

FULL SAP CALCULATION PRINTOUT

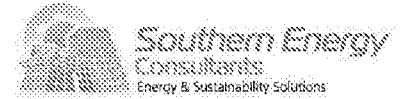
Calculation Type: New Build (As Designed)



Property Reference	SECANG005e		Issued on Date	04/02/2021	
Assessment Reference	001	Prop Type Ref	Det Br Re Ea Ga		
Property	Lockwood Corner, Plot 35				
SAP Rating	83 B	DER	18.17	TET	18.54
Environmental	85 B	% DER<TER	1.97		
CO ₂ Emissions (t/year)	1.37	DPEE	52.56	TPEE	56.53
General Requirements Compliance	Pass	% DPEE<TPEE	7.02		
Assessor Details	Mr. Stuart Harvey, Stuart Harvey			Assessor ID	T555-0001
Client	Persimon Homes Thames Valley				

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

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DWELLING AS DESIGNED

Detached House, total floor area 92 m²

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

1a TER and DER

Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.54 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.17 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)56.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)52.6 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	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.30 (max. 0.35)	OK
Openings	1.34 (max. 2.00)	1.60 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system:

None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls:

No cylinder

Boiler interlock

Yes OK

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK

Based on:

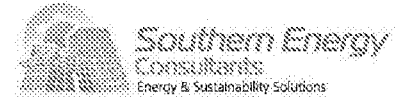
Overshading: Average
Windows facing North: 3.93 m², No overhang
Windows facing East: 6.97 m², No overhang
Windows facing South: 5.16 m², No overhang
Windows facing West: 0.48 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

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

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Air changes per hour					
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1804 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4304 (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) =		0.3658 (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	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298 (22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924 (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)			16.5400	1.2357	20.4392		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			45.5700	0.2000	9.1140	75.0000	3417.7500 (28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.2500	28.6000	60.0000	6864.0000 (29a)
Main Plane	45.5700		45.5700	0.1100	5.0127	9.0000	410.1300 (30)
Bay Roof/GRP	0.5300		0.5300	0.3000	0.1590	9.0000	4.7700 (30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.7749		(33)
Internal Wall 1			52.0200			75.0000	3901.5000 (32c)
Internal Wall 2			162.4500			9.0000	1462.0500 (32c)
Internal Floor 1			45.5700			18.0000	820.2600 (32d)
Internal Ceiling 1			45.5700			18.0000	820.2600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17700.7200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1971 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6487 (36)
Total fabric heat loss						(33) + (36) =	79.4235 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	44.5528	44.2437	43.9407	42.5176	42.2513	41.0119	41.0119	40.7823	41.4893	42.2513	42.7900	43.3531 (38)
Heat transfer coeff	123.9763	123.6672	123.3642	121.9411	121.6749	120.4354	120.4354	120.2059	120.9128	121.6749	122.2135	122.7766 (39)
Average = Sum(39)m / 12 =												121.9399 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3532	1.3498	1.3465	1.3309	1.3280	1.3145	1.3145	1.3120	1.3197	1.3280	1.3339	1.3401 (40)
HLP (average)												1.3309 (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	2.6473 (42)
Average daily hot water use (litres/day)	97.0722 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)

Regs Region: England

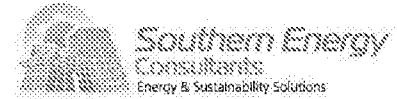
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1527.3239 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.7526	20.7742	21.4371	18.6894	17.9329	15.4747	14.3396	16.4549	16.6515	19.4057	21.1828	23.0031 (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	14.1366	12.7577	14.0962	13.5973	14.0184	13.5291	13.9570	13.9968	13.5663	14.0640	13.6517 (61)
Total heat required for water heating calculated for each month											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (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											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (64)
Heat gains from water heating, kWh/month											
56.1858	49.2389	51.0430	44.8275	43.2559	37.6846	35.2754	39.9743	40.3023	46.5319	50.3681	54.5215 (65)
Total per year (kWh/year) = Sum(64)m =	1692.8195 (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	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.0274	19.5645	15.9109	12.0456	9.0042	7.6018	8.2140	10.6768	14.3304	18.1957	21.2371	22.6396	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	242.0267	244.5382	238.2094	224.7360	207.7283	191.7434	181.0646	178.5531	184.8819	198.3553	215.3630	231.3479	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	(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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	(71)
Water heating gains (Table 5)	75.5185	73.2721	68.6061	62.2604	58.1396	52.3398	47.4132	53.7289	55.9754	62.5429	69.9557	73.2815	(72)
Total internal gains	405.2814	403.0836	388.4352	364.7507	340.5809	317.3937	302.4005	308.6676	320.8965	344.8027	372.2646	392.9778	(73)

6. Solar gains

[Jan]			Area m2		Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North			3.9300		10.6334		0.4400		0.0000		0.7700		14.1582 (74)
East			6.9700		19.6403		0.4400		0.0000		0.7700		46.3792 (76)
South			5.1600		46.7521		0.4400		0.0000		0.7700		81.7323 (78)
West			0.4800		19.6403		0.4400		0.0000		0.7700		3.1940 (80)
Solar gains	145.4637	257.8892	376.1911	499.4832	585.7541	591.9715	566.4554	501.2305	419.1396	291.6545	176.1586	123.1938	(83)
Total gains	550.7452	660.9729	764.6263	864.2339	926.3350	909.3652	868.8559	809.8981	740.0361	636.4572	548.4232	516.1716	(84)

7. Mean internal temperature (heating season)

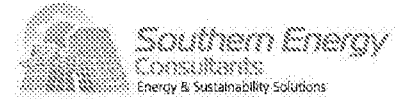
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	39.6597	39.7589	39.8565	40.3216	40.4099	40.8258	40.8258	40.9037	40.6646	40.4099	40.2318	40.0473
alpha	3.6440	3.6506	3.6571	3.6881	3.6940	3.7217	3.7217	3.7269	3.7110	3.6940	3.6821	3.6698
util living area	0.9941	0.9880	0.9739	0.9373	0.8578	0.7188	0.5681	0.6202	0.8322	0.9591	0.9894	0.9953 (86)
MIT	19.1793	19.3992	19.7499	20.2006	20.5950	20.8588	20.9562	20.9389	20.7370	20.2127	19.6121	19.1430 (87)
Th 2	19.7994	19.8020	19.8046	19.8167	19.8189	19.8295	19.8295	19.8314	19.8254	19.8189	19.8144	19.8096 (88)
util rest of house	0.9925	0.9847	0.9663	0.9179	0.8115	0.6267	0.4349	0.4882	0.7607	0.9427	0.9859	0.9941 (89)
MIT 2	17.3917	17.7132	18.2222	18.8702	19.4032	19.7237	19.8100	19.8013	19.5973	18.9004	18.0329	17.3453 (90)
Living area fraction	fLA = Living area / (4) =											0.1914 (91)
MIT	17.7340	18.0360	18.5146	19.1249	19.6314	19.9410	20.0294	20.0191	19.8155	19.1516	18.3352	17.6894 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.5840	17.8860	18.3646	18.9749	19.4814	19.7910	19.8794	19.8691	19.6655	19.0016	18.1852	17.5394 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9876	0.9766	0.9533	0.8997	0.7955	0.6233	0.4411	0.4929	0.7488	0.9265	0.9784	0.9901	(94)
Useful gains	543.9320	645.5041	728.9097	777.5307	736.8749	566.7839	383.2206	399.1867	554.1395	589.6755	536.5665	511.0418	(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	1646.8957	1605.9363	1463.6718	1228.5460	946.7975	625.1798	394.9592	417.0025	672.9409	1022.2688	1354.7671	1637.7726	(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	820.6050	645.4104	546.6630	324.7310	156.1825	0.0000	0.0000	0.0000	0.0000	321.8494	589.1044	838.2877	(98)
Space heating												4242.8333	(98)
Space heating per m2												(98) / (4) =	46.3090 (99)

