.6484	19.8826	19.9351	19.9325	19.8098	19.3332	18.7188	18.2072 (90)
Living area fraction	FLA = Living area / (4) = 0.1802 (91)											
MIT	18.5023	18.6805	19.0130	19.4646	19.8413	20.0687	20.1232	20.1196	19.9960	19.5390	18.9580	18.4755 (92)
Temperature adjustment	-0.1500											
adjusted MIT	18.3523	18.5305	18.8630	19.3146	19.6913	19.9187	19.9732	19.9696	19.8460	19.3890	18.8080	18.3255 (93)

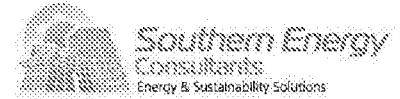
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9807	0.9730	0.9544	0.9083	0.8106	0.6302	0.4392	0.4810	0.7369	0.9164	0.9691	0.9834 (94)
Useful gains	563.9370	596.9602	620.1924	621.8021	567.4691	426.8221	284.5801	298.5394	435.3939	511.8961	528.6642	543.7333 (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	1242.1467	1201.6429	1087.0398	904.4056	692.3370	455.7608	289.0519	305.2508	494.4695	761.4492	1019.1551	1235.6763 (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	504.5881	406.3468	347.3344	203.4746	92.9017	0.0000	0.0000	0.0000	0.0000	185.6675	353.1534	514.8056 (98)
Space heating	2608.2721 (98)											
Space heating per m2	(98) / (4) = 35.6127 (99)											

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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												2882.0686 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	504.5881	406.3468	347.3344	203.4746	92.9017	0.0000	0.0000	0.0000	0.0000	185.6675	353.1534	514.8056 (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)	557.5559	449.0020	383.7950	224.8338	102.6539	0.0000	0.0000	0.0000	0.0000	205.1575	390.2248	568.8459 (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	159.8558	140.1937	145.5908	128.2393	124.0218	108.4552	101.9199	114.9340	115.7074	133.0978	143.5942	155.2459 (64)
Efficiency of water heater (217)m	89.7089	89.6570	89.5307	89.2355	88.6423	87.3000	87.3000	87.3000	87.3000	89.1358	89.5511	87.3000 (216)
Fuel for water heating, kWh/month	178.1939	156.3667	162.6155	143.7088	139.9126	124.2327	116.7468	131.6541	132.5400	149.3203	160.3489	172.9993 (219)
Water heating fuel used												1768.6396 (219)
Annual totals kWh/year												
Space heating fuel - main system												2882.0686 (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)												377.7519 (232)
Total delivered energy for all uses												5103.4601 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2882.0686	3.4800	100.2960 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1768.6396	3.4800	61.5487 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	377.7519	13.1900	49.8255 (250)
Additional standing charges			120.0000 (251)
Total energy cost			341.5626 (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] =	
SAP value	83.0750	
SAP rating (Section 12)	83 (258)	
SAP band	B	

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

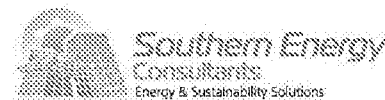
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2882.0686	0.2160	622.5268 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1768.6396	0.2160	382.0261 (264)
Space and water heating			1004.5530 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	377.7519	0.5190	196.0533 (268)
Total kg/year			1239.5312 (272)
CO2 emissions per m2			16.9200 (273)
EI value			85.9525
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	$3.48 / 0.8870 = 3.923$, stars = 4
Water heating environmental impact	$0.216 / 0.8870 = 0.2435$, stars = 4

FULL SAP CALCULATION PRINTOUT

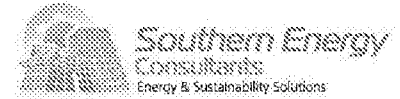
Calculation Type: New Build (As Designed)



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	36.6200 (1b)	x 2.3500 (2b)	= 86.0570 (1b) - (3b)
First floor	36.6200 (1c)	x 2.6600 (2c)	= 97.4092 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.2400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.4662 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1635 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4135 (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) =		0.3515 (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	0.3691	0.3515	0.3515	0.3251	0.3251	0.2900	0.2988	0.2812	0.2900	0.3076	0.3076	0.3339 (22b)
Effective ac	0.5681	0.5618	0.5618	0.5529	0.5529	0.5420	0.5446	0.5395	0.5420	0.5473	0.5473	0.5557 (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)			6.8200	1.2357	8.4278		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			36.6200	0.1900	6.9578	75.0000	2746.5000 (28a)
Brick Cavity	85.6700	11.1200	74.5500	0.2500	18.6375	60.0000	4473.0000 (29a)
External Roof 1	36.6200		36.6200	0.1100	4.0282	9.0000	329.5800 (30)
Total net area of external elements Aum (A, m ²)			158.9100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		44.5013		(33)
Party Wall 1			39.9700	0.0000	0.0000	110.0000	4396.7000 (32)
Internal Wall 1			119.6100			9.0000	1076.4900 (32c)
Internal Wall 2			21.5300			75.0000	1614.7500 (32c)
Internal Floor 1			36.6200			18.0000	659.1600 (32d)
Internal Ceiling 1			36.6200			18.0000	659.1600 (32e)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =				15955.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							217.8501 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.5415 (36)
Total fabric heat loss			(33) + (36) =				52.0427 (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	34.3952	34.0119	34.0119	33.4719	33.4719	32.8174	32.9740	32.6655	32.8174	33.1353	33.1353	33.6472 (38)
Heat transfer coeff	86.4380	86.0546	86.0546	85.5146	85.5146	84.8602	85.0168	84.7082	84.8602	85.1781	85.1781	85.6900 (39)
Average = Sum(39)m / 12 =												85.4223 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1802	1.1750	1.1750	1.1676	1.1676	1.1587	1.1608	1.1566	1.1587	1.1630	1.1630	1.1700 (40)
HLP (average)												1.1663 (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												2.3221 (42)
Average daily hot water use (litres/day)												89.3510 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	98.2861	94.7120	91.1380	87.5640	83.9899	80.4159	80.4159	83.9899	87.5640	91.1380	94.7120	98.2861 (44)
Energy conte	145.7554	127.4786	131.5465	114.6854	110.0434	94.9591	87.9936	100.9739	102.1798	119.0808	129.9860	141.1563 (45)

Regs Region: England

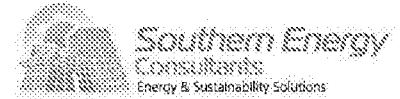
Elmhurst Energy Systems

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 =	1405.8389 (45)
Distribution loss (46)m = 0.15 x (45)m	21.8633	19.1218	19.7320	17.2028	16.5065	14.2439	13.1990	15.1461	15.3270	17.8621	19.4979	21.1735 (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	14.1004	12.7151	14.0443	13.5538	13.9784	13.4961	13.9264	13.9601	13.5275	14.0170	13.6083	14.0895 (61)	
Total heat required for water heating calculated for each month	159.8558	140.1937	145.5908	128.2393	124.0218	108.4552	101.9199	114.9340	115.7074	133.0978	143.5942	155.2459 (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	159.8558	140.1937	145.5908	128.2393	124.0218	108.4552	101.9199	114.9340	115.7074	133.0978	143.5942	155.2459 (64)	
								Total per year (kWh/year) = Sum(64)m =					1570.8557 (64)
Heat gains from water heating, kWh/month	51.9888	45.5654	47.2503	41.5214	40.0840	34.9479	32.7395	37.0638	37.3567	43.0986	46.6224	50.4569 (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	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	53.4747	47.4958	38.6261	29.2425	21.8591	18.4544	19.9406	25.9195	34.7891	44.1728	51.5562	54.9609 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	305.5789	308.7499	300.7592	283.7479	262.2743	242.0921	228.6091	225.4382	233.4289	250.4401	271.9138	292.0960 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550 (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)	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859 (71)
Water heating gains (Table 5)	69.8774	67.8057	63.5085	57.6686	53.8764	48.5388	44.0046	49.8170	51.8843	57.9282	64.7533	67.8184 (72)
Total internal gains	529.6290	524.7493	503.5917	471.3569	438.7077	409.7832	393.2523	401.8727	420.8003	453.2391	488.9213	515.5732 (73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d	Gains W	
East				3.5800	22.3313	0.4400	0.0000			0.7700	27.0857 (76)	
West				3.2400	22.3313	0.4400	0.0000			0.7700	24.5134 (80)	