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Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												90.5000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												4688.2136 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	820.6050	645.4104	546.6630	324.7310	156.1825	0.0000	0.0000	0.0000	0.0000	321.8494	589.1044	838.2877 (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)	906.7458	713.1607	604.0475	358.8187	172.5773	0.0000	0.0000	0.0000	0.0000	355.6347	650.9441	926.2848 (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	172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (64)
Efficiency of water heater	89.9275	89.8745	89.7658	89.5204	88.9962	87.3000	87.3000	87.3000	87.3000	89.4888	89.8147	87.3000 (216)
Fuel for water heating, kWh/month	191.8073	168.2927	174.9109	154.3706	150.0864	133.6702	125.4920	141.6911	142.6987	160.2827	172.4333	186.1891 (219)
Water heating fuel used												1901.9249 (219)
Annual totals kWh/year												
Space heating fuel - main system												4688.2136 (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)												389.0105 (232)
Total delivered energy for all uses												7054.1490 (238)

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

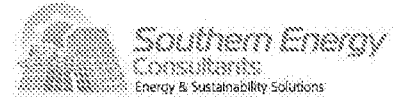
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4688.2136	0.2160	1012.6541 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1901.9249	0.2160	410.8158 (264)
Space and water heating			1423.4699 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	389.0105	0.5190	201.8964 (268)
Total CO2, kg/year			1664.2914 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.1700 (273)

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

DER		18.1700 ZC1
Total Floor Area	TFA	91.6200
Assumed number of occupants	N	2.6473
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190
CO2 emissions from appliances, equation (L14)		15.6538 ZC2
CO2 emissions from cooking, equation (L16)		1.9923 ZC3
Total CO2 emissions		35.8161 ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000 ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000 ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000 ZC7
Net CO2 emissions		35.8161 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	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (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) = 0.1353 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3853 (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) =	0.3275 (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	0.4175	0.4094	0.4012	0.3602	0.3520	0.3111	0.3111	0.3029	0.3275	0.3520	0.3684	0.3848 (22b)
Effective ac	0.5872	0.5838	0.5805	0.5649	0.5620	0.5484	0.5484	0.5459	0.5536	0.5620	0.5679	0.5740 (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)			16.5400	1.3258	21.9280		(27)
Heat Loss Floor 1			45.5700	0.1300	5.9241		(28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.1800	20.5920		(29a)
Main Plane	45.5700		45.5700	0.1300	5.9241		(30)
Bay Roof/GRP	0.5300		0.5300	0.1300	0.0689		(30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		59.1671		(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)							11.5960 (36)
Total fabric heat loss						(33) + (36) =	70.7631 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	42.9721	42.7244	42.4816	41.3411	41.1277	40.1343	40.1343	39.9504	40.5169	41.1277	41.5593	42.0106 (38)
Heat transfer coeff	113.7352	113.4875	113.2447	112.1042	111.8908	110.8974	110.8974	110.7135	111.2801	111.8908	112.3225	112.7738 (39)
Average = Sum(39)m / 12 =												112.1032 (39)
HLP	1.2414	1.2387	1.2360	1.2236	1.2212	1.2104	1.2104	1.2084	1.2146	1.2212	1.2260	1.2309 (40)
HLP (average)												1.2236 (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												2.6473 (42)
Average daily hot water use (litres/day)												97.0722 (43)
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)
Energy content (annual)										Total = Sum(45)m =		1527.3239 (45)
Distribution loss (46)m = 0.15 x (45)m												
23.7526	20.7742	21.4371	18.6894	17.9329	15.4747	14.3396	16.4549	16.6515	19.4057	21.1828	23.0031 (46)	
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	50.9589	46.0274	50.4563	46.9138	46.4989	43.0841	44.5202	46.4989	46.9138	50.4563	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	209.3097	184.5220	193.3703	171.5097	166.0517	146.2491	140.1177	156.1984	157.9235	179.8274	190.5337	204.3132 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	209.3097	184.5220	193.3703	171.5097	166.0517	146.2491	140.1177	156.1984	157.9235	179.8274	190.5337	204.3132 (64)
Heat gains from water heating, kWh/month	65.3914	57.5563	60.1330	53.1566	51.3760	45.0734	42.9162	48.0998	48.6392	55.6300	59.2840	63.7300 (65)
Solar input (sum of months) = Sum (63)m = 0.0000 (63)												
Total per year (kWh/year) = Sum (64)m = 2099.9266 (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)
(66)m	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.0274	19.5645	15.9109	12.0456	9.0042	7.6018	8.2140	10.6768	14.3304	18.1957	21.2371	22.6396	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	242.0267	244.5382	238.2094	224.7360	207.7283	191.7434	181.0646	178.5531	184.8819	198.3553	215.3630	231.3479	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	(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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	(71)
Water heating gains (Table 5)	87.8916	85.6493	80.8239	73.8286	69.0538	62.6019	57.6831	64.6503	67.5544	74.7714	82.3388	85.6586	(72)
Total internal gains	417.6545	415.4608	400.6530	376.3190	351.4951	327.6559	312.6704	319.5890	332.4755	357.0313	384.6477	405.3549	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					3.9300	10.6334	0.6300	0.7000	0.7700		12.7713 (74)	
East					6.9700	19.6403	0.6300	0.7000	0.7700		41.8362 (76)	
South					5.1600	46.7521	0.6300	0.7000	0.7700		73.7263 (78)	
West					0.4800	19.6403	0.6300	0.7000	0.7700		2.8811 (80)	
Solar gains	131.2149	232.6278	339.3415	450.5566	528.3768	533.9852	510.9685	452.1327	378.0830	263.0856	158.9031	111.1264 (83)
Total gains	548.8694	648.0886	739.9945	826.8755	879.8719	861.6411	823.6389	771.7217	710.5585	620.1169	543.5508	516.4813 (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	55.9413	56.0634	56.1836	56.7552	56.8635	57.3728	57.3728	57.4682	57.1756	56.8635	56.6449	56.4183	
alpha	4.7294	4.7376	4.7456	4.7837	4.7909	4.8249	4.8249	4.8312	4.8117	4.7909	4.7763	4.7612	
util living area	0.9980	0.9952	0.9874	0.9612	0.8888	0.7395	0.5722	0.6269	0.8584	0.9765	0.9958	0.9985	(86)
MIT	19.6372	19.8075	20.0802	20.4319	20.7383	20.9265	20.9831	20.9741	20.8400	20.4352	19.9687	19.6071	(87)
Th 2	19.8870	19.8892	19.8913	19.9012	19.9030	19.9117	19.9117	19.9133	19.9084	19.9030	19.8993	19.8954	(88)
util rest of house	0.9973	0.9936	0.9827	0.9460	0.8443	0.6449	0.4408	0.4947	0.7865	0.9644	0.9940	0.9980	(89)
MIT 2	18.0774	18.3272	18.7246	19.2329	19.6437	19.8621	19.9055	19.9026	19.7785	19.2467	18.5704	18.0391	(90)
Living area fraction	18.3760	18.6106	18.9841	19.4624	19.8533	20.0659	20.1118	20.1078	19.9818	19.4742	18.8381	18.3393	(92)
Temperature adjustment	18.3760	18.6106	18.9841	19.4624	19.8533	20.0659	20.1118	20.1078	19.9818	19.4742	18.8381	18.3393	(93)
adjusted MIT	18.3760	18.6106	18.9841	19.4624	19.8533	20.0659	20.1118	20.1078	19.9818	19.4742	18.8381	18.3393	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9958	0.9907	0.9774	0.9381	0.8419	0.6596	0.4660	0.5198	0.7923	0.9579	0.9914	0.9968	(94)
Useful gains	546.5820	642.0838	723.2520	775.6900	740.7879	568.3425	383.8441	401.1609	562.9429	593.9975	538.8844	514.8493	(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	1600.9379	1555.9847	1413.7571	1184.0942	912.2775	606.1509	389.4481	410.4986	654.5218	992.9409	1318.4539	1594.5440	(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	784.4408	614.1414	513.7358	294.0510	127.5882	0.0000	0.0000	0.0000	0.0000	296.8139	561.2900	803.2929	(98)
Space heating												3995.3540	(98)
Space heating per m2												43.6079	(99)
(98) / (4) =													

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

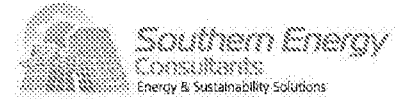
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													93.4000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4277.6810 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	784.4408	614.1414	513.7358	294.0510	127.5882	0.0000	0.0000	0.0000	0.0000	296.8139	561.2900	803.2929	(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)	839.8724	657.5389	550.0383	314.8298	136.6041	0.0000	0.0000	0.0000	0.0000	317.7879	600.9529	860.0566	(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	209.3097	184.5220	193.3703	171.5097	166.0517	146.2491	140.1177	156.1984	157.9235	179.8274	190.5337	204.3132	(64)
Efficiency of water heater (217)m	88.0669	87.8472	87.3940	86.3967	84.3971	80.3000	80.3000	80.3000	80.3000	86.3045	87.6074	88.1518	(217)
Fuel for water heating, kWh/month	237.6712	210.0489	221.2628	198.5142	196.7505	182.1283	174.4928	194.5186	196.6669	208.3637	217.4858	231.7744	(219)
Water heating fuel used													(219)
Annual totals kWh/year													
Space heating fuel - main system													4277.6810 (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)													389.0105 (232)
Total delivered energy for all uses													7211.3696 (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	4277.6810	0.2160	923.9791 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2469.6781	0.2160	533.4505 (264)
Space and water heating			1457.4296 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	389.0105	0.5190	201.8964 (268)
Total CO2, kg/m2/year			1698.2510 (272)
Emissions per m2 for space and water heating			15.9073 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.2036 (272b)
Emissions per m2 for pumps and fans			0.4249 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.9073 * 1.00) + 2.2036 + 0.4249, rounded to 2 d.p.			18.5400 (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	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (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) = 0.1353 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3853 (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) =	0.3275 (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	0.4175	0.4094	0.4012	0.3602	0.3520	0.3111	0.3111	0.3029	0.3275	0.3520	0.3684	0.3848 (22b)
Effective ac	0.5872	0.5838	0.5805	0.5649	0.5620	0.5484	0.5484	0.5459	0.5536	0.5620	0.5679	0.5740 (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)			16.5400	1.2357	20.4392		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			45.5700	0.2000	9.1140	75.0000	3417.7500 (28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.2500	28.6000	60.0000	6864.0000 (29a)
Main Plane	45.5700		45.5700	0.1100	5.0127	9.0000	410.1300 (30)
Bay Roof/GRP	0.5300		0.5300	0.3000	0.1590	9.0000	4.7700 (30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.7749		(33)
Internal Wall 1			52.0200			75.0000	3901.5000 (32c)
Internal Wall 2			162.4500			9.0000	1462.0500 (32c)
Internal Floor 1			45.5700			18.0000	820.2600 (32d)
Internal Ceiling 1			45.5700			9.0000	410.1300 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17290.5900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							188.7207 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6487 (36)
Total fabric heat loss						(33) + (36) =	79.4235 (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	42.9721	42.7244	42.4816	41.3411	41.1277	40.1343	40.1343	39.9504	40.5169	41.1277	41.5593	42.0106 (38)
Heat transfer coeff	122.3957	122.1479	121.9051	120.7646	120.5512	119.5579	119.5579	119.3739	119.9405	120.5512	120.9829	121.4342 (39)
Average = Sum(39)m / 12 =												120.7636 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3359	1.3332	1.3306	1.3181	1.3158	1.3049	1.3049	1.3029	1.3091	1.3158	1.3205	1.3254 (40)
HLP (average)												1.3181 (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	2.6473 (42)
Average daily hot water use (litres/day)	97.0722 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)

Regs Region: England

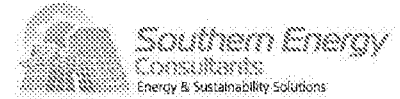
Elmhurst Energy Systems

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 = 1527.3239 (45)											
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	33.6495	29.4301	30.3692	26.4766	25.4050	21.9226	20.3145	23.3111	23.5896	27.4914	30.0090	32.5878 (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	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.0274	19.5645	15.9109	12.0456	9.0042	7.6018	8.2140	10.6768	14.3304	18.1957	21.2371	22.6396	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	242.0267	244.5382	238.2094	224.7360	207.7283	191.7434	181.0646	178.5531	184.8819	198.3553	215.3630	231.3479	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	(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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	(71)
Water heating gains (Table 5)	45.2279	43.7948	40.8189	36.7731	34.1465	30.4480	27.3044	31.3322	32.7633	36.9507	41.6791	43.8008	(72)
Total internal gains	371.9908	370.6063	357.6479	336.2635	313.5877	292.5019	279.2917	283.2709	294.6844	316.2106	340.9880	360.4970	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				3.9300	10.6334	0.4400	0.0000	0.7700	14.1582 (74)			
East				6.9700	19.6403	0.4400	0.0000	0.7700	46.3792 (76)			
South				5.1600	46.7521	0.4400	0.0000	0.7700	81.7323 (78)			
West				0.4800	19.6403	0.4400	0.0000	0.7700	3.1940 (80)			
Solar gains	145.4637	257.8892	376.1911	499.4832	585.7541	591.9715	566.4554	501.2305	419.1396	291.6545	176.1586	123.1938 (83)
Total gains	517.4545	628.4955	733.8391	835.7467	899.3418	884.4734	845.7471	784.5014	713.8240	607.8651	517.1466	483.6908 (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	39.2411	39.3207	39.3990	39.7711	39.8415	40.1725	40.1725	40.2344	40.0444	39.8415	39.6993	39.5518	
alpha	3.6161	3.6214	3.6266	3.6514	3.6561	3.6782	3.6782	3.6823	3.6696	3.6561	3.6466	3.6368	
util living area	0.9948	0.9890	0.9755	0.9399	0.8623	0.7260	0.5760	0.6304	0.8398	0.9622	0.9906	0.9959	(86)
MIT	19.1340	19.3579	19.7151	20.1723	20.5764	20.8489	20.9522	20.9329	20.7200	20.1803	19.5683	19.0942	(87)
Th 2	19.8128	19.8149	19.8170	19.8267	19.8285	19.8370	19.8370	19.8385	19.8337	19.8285	19.8248	19.8210	(88)
util rest of house	0.9934	0.9860	0.9684	0.9214	0.8176	0.6355	0.4432	0.4991	0.7710	0.9471	0.9875	0.9948	(89)
MIT 2	18.1233	18.3472	18.7020	19.1536	19.5287	19.7583	19.8220	19.8153	19.6651	19.1706	18.5653	18.0896	(90)
Living area fraction	18.3168	18.5407	18.8959	19.3486	19.7293	19.9671	20.0384	20.0292	19.8671	19.3639	18.7573	18.2819	(92)
Temperature adjustment	18.3168	18.5407	18.8959	19.3486	19.7293	19.9671	20.0384	20.0292	19.8671	19.3639	18.7573	18.2819	(93)
adjusted MIT	18.3168	18.5407	18.8959	19.3486	19.7293	19.9671	20.0384	20.0292	19.8671	19.3639	18.7573	18.2819	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	512.6971	616.9051	705.3384	762.2337	731.2579	572.0533	395.6869	410.0084	552.0089	570.8323	508.6255	480.1681	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1715.5908	1666.1871	1511.1276	1261.8251	967.9382	641.6748	411.0889	433.2374	691.7045	1056.4988	1410.3341	1710.0243	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	894.9529	705.1175	599.5072	359.7059	176.0901	0.0000	0.0000	0.0000	0.0000	361.3359	649.2302	915.0130	(98)
Space heating													4660.9526 (98)
Space heating per m2													50.8727 (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													