Solar gains	51.5991	90.7961	147.4368	220.9655	263.2897	288.2187	271.5137	238.8677	185.6630	114.9720	65.9115	42.0209 (83)
Total gains	581.2281	615.5453	651.0285	692.3224	701.9974	698.0019	664.7660	640.7404	606.4633	568.2111	554.8328	557.5941 (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	51.2742	51.5026	51.5026	51.8278	51.8278	52.2276	52.1314	52.3212	52.2276	52.0326	52.0326	51.7218
alpha	4.4183	4.4335	4.4335	4.4552	4.4552	4.4818	4.4754	4.4881	4.4818	4.4688	4.4688	4.4481
util living area	0.9870	0.9818	0.9656	0.9192	0.8060	0.5805	0.3926	0.4179	0.7236	0.9259	0.9767	0.9888 (86)
MIT	19.8640	19.9762	20.2307	20.5551	20.8317	20.9728	20.9964	20.9953	20.9239	20.6091	20.1951	19.8469 (87)
Th 2	19.9359	19.9401	19.9401	19.9460	19.9460	19.9532	19.9515	19.9549	19.9532	19.9497	19.9497	19.9441 (88)
util rest of house	0.9832	0.9765	0.9549	0.8927	0.7427	0.4711	0.2619	0.2842	0.6250	0.8957	0.9686	0.9855 (89)
MIT 2	18.4586	18.6235	18.9885	19.4439	19.7948	19.9393	19.9508	19.9539	19.9025	19.5280	18.9480	18.4397 (90)
Living area fraction	18.7119	18.8673	19.2124	19.6442	19.9817	20.1256	20.1393	20.1416	20.0666	19.7228	19.1727	18.6933 (92)
MIT	18.5619	18.7173	19.0624	19.4942	19.8317	19.9756	19.9893	19.9916	19.9366	19.5728	19.0227	18.5433 (93)
Temperature adjustment												-0.1500
adjusted MIT												18.5433 (93)

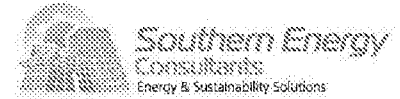
8. Space heating requirement

Utilisation	0.9761	0.9679	0.9430	0.8787	0.7349	0.4736	0.2667	0.2889	0.6233	0.8818	0.9587	0.9791 (94)
Useful gains	567.3600	595.7855	613.9248	608.3101	515.8701	330.5406	177.2674	185.1382	377.9796	501.0515	531.9140	545.9618 (95)
Ext temp.	5.1000	5.6000	7.4000	9.0000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000 (96)
Heat loss rate W	1163.6205	1128.8018	1003.5998	820.4424	584.2076	337.3689	177.6218	185.6464	401.9456	679.1099	938.8945	1151.9586 (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	443.6178	358.1870	289.9182	152.7352	50.8431	0.0000	0.0000	0.0000	0.0000	132.4754	293.0259	450.8616 (98)
Space heating												2171.6641 (98)
Space heating per m2												(98) / (4) = 29.6513 (99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Calculation of EPC Costs, Emissions and Primary Energy 09 Jan 2014

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													2399.6288 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	443.6178	358.1870	289.9182	152.7352	50.8431	0.0000	0.0000	0.0000	0.0000	132.4754	293.0259	450.8616	(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)	490.1854	395.7867	320.3516	168.7682	56.1802	0.0000	0.0000	0.0000	0.0000	146.3817	323.7855	498.1896	(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	159.8558	140.1937	145.5908	128.2393	124.0218	108.4552	101.9199	114.9340	115.7074	133.0978	143.5942	155.2459	(64)
Efficiency of water heater (217)m	89.6297	89.5764	89.4045	89.0109	88.2068	87.3000	87.3000	87.3000	87.3000	88.8675	89.4220	87.3000	(216)
Fuel for water heating, kWh/month	178.3513	156.5074	162.8451	144.0715	140.6034	124.2327	116.7468	131.6541	132.5400	149.7711	160.5804	173.1530	(219)
Water heating fuel used												1771.0567	(219)
Annual totals kWh/year													
Space heating fuel - main system													2399.6288 (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)													377.7519 (232)
Total delivered energy for all uses													4623.4375 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2399.6288	3.8700	92.8656 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1771.0567	3.8700	68.5399 (247)
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)
Energy for lighting	377.7519	18.9000	71.3951 (250)
Additional standing charges			93.0000 (251)
Total energy cost			339.9756 (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	2399.6288	0.2160	518.3198 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1771.0567	0.2160	382.5483 (264)
Space and water heating			900.8681 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	377.7519	0.5190	196.0533 (268)
Total kg/year			1135.8463 (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	2399.6288	1.2200	2927.5472 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1771.0567	1.2200	2160.6892 (264)
Space and water heating			5088.2364 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	377.7519	3.0700	1159.6985 (268)
Primary energy kWh/year			6478.1849 (272)
Primary energy kWh/m2/year			88.4515 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 83
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	+ 1.3	-£ 27	-177 kg (15.6%)
U Solar photovoltaic panels	+ 11.3	-£ 345	-947 kg (98.8%)

Recommended measures	Typical annual savings		Energy efficiency	Environmental impact
Solar water heating	£27	2.42 kg/m²	B 84	B 88
Solar photovoltaic panels	£345	12.93 kg/m²	A 96	A 98
Total Savings	£372	15.35 kg/m²		

Potential energy efficiency rating: A 96
 Potential environmental impact rating: A 98

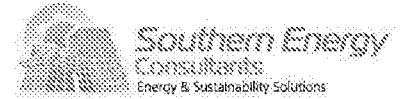
Fuel prices for cost data on this page from database revision number 470 TEST (21 Dec 2020)
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£86	£95	-£9
Mains gas	£254	£218	£36
Space heating	£200	£200	£0
Water heating	£69	£42	£27
Lighting	£71	£71	£0
Generated (PV)	-£0	-£345	£345
Total cost of fuels	£340	-£32	£372
Total cost of uses	£340	-£32	£372
Delivered energy	63 kWh/m²	26 kWh/m²	37 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.0 tonnes	1.1 tonnes
CO2 emissions per m²	16 kg/m²	0 kg/m²	15 kg/m²
Primary energy	88 kWh/m²	-2 kWh/m²	90 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	36.6200 (1b)	x 2.3500 (2b)	= 86.0570 (1b) - (3b)
First floor	36.6200 (1c)	x 2.6600 (2c)	= 97.4092 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.2400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.4662 (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) = 0.1635 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4135 (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) = 0.3515 (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	0.4481	0.4394	0.4306	0.3866	0.3779	0.3339	0.3339	0.3251	0.3515	0.3779	0.3954	0.4139 (22b)
Effective ac	0.6004	0.5965	0.5927	0.5747	0.5714	0.5557	0.5557	0.5529	0.5618	0.5714	0.5782	0.5853 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Opening Type 1			2.1500	1.4000	3.0100		(26)
Opening Type 2 (Uw = 1.30)			6.8200	1.2357	8.4278		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			36.6200	0.1900	6.9578	75.0000	2746.5000 (28a)
Brick Cavity	85.6700	11.1200	74.5500	0.2500	18.6375	60.0000	4473.0000 (29a)
External Roof 1	36.6200		36.6200	0.1100	4.0282	9.0000	329.5800 (30)
Total net area of external elements Aum (A, m ²)			158.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.5013		(33)
Party Wall 1			39.9700	0.0000	0.0000	110.0000	4396.7000 (32)
Internal Wall 1			119.6100			9.0000	1076.4900 (32c)
Internal Wall 2			21.5300			75.0000	1614.7500 (32c)
Internal Floor 1			36.6200			18.0000	659.1600 (32d)
Internal Ceiling 1			36.6200			18.0000	659.1600 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 15955.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							217.8501 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.5415 (36)
Total fabric heat loss							(33) + (36) = 52.0427 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	36.3517	36.1156	35.8842	34.7973	34.5939	33.6472	33.6472	33.4719	34.0119	34.5939	35.0053	35.4354 (38)
Heat transfer coeff	88.3944	88.1583	87.9269	86.8400	86.6366	85.6900	85.6900	85.5146	86.0546	86.6366	87.0480	87.4781 (39)
Average = Sum(39)m / 12 =												86.8390 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2069	1.2037	1.2005	1.1857	1.1829	1.1700	1.1700	1.1676	1.1750	1.1829	1.1885	1.1944 (40)
HLP (average)												1.1857 (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												2.3221 (42)
Average daily hot water use (litres/day)												89.3510 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	98.2861	94.7120	91.1380	87.5640	83.9899	80.4159	80.4159	83.9899	87.5640	91.1380	94.7120	98.2861 (44)
Energy conte	145.7554	127.4786	131.5465	114.6854	110.0434	94.9591	87.9936	100.9739	102.1798	119.0808	129.9860	141.1563 (45)