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

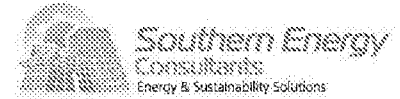


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	1123.8438	884.7281	907.2417	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.7898	0.8588	0.8288	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	887.5814	759.7901	751.9491	0.0000	0.0000	0.0000	0.0000 (102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1134.0271	1086.6515	1016.8510	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	177.4410	243.1849	197.0870	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									FC = cooled area / (4) =			617.7129 (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	44.3602	60.7962	49.2718	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												154.4282 (107)
Energy for space heating												1.6855 (108)
Energy for space cooling												50.8727 (99)
Total												1.6855 (108)
Dwelling Fabric Energy Efficiency (DFEE)												52.5582 (109)
												52.6 (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	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (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) = 0.1353 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3853 (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) =	0.3275 (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	0.4175	0.4094	0.4012	0.3602	0.3520	0.3111	0.3111	0.3029	0.3275	0.3520	0.3684	0.3848 (22b)
Effective ac	0.5872	0.5838	0.5805	0.5649	0.5620	0.5484	0.5484	0.5459	0.5536	0.5620	0.5679	0.5740 (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)			16.5400	1.3258	21.9280		(27)
Heat Loss Floor 1			45.5700	0.1300	5.9241		(28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.1800	20.5920		(29a)
Main Plane	45.5700		45.5700	0.1300	5.9241		(30)
Bay Roof/GRP	0.5300		0.5300	0.1300	0.0689		(30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	59.1671		(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)							11.5960 (36)
Total fabric heat loss						(33) + (36) =	70.7631 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	42.9721	42.7244	42.4816	41.3411	41.1277	40.1343	40.1343	39.9504	40.5169	41.1277	41.5593	42.0106 (38)
Heat transfer coeff	113.7352	113.4875	113.2447	112.1042	111.8908	110.8974	110.8974	110.7135	111.2801	111.8908	112.3225	112.7738 (39)
Average = Sum(39)m / 12 =												112.1032 (39)
HLP	1.2414	1.2387	1.2360	1.2236	1.2212	1.2104	1.2104	1.2084	1.2146	1.2212	1.2260	1.2309 (40)
HLP (average)												1.2236 (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												2.6473 (42)
Average daily hot water use (litres/day)												97.0722 (43)
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)
Energy content (annual)										Total = Sum(45)m =		1527.3239 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	33.6495	29.4301	30.3692	26.4766	25.4050	21.9226	20.3145	23.3111	23.5896	27.4914	30.0090	32.5878 (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	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	132.3626	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.0274	19.5645	15.9109	12.0456	9.0042	7.6018	8.2140	10.6768	14.3304	18.1957	21.2371	22.6396	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	242.0267	244.5382	238.2094	224.7360	207.7283	191.7434	181.0646	178.5531	184.8819	198.3553	215.3630	231.3479	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	36.2363	(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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	(71)
Water heating gains (Table 5)	45.2279	43.7948	40.8189	36.7731	34.1465	30.4480	27.3044	31.3322	32.7633	36.9507	41.6791	43.8008	(72)
Total internal gains	371.9908	370.6063	357.6479	336.2635	313.5877	292.5019	279.2917	283.2709	294.6844	316.2106	340.9880	360.4970	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.9300	10.6334	0.6300	0.7000	0.7700	12.7713	(74)
East	6.9700	19.6403	0.6300	0.7000	0.7700	41.8362	(76)
South	5.1600	46.7521	0.6300	0.7000	0.7700	73.7263	(78)
West	0.4800	19.6403	0.6300	0.7000	0.7700	2.8811	(80)

Solar gains	131.2149	232.6278	339.3415	450.5566	528.3768	533.9852	510.9685	452.1327	378.0830	263.0856	158.9031	111.1264	(83)
Total gains	503.2057	603.2341	696.9894	786.8200	841.9646	826.4871	790.2602	735.4036	672.7674	579.2962	499.8911	471.6234	(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	55.9413	56.0634	56.1836	56.7552	56.8635	57.3728	57.3728	57.4682	57.1756	56.8635	56.6449	56.4183	
alpha	4.7294	4.7376	4.7456	4.7837	4.7909	4.8249	4.8249	4.8312	4.8117	4.7909	4.7763	4.7612	
util living area	0.9986	0.9965	0.9901	0.9676	0.9021	0.7598	0.5929	0.6516	0.8777	0.9819	0.9970	0.9990	(86)
MIT	19.5916	19.7632	20.0392	20.3980	20.7156	20.9171	20.9803	20.9695	20.8204	20.3981	19.9254	19.5621	(87)
Th 2	19.8870	19.8892	19.8913	19.9012	19.9030	19.9117	19.9117	19.9133	19.9084	19.9030	19.8993	19.8954	(88)
util rest of house	0.9981	0.9952	0.9863	0.9544	0.8610	0.6663	0.4585	0.5171	0.8109	0.9723	0.9958	0.9986	(89)
MIT 2	18.6060	18.7788	19.0546	19.4133	19.7078	19.8728	19.9067	19.9045	19.8062	19.4197	18.9490	18.5831	(90)
Living area fraction									fLA = Living area / (4) =			0.1914	(91)
MIT	18.7947	18.9673	19.2431	19.6018	19.9007	20.0727	20.1122	20.1084	20.0004	19.6070	19.1359	18.7705	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7947	18.9673	19.2431	19.6018	19.9007	20.0727	20.1122	20.1084	20.0004	19.6070	19.1359	18.7705	(93)

8. Space heating requirement

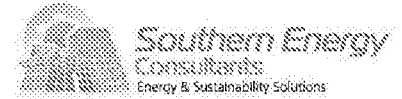
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9975	0.9938	0.9834	0.9499	0.8609	0.6816	0.4845	0.5430	0.8177	0.9688	0.9945	0.9981	(94)
Useful gains	501.9271	599.4880	685.4151	747.3870	724.8195	563.3609	382.8868	399.3409	550.1273	561.2097	497.1618	470.7404	(95)
Ext temp.	4.3000	4.9000	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	1648.5557	1596.4591	1443.0879	1199.7212	917.5866	606.9105	389.4970	410.5691	656.5960	1007.7979	1351.9061	1643.1729	(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	853.0917	669.9646	563.7086	325.6806	143.4187	0.0000	0.0000	0.0000	0.0000	332.2616	615.4159	872.2898	(98)
Space heating												4375.8315	(98)
Space heating per m ²										(98) / (4) =		47.7607	(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	1042.4360	820.6411	841.4225	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8375	0.9052	0.8780	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	873.0824	742.8501	738.7890	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1066.2509	1021.7967	959.4640	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)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