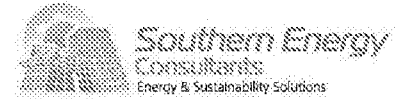
Regs Region: England

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 =	1405.8389 (45)
Distribution loss (46)m = 0.15 x (45)m													
	21.8633	19.1218	19.7320	17.2028	16.5065	14.2439	13.1990	15.1461	15.3270	17.8621	19.4979	21.1735 (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	14.1004	12.7151	14.0443	13.5538	13.9784	13.4961	13.9264	13.9601	13.5275	14.0170	13.6083	14.0895 (61)	
Total heat required for water heating calculated for each month													
	159.8558	140.1937	145.5908	128.2393	124.0218	108.4552	101.9199	114.9340	115.7074	133.0978	143.5942	155.2459 (62)	
Aperture area of solar collector												3.0000 (H1)	
Zero-loss collector efficiency												0.7000 (H2)	
Collector heat loss coefficient												1.8000 (H3)	
Collector 2nd order heat loss coefficient												0.0050 (H3a)	
Collector effective heat loss coefficient												1.8063 (H3b)	
Collector performance ratio												2.5804 (H4)	
Annual solar radiation per m2												1079.5246 (H5)	
Overshading factor												0.8000 (H6)	
Solar energy available												1813.6014 (H7)	
Adjustment factor for showers												1.0000 (H7a)	
Solar-to-load ratio												1.2900 (H8)	
Utilisation factor												0.5394 (H9)	
Collector performance factor												0.8793 (H10)	
Dedicated solar storage volume												75.0000 (H11)	
Effective solar volume												75.0000 (H13)	
Daily hot water demand												89.3510 (H14)	
Volume ratio Veff/V												0.8394 (H15)	
Solar storage volume factor												0.9650 (H16)	
Solar input												-830.0107 (H17)	
Solar input	-24.0687	-40.1637	-68.4033	-91.6739	-113.2554	-111.3481	-109.8766	-95.9997	-75.1871	-51.3439	-28.5489	-20.1414 (63)	
	Solar input (sum of months) = Sum(63)m =											-830.0107 (63)	
Output from w/h													
	135.7871	100.0300	77.1875	36.5653	10.7664	0.0000	0.0000	18.9342	40.5203	81.7539	115.0453	135.1045 (64)	
	Total per year (kWh/year) = Sum(64)m =											751.6946 (64)	
Heat gains from water heating, kWh/month													
	51.9888	45.5654	47.2503	41.5214	40.0840	34.9479	32.7395	37.0638	37.3567	43.0986	46.6224	50.4569 (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	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	53.4747	47.4958	38.6261	29.2425	21.8591	18.4544	19.9406	25.9195	34.7891	44.1728	51.5562	54.9609	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	305.5789	308.7499	300.7592	283.7479	262.2743	242.0921	228.6091	225.4382	233.4289	250.4401	271.9138	292.0960	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	(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)	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	(71)
Water heating gains (Table 5)	69.8774	67.8057	63.5085	57.6686	53.8764	48.5388	44.0046	49.8170	51.8843	57.9282	64.7533	67.8184	(72)
Total internal gains	529.6290	524.7493	503.5917	471.3569	438.7077	409.7832	393.2523	401.8727	420.8003	453.2391	488.9213	515.5732	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East					3.5800	19.6403	0.4400	0.0000	0.7700	23.8218 (76)
West					3.2400	19.6403	0.4400	0.0000	0.7700	21.5594 (80)

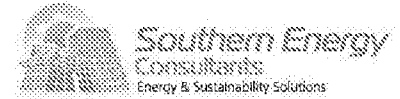
Solar gains	45.3811	88.7751	146.1999	213.2238	261.3138	267.5012	254.6720	218.7595	170.0365	105.3391 56.5849 37.3192 (83)
Total gains	575.0101	613.5243	649.7916	684.5808	700.0215	677.2844	647.9244	620.6322	590.8368	558.5782 545.5062 552.8924 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	50.1394	50.2736	50.4059	51.0368	51.1566	51.7218	51.7218	51.8278	51.5026	51.1566	50.9149	50.6645
alpha	4.3426	4.3516	4.3604	4.4025	4.4104	4.4481	4.4481	4.4552	4.4335	4.4104	4.3943	4.3776
util living area	0.9898	0.9851	0.9733	0.9414	0.8676	0.7215	0.5588	0.6006	0.8180	0.9501	0.9832	0.9913 (86)
MIT	19.7200	19.8492	20.0922	20.4242	20.7187	20.9151	20.9787	20.9707	20.8431	20.4749	20.0459	19.6963 (87)
Th 2	19.9145	19.9170	19.9196	19.9315	19.9337	19.9441	19.9441	19.9460	19.9401	19.9337	19.9292	19.9245 (88)
util rest of house	0.9869	0.9808	0.9653	0.9223	0.8228	0.6326	0.4356	0.4781	0.7446	0.9301	0.9776	0.9889 (89)
MIT 2	18.2346	18.4236	18.7757	19.2537	19.6484	19.8826	19.9351	19.9325	19.8098	19.3332	18.7188	18.2072 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.5023	18.6805	19.0130	19.4646	19.8413	20.0687	20.1232	20.1196	19.9960	19.5390	18.9580	18.4755 (91)
Temperature adjustment	-0.1500											
adjusted MIT	18.3523	18.5305	18.8630	19.3146	19.6913	19.9187	19.9732	19.9696	19.8460	19.3890	18.8080	18.3255 (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	0.9807	0.9730	0.9544	0.9083	0.8106	0.6302	0.4392	0.4810	0.7369	0.9164	0.9691	0.9834	(94)
Useful gains	563.9370	596.9602	620.1924	621.8021	567.4691	426.8221	284.5801	298.5394	435.3939	511.8961	528.6642	543.7333	(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	1242.1467	1201.6429	1087.0398	904.4056	692.3370	455.7608	289.0519	305.2508	494.4695	761.4492	1019.1551	1235.6763	(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	504.5881	406.3468	347.3344	203.4746	92.9017	0.0000	0.0000	0.0000	0.0000	185.6675	353.1534	514.8056	(98)
Space heating												2608.2721	(98)
Space heating per m2											(98) / (4) =	35.6127	(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													2882.0686	(211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Space heating requirement	504.5881	406.3468	347.3344	203.4746	92.9017	0.0000	0.0000	0.0000	0.0000	185.6675	353.1534	514.8056	(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)	557.5559	449.0020	383.7950	224.8338	102.6539	0.0000	0.0000	0.0000	0.0000	205.1575	390.2248	568.8459	(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	135.7871	100.0300	77.1875	36.5653	10.7664	0.0000	0.0000	18.9342	40.5203	81.7539	115.0453	135.1045	(64)	
Efficiency of water heater	89.8020	89.8494	89.9008	89.9975	90.1568	87.3000	87.3000	87.3000	87.3000	89.4971	89.6922	89.8156	(217)	
Fuel for water heating, kWh/month	151.2072	111.3307	85.8585	40.6293	11.9418	0.0000	0.0000	21.6887	46.4150	91.3481	128.2669	150.4243	(219)	
Water heating fuel used												839.1106	(219)	
Annual totals kWh/year														
Space heating fuel - main system													2882.0686	(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)													377.7519	(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													2496.6918	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2882.0686	3.4800	100.2960	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	839.1106	3.4800	29.2010	(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	377.7519	13.1900	49.8255	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			87.9871	(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] =	0.3125	(257)
SAP value			95.6401	
SAP rating (Section 12)			96	(258)
SAP band			A	

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

Energy	Emission factor	Emissions
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FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

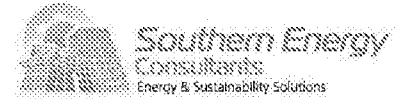


CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1	2882.0686	0.2160	622.5268 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	839.1106	0.2160	181.2479 (264)
Space and water heating			803.7747 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	377.7519	0.5190	196.0533 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			168.2657 (272)
CO2 emissions per m2			2.3000 (273)
EI value			98.0931
EI rating			98 (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	36.6200 (1b)	x 2.3500 (2b)	= 86.0570 (1b) - (3b)
First floor	36.6200 (1c)	x 2.6600 (2c)	= 97.4092 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	73.2400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 183.4662 (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) = 0.1635 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4135 (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) = 0.3515 (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	0.3691	0.3515	0.3515	0.3251	0.3251	0.2900	0.2988	0.2812	0.2900	0.3076	0.3076	0.3339 (22b)
Effective ac	0.5681	0.5618	0.5618	0.5529	0.5529	0.5420	0.5446	0.5395	0.5420	0.5473	0.5473	0.5557 (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)			6.8200	1.2357	8.4278		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			36.6200	0.1900	6.9578	75.0000	2746.5000 (28a)
Brick Cavity	85.6700	11.1200	74.5500	0.2500	18.6375	60.0000	4473.0000 (29a)
External Roof 1	36.6200		36.6200	0.1100	4.0282	9.0000	329.5800 (30)
Total net area of external elements Aum (A, m ²)			158.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.5013		(33)
Party Wall 1			39.9700	0.0000	0.0000	110.0000	4396.7000 (32)
Internal Wall 1			119.6100			9.0000	1076.4900 (32c)
Internal Wall 2			21.5300			75.0000	1614.7500 (32c)
Internal Floor 1			36.6200			18.0000	659.1600 (32d)
Internal Ceiling 1			36.6200			18.0000	659.1600 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 15955.3400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							217.8501 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.5415 (36)
Total fabric heat loss							(33) + (36) = 52.0427 (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	34.3952	34.0119	34.0119	33.4719	33.4719	32.8174	32.9740	32.6655	32.8174	33.1353	33.1353	33.6472 (38)
Heat transfer coeff	86.4380	86.0546	86.0546	85.5146	85.5146	84.8602	85.0168	84.7082	84.8602	85.1781	85.1781	85.6900 (39)
Average = Sum(39)m / 12 =												85.4223 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1802	1.1750	1.1750	1.1676	1.1676	1.1587	1.1608	1.1566	1.1587	1.1630	1.1630	1.1700 (40)
HLP (average)												1.1663 (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												2.3221 (42)
Average daily hot water use (litres/day)												89.3510 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	98.2861	94.7120	91.1380	87.5640	83.9899	80.4159	80.4159	83.9899	87.5640	91.1380	94.7120	98.2861 (44)
Energy conte	145.7554	127.4786	131.5465	114.6854	110.0434	94.9591	87.9936	100.9739	102.1798	119.0808	129.9860	141.1563 (45)