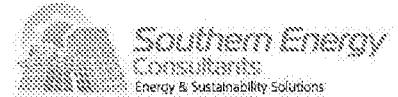


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	139.0813	207.5363	164.1822	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												510.7998 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	34.7703	51.8841	41.0456	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												127.7000 (107)
Space cooling per m2												1.3938 (108)
Energy for space heating												47.7607 (99)
Energy for space cooling												1.3938 (108)
Total												49.1545 (109)
Target Fabric Energy Efficiency (TFEE)												56.5 (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	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					40.0000 / (5) = 0.1804 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4304 (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)	=	0.3658 (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	0.3841	0.3658	0.3658	0.3384	0.3384	0.3018	0.3109	0.2926	0.3018	0.3201	0.3201	0.3475 (22b)
Effective ac	0.5738	0.5669	0.5669	0.5572	0.5572	0.5455	0.5483	0.5428	0.5455	0.5512	0.5512	0.5604 (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)			16.5400	1.2357	20.4392		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			45.5700	0.2000	9.1140	75.0000	3417.7500 (28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.2500	28.6000	60.0000	6864.0000 (29a)
Main Plane	45.5700		45.5700	0.1100	5.0127	9.0000	410.1300 (30)
Bay Roof/GRP	0.5300		0.5300	0.3000	0.1590	9.0000	4.7700 (30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.7749		(33)
Internal Wall 1			52.0200			75.0000	3901.5000 (32c)
Internal Wall 2			162.4500			9.0000	1462.0500 (32c)
Internal Floor 1			45.5700			18.0000	820.2600 (32d)
Internal Ceiling 1			45.5700			18.0000	820.2600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17700.7200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1971 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6487 (36)
Total fabric heat loss						(33) + (36) =	79.4235 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	41.9912	41.4893	41.4893	40.7823	40.7823	39.9254	40.1304	39.7265	39.9254	40.3416	40.3416	41.0119 (38)
Heat transfer coeff	121.4147	120.9128	120.9128	120.2059	120.2059	119.3489	119.5540	119.1500	119.3489	119.7652	119.7652	120.4354 (39)
Average = Sum(39)m / 12 =												120.0850 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3252	1.3197	1.3197	1.3120	1.3120	1.3027	1.3049	1.3005	1.3027	1.3072	1.3072	1.3145 (40)
HLP (average)												1.3107 (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												2.6473 (42)
Average daily hot water use (litres/day)												97.0722 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)

Regs Region: England

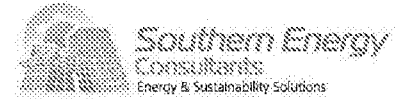
Elmhurst Energy Systems

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 = 1527.3239 (45)
Distribution loss (46)m = 0.15 x (45)m												
23.7526	20.7742	21.4371	18.6894	17.9329	15.4747	14.3396	16.4549	16.6515	19.4057	21.1828	23.0031	(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	14.1366	12.7577	14.0962	13.5973	14.0184	13.5291	13.9570	13.9968	13.5663	14.0640	13.6517	14.1246 (61)
Total heat required for water heating calculated for each month												
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789	(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												
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789	(64)
RHI water heating demand												
Heat gains from water heating, kWh/month												
56.1858	49.2389	51.0430	44.8275	43.2559	37.6846	35.2754	39.9743	40.3023	46.5319	50.3681	54.5215	(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	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.0685	48.9113	39.7774	30.1140	22.5106	19.0044	20.5349	26.6920	35.8260	45.4893	53.0928	56.5990 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	361.2339	364.9824	355.5364	335.4268	310.0422	286.1842	270.2456	266.4971	275.9432	296.0527	321.4373	345.2953 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308 (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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900 (71)
Water heating gains (Table 5)	75.5185	73.2721	68.6061	62.2604	58.1396	52.3398	47.4132	53.7289	55.9754	62.5429	69.9557	73.2815 (72)
Total internal gains	601.2967	596.6416	573.3956	537.2770	500.1682	467.0041	447.6695	456.3939	477.2204	513.5607	553.9616	584.6516 (73)

6. Solar gains

[Jan]			Area m2		Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North			3.9300		11.9814		0.4400		0.0000		0.7700		15.9531 (74)
East			6.9700		22.3313		0.4400		0.0000		0.7700		52.7340 (76)
South			5.1600		50.9848		0.4400		0.0000		0.7700		89.1321 (78)
West			0.4800		22.3313		0.4400		0.0000		0.7700		3.6316 (80)
Solar gains	161.4508	257.8650	372.5663	511.7584	586.4964	635.1253	600.8511	542.3625	450.6128	311.6373	200.3604	135.3821	(83)
Total gains	762.7475	854.5066	945.9619	1049.0354	1086.6646	1102.1295	1048.5206	998.7563	927.8332	825.1980	754.3220	720.0337	(84)

7. Mean internal temperature (heating season)

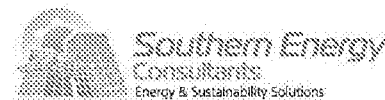
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	40.4965	40.6646	40.6646	40.9037	40.9037	41.1974	41.1267	41.2662	41.1974	41.0542	41.0542	Dec
alpha	3.6998	3.7110	3.7110	3.7269	3.7269	3.7465	3.7418	3.7511	3.7465	3.7369	3.7369	3.7217
util living area	0.9803	0.9692	0.9411	0.8716	0.7378	0.5151	0.3488	0.3753	0.6619	0.8914	0.9645	0.9835 (86)
MIT	19.5774	19.7551	20.0919	20.4935	20.8072	20.9649	20.9940	20.9922	20.9056	20.5289	19.9986	19.5452 (87)
Th 2	19.8211	19.8254	19.8254	19.8314	19.8314	19.8388	19.8370	19.8405	19.8388	19.8352	19.8352	19.8295 (88)
util rest of house	0.9750	0.9610	0.9250	0.8362	0.6671	0.4065	0.2203	0.2425	0.5586	0.8529	0.9534	0.9790 (89)
MIT 2	17.9826	18.2402	18.7189	19.2721	19.6615	19.8208	19.8359	19.8388	19.7763	19.3357	18.6003	17.9420 (90)
Living area fraction												
MIT	18.2879	18.5302	18.9818	19.5059	19.8808	20.0398	20.0576	20.0596	19.9925	19.5641	18.6680	18.2489 (92)
Temperature adjustment												
adjusted MIT	18.1379	18.3802	18.8318	19.3559	19.7308	19.8898	19.9076	19.9096	19.8425	19.4141	18.7180	18.0989 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9641	0.9472	0.9072	0.8189	0.6603	0.4115	0.2282	0.2506	0.5590	0.8355	0.9385	0.9692 (94)
Useful gains	735.3362	809.3489	858.1732	859.0115	717.5335	453.5382	239.2729	250.2981	518.6612	689.4245	707.9234	697.8663 (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	1582.9992	1545.2951	1382.2472	1136.6574	809.0809	464.2470	240.0172	251.3635	554.0734	935.8626	1283.6470	1565.5298 (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	630.6613	494.5559	389.9111	199.9050	68.1112	0.0000	0.0000	0.0000	0.0000	183.3499	414.5210	645.5401 (98)
Space heating												3026.5556 (98)
RHI space heating demand												3027 (98)