Regs Region: England

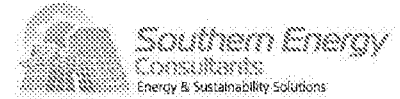
Elmhurst Energy Systems

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 =	1405.8389 (45)
Distribution loss (46)m = 0.15 x (45)m													
	21.8633	19.1218	19.7320	17.2028	16.5065	14.2439	13.1990	15.1461	15.3270	17.8621	19.4979	21.1735 (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	14.1004	12.7151	14.0443	13.5538	13.9784	13.4961	13.9264	13.9601	13.5275	14.0170	13.6083	14.0895 (61)	
Total heat required for water heating calculated for each month	159.8558	140.1937	145.5908	128.2393	124.0218	108.4552	101.9199	114.9340	115.7074	133.0978	143.5942	155.2459 (62)	
Aperture area of solar collector												3.0000 (H1)	
Zero-loss collector efficiency												0.7000 (H2)	
Collector heat loss coefficient												1.8000 (H3)	
Collector 2nd order heat loss coefficient												0.0050 (H3a)	
Collector effective heat loss coefficient												1.8063 (H3b)	
Collector performance ratio												2.5804 (H4)	
Annual solar radiation per m2												1140.0998 (H5)	
Overshading factor												0.8000 (H6)	
Solar energy available												1915.3676 (H7)	
Adjustment factor for showers												1.0000 (H7a)	
Solar-to-load ratio												1.3624 (H8)	
Utilisation factor												0.5200 (H9)	
Collector performance factor												0.8793 (H10)	
Dedicated solar storage volume												75.0000 (H11)	
Effective solar volume												75.0000 (H13)	
Daily hot water demand												89.3510 (H14)	
Volume ratio Veff/V												0.8394 (H15)	
Solar storage volume factor												0.9650 (H16)	
Solar input												-845.1092 (H17)	
Solar input	-26.0120	-39.0960	-65.8427	-91.0148	-109.6124	-115.3623	-112.5922	-100.5455	-78.4761	-53.3858	-31.6183	-21.5511 (63)	
	Solar input (sum of months) = Sum(63)m =											-845.1092 (63)	
Output from w/h	133.8438	101.0976	79.7481	37.2245	14.4094	0.0000	0.0000	14.3885	37.2313	79.7119	111.9759	133.6947 (64)	
	Total per year (kWh/year) = Sum(64)m =											743.3258 (64)	
Heat gains from water heating, kWh/month	51.9888	45.5654	47.2503	41.5214	40.0840	34.9479	32.7395	37.0638	37.3567	43.0986	46.6224	50.4569 (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	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	139.3288	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	53.4747	47.4958	38.6261	29.2425	21.8591	18.4544	19.9406	25.9195	34.7891	44.1728	51.5562	54.9609	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	305.5789	308.7499	300.7592	283.7479	262.2743	242.0921	228.6091	225.4382	233.4289	250.4401	271.9138	292.0960	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	51.2550	(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)	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	-92.8859	(71)
Water heating gains (Table 5)	69.8774	67.8057	63.5085	57.6686	53.8764	48.5388	44.0046	49.8170	51.8843	57.9282	64.7533	67.8184	(72)
Total internal gains	529.6290	524.7493	503.5917	471.3569	438.7077	409.7832	393.2523	401.8727	420.8003	453.2391	488.9213	515.5732	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c			Access factor Table 6d			Gains W
East					3.5800	22.3313	0.4400	0.0000			0.7700			27.0857 (76)
West					3.2400	22.3313	0.4400	0.0000			0.7700			24.5134 (80)

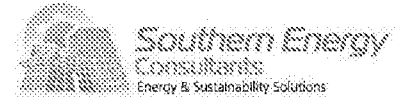
Solar gains	51.5991	90.7961	147.4368	220.9655	263.2897	288.2187	271.5137	238.8677	185.6630	114.9720	65.9115			42.0209 (83)
Total gains	581.2281	615.5453	651.0285	692.3224	701.9974	698.0019	664.7660	640.7404	606.4633	568.2111	554.8328	557.5941	(84)	