FULL SAP CALCULATION PRINTOUT

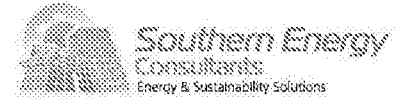
Calculation Type: New Build (As Designed)



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	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1804 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4304 (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) =		0.3658 (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	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298 (22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924 (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)			16.5400	1.2357	20.4392		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			45.5700	0.2000	9.1140	75.0000	3417.7500 (28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.2500	28.6000	60.0000	6864.0000 (29a)
Main Plane	45.5700		45.5700	0.1100	5.0127	9.0000	410.1300 (30)
Bay Roof/GRP	0.5300		0.5300	0.3000	0.1590	9.0000	4.7700 (30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.7749		(33)
Internal Wall 1			52.0200			75.0000	3901.5000 (32c)
Internal Wall 2			162.4500			9.0000	1462.0500 (32c)
Internal Floor 1			45.5700			18.0000	820.2600 (32d)
Internal Ceiling 1			45.5700			18.0000	820.2600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17700.7200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1971 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6487 (36)
Total fabric heat loss						(33) + (36) =	79.4235 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	44.5528	44.2437	43.9407	42.5176	42.2513	41.0119	41.0119	40.7823	41.4893	42.2513	42.7900	43.3531 (38)
Heat transfer coeff	123.9763	123.6672	123.3642	121.9411	121.6749	120.4354	120.4354	120.2059	120.9128	121.6749	122.2135	122.7766 (39)
Average = Sum(39)m / 12 =												121.9399 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3532	1.3498	1.3465	1.3309	1.3280	1.3145	1.3145	1.3120	1.3197	1.3280	1.3339	1.3401 (40)
HLP (average)												1.3309 (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	2.6473 (42)
Average daily hot water use (litres/day)	97.0722 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)

Regs Region: England

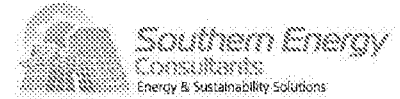
Elmhurst Energy Systems

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 = 1527.3239 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.7526	20.7742	21.4371	18.6894	17.9329	15.4747	14.3396	16.4549	16.6515	19.4057	21.1828	23.0031 (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	14.1366	12.7577	14.0962	13.5973	14.0184	13.5291	13.9570	13.9968	13.5663	14.0640	13.6517 (61)
Total heat required for water heating calculated for each month											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (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											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (64)
Heat gains from water heating, kWh/month											
56.1858	49.2389	51.0430	44.8275	43.2559	37.6846	35.2754	39.9743	40.3023	46.5319	50.3681	54.5215 (65)
Total per year (kWh/year) = Sum(64)m =	1692.8195 (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	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.0685	48.9113	39.7774	30.1140	22.5106	19.0044	20.5349	26.6920	35.8260	45.4893	53.0928	56.5990	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	361.2339	364.9824	355.5364	335.4268	310.0422	286.1842	270.2456	266.4971	275.9432	296.0527	321.4373	345.2953	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	(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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	(71)
Water heating gains (Table 5)	75.5185	73.2721	68.6061	62.2604	58.1396	52.3398	47.4132	53.7289	55.9754	62.5429	69.9557	73.2815	(72)
Total internal gains	601.2967	596.6416	573.3956	537.2770	500.1682	467.0041	447.6695	456.3939	477.2204	513.5607	553.9616	584.6516	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W		
North				3.9300	10.6334	0.4400	0.0000	0.7700		14.1582 (74)		
East				6.9700	19.6403	0.4400	0.0000	0.7700		46.3792 (76)		
South				5.1600	46.7521	0.4400	0.0000	0.7700		81.7323 (78)		
West				0.4800	19.6403	0.4400	0.0000	0.7700		3.1940 (80)		
Solar gains	145.4637	257.8892	376.1911	499.4832	585.7541	591.9715	566.4554	501.2305	419.1396	291.6545	176.1586	123.1938 (83)
Total gains	746.7604	854.5309	949.5867	1036.7602	1085.9223	1058.9756	1014.1249	957.6244	896.3600	805.2152	730.1202	707.8454 (84)

7. Mean internal temperature (heating season)

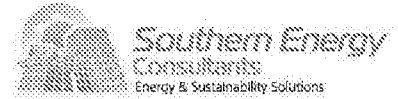
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	39.6597	39.7589	39.8565	40.3216	40.4099	40.8258	40.8258	40.9037	40.6646	40.4099	40.2318	40.0473
alpha	3.6440	3.6506	3.6571	3.6881	3.6940	3.7217	3.7217	3.7269	3.7110	3.6940	3.6821	3.6698
util living area	0.9843	0.9735	0.9511	0.9000	0.8029	0.6497	0.4992	0.5434	0.7586	0.9222	0.9741	0.9869 (86)
MIT	19.4035	19.6131	19.9397	20.3484	20.6878	20.9002	20.9714	20.9607	20.8142	20.3716	19.8144	19.3646 (87)
Th 2	19.7994	19.8020	19.8046	19.8167	19.8189	19.8295	19.8295	19.8314	19.8254	19.8189	19.8144	19.8096 (88)
util rest of house	0.9802	0.9666	0.9382	0.8725	0.7483	0.5566	0.3768	0.4199	0.6766	0.8949	0.9662	0.9835 (89)
MIT 2	17.7164	18.0201	18.4887	19.0662	19.5103	19.7582	19.8174	19.8131	19.6740	19.1128	18.3226	17.6668 (90)
Living area fraction	fLA = Living area / (4) =											0.1914 (91)
MIT	18.0394	18.3251	18.7665	19.3116	19.7357	19.9768	20.0383	20.0328	19.8923	19.3538	18.6082	17.9918 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8894	18.1751	18.6165	19.1616	19.5857	19.8268	19.8883	19.8828	19.7423	19.2038	18.4582	17.8418 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9706	0.9536	0.9211	0.8538	0.7358	0.5564	0.3832	0.4257	0.6699	0.8764	0.9532	0.9751 (94)
Useful gains	724.8192	814.8404	874.6176	885.1594	799.0219	589.1967	388.6512	407.6452	600.4428	705.6798	695.9417	690.2030 (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	1684.7615	1641.6941	1494.7423	1251.3157	959.4924	629.4951	396.0308	418.6551	682.2264	1046.8612	1388.1206	1674.8967 (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	714.1971	555.6457	461.3728	263.6326	119.3901	0.0000	0.0000	0.0000	0.0000	253.8390	498.3688	732.6121 (98)
Space heating												3599.0581 (98)
Space heating per m2												(98) / (4) = 39.2825 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3976.8598	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	714.1971	555.6457	461.3728	263.6326	119.3901	0.0000	0.0000	0.0000	0.0000	253.8390	498.3688	732.6121	(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)	789.1681	613.9731	509.8042	291.3067	131.9227	0.0000	0.0000	0.0000	0.0000	280.4851	550.6837	809.5162	(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	172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789	(64)
Efficiency of water heater	89.8593	89.7957	89.6655	89.3733	88.7816	87.3000	87.3000	87.3000	87.3000	89.3179	89.7203	89.8869	(216)
Fuel for water heating, kWh/month	191.9529	168.4404	175.1066	154.6246	150.4491	133.6702	125.4920	141.6911	142.6987	160.5893	172.6146	186.3218	(219)
Water heating fuel used												1903.6513	(219)
Annual totals kWh/year													
Space heating fuel - main system												3976.8598	(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)												389.0105	(232)
Total delivered energy for all uses												6344.5216	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3976.8598	3.4800	138.3947 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1903.6513	3.4800	66.2471 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	389.0105	13.1900	51.3105 (250)
Additional standing charges			120.0000 (251)
Total energy cost			385.8448 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200 (256)
Energy cost factor (ECF)	1.1862 (257)
SAP value	83.4529
SAP rating (Section 12)	83 (258)
SAP band	B

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

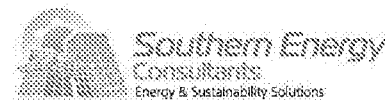
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	3976.8598	0.2160	859.0017 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1903.6513	0.2160	411.1887 (264)
Space and water heating			1270.1904 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	389.0105	0.5190	201.8964 (268)
Total kg/year			1511.0118 (272)
CO2 emissions per m2			16.4900 (273)
EI value			85.1797
EI rating			85 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$, stars = 4
Water heating energy efficiency	$3.48 / 0.8880 = 3.919$, stars = 4
Water heating environmental impact	$0.216 / 0.8880 = 0.2432$, 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	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1804 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4304 (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) =		0.3658 (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	0.3841	0.3658	0.3658	0.3384	0.3384	0.3018	0.3109	0.2926	0.3018	0.3201	0.3201	0.3475 (22b)
Effective ac	0.5738	0.5669	0.5669	0.5572	0.5572	0.5455	0.5483	0.5428	0.5455	0.5512	0.5512	0.5604 (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)			16.5400	1.2357	20.4392		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			45.5700	0.2000	9.1140	75.0000	3417.7500 (28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.2500	28.6000	60.0000	6864.0000 (29a)
Main Plane	45.5700		45.5700	0.1100	5.0127	9.0000	410.1300 (30)
Bay Roof/GRP	0.5300		0.5300	0.3000	0.1590	9.0000	4.7700 (30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.7749		(33)
Internal Wall 1			52.0200			75.0000	3901.5000 (32c)
Internal Wall 2			162.4500			9.0000	1462.0500 (32c)
Internal Floor 1			45.5700			18.0000	820.2600 (32d)
Internal Ceiling 1			45.5700			18.0000	820.2600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17700.7200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1971 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6487 (36)
Total fabric heat loss						(33) + (36) =	79.4235 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	41.9912	41.4893	41.4893	40.7823	40.7823	39.9254	40.1304	39.7265	39.9254	40.3416	40.3416	41.0119 (38)
Heat transfer coeff	121.4147	120.9128	120.9128	120.2059	120.2059	119.3489	119.5540	119.1500	119.3489	119.7652	119.7652	120.4354 (39)
Average = Sum(39)m / 12 =												120.0850 (39)
HLP	1.3252	1.3197	1.3197	1.3120	1.3120	1.3027	1.3049	1.3005	1.3027	1.3072	1.3072	1.3145 (40)
HLP (average)												1.3107 (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												2.6473 (42)
Average daily hot water use (litres/day)												97.0722 (43)
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (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 = 1527.3239 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.7526	20.7742	21.4371	18.6894	17.9329	15.4747	14.3396	16.4549	16.6515	19.4057	21.1828	23.0031 (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	14.1366	12.7577	14.0962	13.5973	14.0184	13.5291	13.9570	13.9968	13.5663	14.0640	13.6517 (61)
Total heat required for water heating calculated for each month											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (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											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (64)
Heat gains from water heating, kWh/month											
56.1858	49.2389	51.0430	44.8275	43.2559	37.6846	35.2754	39.9743	40.3023	46.5319	50.3681	54.5215 (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	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.0685	48.9113	39.7774	30.1140	22.5106	19.0044	20.5349	26.6920	35.8260	45.4893	53.0928	56.5990	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	361.2339	364.9824	355.5364	335.4268	310.0422	286.1842	270.2456	266.4971	275.9432	296.0527	321.4373	345.2953	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	(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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	(71)
Water heating gains (Table 5)	75.5185	73.2721	68.6061	62.2604	58.1396	52.3398	47.4132	53.7289	55.9754	62.5429	69.9557	73.2815	(72)
Total internal gains	601.2967	596.6416	573.3956	537.2770	500.1682	467.0041	447.6695	456.3939	477.2204	513.5607	553.9616	584.6516	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North				3.9300	11.9814		0.4400		0.0000		0.7700		15.9531 (74)
East				6.9700	22.3313		0.4400		0.0000		0.7700		52.7340 (76)
South				5.1600	50.9848		0.4400		0.0000		0.7700		89.1321 (78)
West				0.4800	22.3313		0.4400		0.0000		0.7700		3.6316 (80)
Solar gains	161.4508	257.8650	372.5663	511.7584	586.4964	635.1253	600.8511	542.3625	450.6128	311.6373	200.3604		135.3821 (83)
Total gains	762.7475	854.5066	945.9619	1049.0354	1086.6646	1102.1295	1048.5206	998.7563	927.8332	825.1980	754.3220		720.0337 (84)

7. Mean internal temperature (heating season)

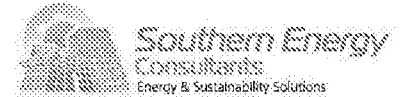
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	40.4965	40.6646	40.6646	40.9037	40.9037	41.1974	41.1267	41.2662	41.1974	41.0542	41.0542	40.8258
alpha	3.6998	3.7110	3.7110	3.7269	3.7269	3.7465	3.7418	3.7511	3.7465	3.7369	3.7369	3.7217
util living area	0.9803	0.9692	0.9411	0.8716	0.7378	0.5151	0.3488	0.3753	0.6619	0.8914	0.9645	0.9835 (86)
MIT	19.5774	19.7551	20.0919	20.4935	20.8072	20.9649	20.9940	20.9922	20.9056	20.5289	19.9986	19.5452 (87)
Th 2	19.8211	19.8254	19.8254	19.8314	19.8314	19.8388	19.8370	19.8405	19.8388	19.8352	19.8352	19.8295 (88)
util rest of house	0.9750	0.9610	0.9250	0.8362	0.6671	0.4065	0.2203	0.2425	0.5586	0.8529	0.9534	0.9790 (89)
MIT 2	17.9826	18.2402	18.7189	19.2721	19.6615	19.8208	19.8359	19.8388	19.7763	19.3357	18.6003	17.9420 (90)
Living area fraction	fLA = Living area / (4) =											0.1914 (91)
MIT	18.2879	18.5302	18.9818	19.5059	19.8808	20.0398	20.0576	20.0596	19.9925	19.5641	18.6680	18.2489 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1379	18.3802	18.8318	19.3559	19.7308	19.8898	19.9076	19.9096	19.8425	19.4141	18.7180	18.0989 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9641	0.9472	0.9072	0.8189	0.6603	0.4115	0.2282	0.2506	0.5590	0.8355	0.9385	0.9692 (94)
Useful gains	735.3362	809.3489	858.1732	859.0115	717.5335	453.5382	239.2729	250.2981	518.6612	689.4245	707.9234	697.8683 (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	1582.9992	1545.2951	1382.2472	1136.6574	809.0809	464.2470	240.0172	251.3635	554.0734	935.8626	1283.6470	1565.5298 (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	630.6613	494.5559	389.9111	199.9050	68.1112	0.0000	0.0000	0.0000	0.0000	183.3499	414.5210	645.5401 (98)
Space heating												3026.5556 (98)
Space heating per m2												(98) / (4) = 33.0338 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3344.2603 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	630.6613	494.5559	389.9111	199.9050	68.1112	0.0000	0.0000	0.0000	0.0000	183.3499	414.5210	645.5401	(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)	696.8633	546.4706	430.8410	220.8895	75.2610	0.0000	0.0000	0.0000	0.0000	202.5966	458.0343	713.3040	(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	172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789	(64)
Efficiency of water heater	89.7931	89.7297	89.5576	89.1641	88.3551	87.3000	87.3000	87.3000	87.3000	89.0670	89.6066	87.3000	(216)
(217)m	89.7931	89.7297	89.5576	89.1641	88.3551	87.3000	87.3000	87.3000	87.3000	89.0670	89.6066	89.8218	(217)
Fuel for water heating, kWh/month	192.0942	168.5644	175.3176	154.9875	151.1754	133.6702	125.4920	141.6911	142.6987	161.0418	172.8336	186.4569	(219)
Water heating fuel used												1906.0234	(219)
Annual totals kWh/year													
Space heating fuel - main system												3344.2603	(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)												389.0105	(232)
Total delivered energy for all uses												5714.2942	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3344.2603	3.8700	129.4229 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1906.0234	3.8700	73.7631 (247)
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)
Energy for lighting	389.0105	18.9000	73.5230 (250)
Additional standing charges			93.0000 (251)
Total energy cost			383.8840 (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	3344.2603	0.2160	722.3602 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1906.0234	0.2160	411.7011 (264)
Space and water heating			1134.0613 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	389.0105	0.5190	201.8964 (268)
Total kg/year			1374.8827 (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	3344.2603	1.2200	4079.9976 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1906.0234	1.2200	2325.3485 (264)
Space and water heating			6405.3461 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	389.0105	3.0700	1194.2622 (268)
Primary energy kWh/year			7829.8583 (272)
Primary energy kWh/m2/year			85.4601 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 83
Current environmental impact rating: B 85