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	51.2742	51.5026	51.5026	51.8278	51.8278	52.2276	52.1314	52.3212	52.2276	52.0326	52.0326	51.7218	
alpha	4.4183	4.4335	4.4335	4.4552	4.4552	4.4818	4.4754	4.4881	4.4818	4.4688	4.4688	4.4481	
util living area	0.9870	0.9818	0.9656	0.9192	0.8060	0.5805	0.3926	0.4179	0.7236	0.9259	0.9767	0.9888	(86)
MIT	19.8640	19.9762	20.2307	20.5551	20.8317	20.9728	20.9964	20.9953	20.9239	20.6091	20.1951	19.8469	(87)
Th 2	19.9359	19.9401	19.9401	19.9460	19.9460	19.9532	19.9515	19.9549	19.9532	19.9497	19.9497	19.9441	(88)
util rest of house	0.9832	0.9765	0.9549	0.8927	0.7427	0.4711	0.2619	0.2842	0.6250	0.8957	0.9686	0.9855	(89)
MIT 2	18.4586	18.6235	18.9885	19.4439	19.7948	19.9393	19.9508	19.9539	19.9025	19.5280	18.9480	18.4397	(90)
Living area fraction	fLA = Living area / (4) =											0.1802	(91)
MIT	18.7119	18.8673	19.2124	19.6442	19.9817	20.1256	20.1393	20.1416	20.0866	19.7228	19.1727	18.6933	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.5619	18.7173	19.0624	19.4942	19.8317	19.9756	19.9893	19.9916	19.9366	19.5728	19.0227	18.5433	(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	0.9761	0.9679	0.9430	0.8787	0.7349	0.4736	0.2667	0.2889	0.6233	0.8818	0.9587	0.9791	(94)
Useful gains	567.3600	595.7855	613.9248	608.3101	515.8701	330.5406	177.2674	185.1382	377.9796	501.0515	531.9140	545.9618	(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													
	1163.6205	1128.8018	1003.5998	820.4424	584.2076	337.3689	177.6218	185.6464	401.9456	679.1099	938.8945	1151.9586	(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													
	443.6178	358.1870	289.9182	152.7352	50.8431	0.0000	0.0000	0.0000	0.0000	132.4754	293.0259	450.8616	(98)
Space heating													2171.6641 (98)
Space heating per m2											(98) / (4) =	29.6513	(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													2399.6288 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	443.6178	358.1870	289.9182	152.7352	50.8431	0.0000	0.0000	0.0000	0.0000	132.4754	293.0259	450.8616	(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)	490.1854	395.7867	320.3516	168.7682	56.1802	0.0000	0.0000	0.0000	0.0000	146.3817	323.7855	498.1896	(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	133.8438	101.0976	79.7481	37.2245	14.4094	0.0000	0.0000	14.3885	37.2313	79.7119	111.9759	133.6947	(64)
Efficiency of water heater	89.7376	89.7756	89.7900	89.8546	89.7733	87.3000	87.3000	87.3000	87.3000	89.2707	89.5920	89.7476	(217)
Fuel for water heating, kWh/month	149.1501	112.6114	88.8163	41.4275	16.0509	0.0000	0.0000	16.4817	42.6475	89.2924	124.9842	148.9675	(219)
Water heating fuel used												830.4295	(219)
Annual totals kWh/year													
Space heating fuel - main system													2399.6288 (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)													377.7519 (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													1908.6507 (238)

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

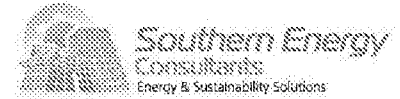
	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2399.6288	3.8700	92.8656	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	830.4295	3.8700	32.1376	(247)
Pumps and fans for heating	75.0000	18.9000	14.1750	(249)
Pump for solar water heating	50.0000	18.9000	9.4500	(249)
Energy for lighting	377.7519	18.9000	71.3951	(250)
Additional standing charges			93.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	18.9000	-344.7662	(252)
Total energy cost			-31.7428	(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	2399.6288	0.2160	518.3198	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	830.4295	0.2160	179.3728	(264)
Space and water heating			697.6926	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	377.7519	0.5190	196.0533	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			11.8820	(272)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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	2399.6288	1.2200	2927.5472	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	830.4295	1.2200	1013.1240	(264)
Space and water heating			3940.6712	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	377.7519	3.0700	1159.6985	(268)
Energy saving/generation technologies				
FV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-116.0504	(272)
Primary energy kWh/m2/year			-1.5845	(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	217.9 (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	242.18	(P1)
Transmission heat loss coefficient	52.04	(37)
Summer heat loss coefficient	294.22	(P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	3.5800	117.5071	0.4400	0.0000	0.9000	166.5874
West	3.2400	117.5071	0.4400	0.0000	0.9000	150.7663
total:						317.3537

Solar gains	Jun	Jul	Aug	(P4)
Internal gains	407	390	399	
Total summer gains	744	708	678	(P5)
Summer gain/loss ratio	2.53	2.41	2.30	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 217.9)	0.48	0.48	0.48	
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			