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 29	-187 kg (13.6%)
U Solar photovoltaic panels	+ 9.8	-£ 345	-947 kg (79.7%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£29	2.04 kg/m²	B 85 B 87
Solar photovoltaic panels	£345	10.33 kg/m²	A 94 A 96
Total Savings	£373	12.37 kg/m²	

Potential energy efficiency rating: A 94
 Potential environmental impact rating: A 96

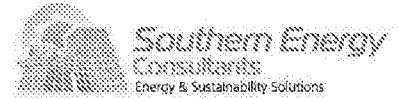
Fuel prices for cost data on this page from database revision number 470 TEST (21 Dec 2020)
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£88	£97	-£9
Mains gas	£296	£258	£38
Space heating	£237	£237	£0
Water heating	£74	£45	£29
Lighting	£74	£74	£0
Generated (PV)	-£0	-£345	£345
Total cost of fuels	£384	£10	£374
Total cost of uses	£385	£11	£374
Delivered energy	62 kWh/m²	32 kWh/m²	30 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.2 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	3 kg/m²	12 kg/m²
Primary energy	85 kWh/m²	13 kWh/m²	73 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	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.1804 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4304 (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) =		0.3658 (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	0.4664	0.4573	0.4481	0.4024	0.3932	0.3475	0.3475	0.3384	0.3658	0.3932	0.4115	0.4298 (22b)
Effective ac	0.6088	0.6045	0.6004	0.5810	0.5773	0.5604	0.5604	0.5572	0.5669	0.5773	0.5847	0.5924 (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)			16.5400	1.2357	20.4392		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			45.5700	0.2000	9.1140	75.0000	3417.7500 (28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.2500	28.6000	60.0000	6864.0000 (29a)
Main Plane	45.5700		45.5700	0.1100	5.0127	9.0000	410.1300 (30)
Bay Roof/GRP	0.5300		0.5300	0.3000	0.1590	9.0000	4.7700 (30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.7749		(33)
Internal Wall 1			52.0200			75.0000	3901.5000 (32c)
Internal Wall 2			162.4500			9.0000	1462.0500 (32c)
Internal Floor 1			45.5700			18.0000	820.2600 (32d)
Internal Ceiling 1			45.5700			18.0000	820.2600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17700.7200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1971 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6487 (36)
Total fabric heat loss						(33) + (36) =	79.4235 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	44.5528	44.2437	43.9407	42.5176	42.2513	41.0119	41.0119	40.7823	41.4893	42.2513	42.7900	43.3531 (38)
Heat transfer coeff	123.9763	123.6672	123.3642	121.9411	121.6749	120.4354	120.4354	120.2059	120.9128	121.6749	122.2135	122.7766 (39)
Average = Sum(39)m / 12 =												121.9399 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3532	1.3498	1.3465	1.3309	1.3280	1.3145	1.3145	1.3120	1.3197	1.3280	1.3339	1.3401 (40)
HLP (average)												1.3309 (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												2.6473 (42)
Average daily hot water use (litres/day)												97.0722 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)

Regs Region: England

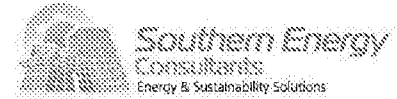
Elmhurst Energy Systems

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 = 1527.3239 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.7526	20.7742	21.4371	18.6894	17.9329	15.4747	14.3396	16.4549	16.6515	19.4057	21.1828	23.0031 (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	14.1366	12.7577	14.0962	13.5973	14.0184	13.5291	13.9570	13.9968	13.5663	14.0640	13.6517 (61)
Total heat required for water heating calculated for each month											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (62)
Aperture area of solar collector											
Zero-loss collector efficiency											3.0000 (H1)
Collector heat loss coefficient											0.7000 (H2)
Collector 2nd order heat loss coefficient											1.8000 (H3)
Collector effective heat loss coefficient											0.0050 (H3a)
Collector performance ratio											1.8063 (H3b)
Annual solar radiation per m2											2.5804 (H4)
Overshading factor											1079.5246 (H5)
Solar energy available											0.8000 (H6)
Adjustment factor for showers											1813.6014 (H7)
Solar-to-load ratio											1.0000 (H7a)
Utilisation factor											1.1874 (H8)
Collector performance factor											0.5692 (H9)
Dedicated solar storage volume											0.8793 (H10)
Effective solar volume											75.0000 (H11)
Daily hot water demand											75.0000 (H13)
Volume ratio Veff/V											97.0722 (H14)
Solar storage volume factor											0.7726 (H15)
Solar input											0.9484 (H16)
Solar input	-24.9641	-41.6579	-70.9482	-95.0845	-117.4689	-115.4907	-113.9644	-99.5713	-77.9843	-53.2541	-29.6110 (H17)
Output from w/h											-860.8902 (H17)
147.5233	109.5944	86.0621	43.1087	16.1022	1.2034	0.0000	24.1250	46.5916	90.1810	125.2594	146.5882 (64)
Heat gains from water heating, kWh/month											
56.1858	49.2389	51.0430	44.8275	43.2559	37.6846	35.2754	39.9743	40.3023	46.5319	50.3681	836.3393 (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	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.0685	48.9113	39.7774	30.1140	22.5106	19.0044	20.5349	26.6920	35.8260	45.4893	53.0928	56.5990	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	361.2339	364.9824	355.5364	335.4268	310.0422	286.1842	270.2456	266.4971	275.9432	296.0527	321.4373	345.2953	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	(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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	(71)
Water heating gains (Table 5)	75.5185	73.2721	68.6061	62.2604	58.1396	52.3398	47.4132	53.7289	55.9754	62.5429	69.9557	73.2815	(72)
Total internal gains	601.2967	596.6416	573.3956	537.2770	500.1682	467.0041	447.6695	456.3939	477.2204	513.5607	553.9616	584.6516	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	3.9300	10.6334	0.4400	0.0000	0.7700	14.1582 (74)
East	6.9700	19.6403	0.4400	0.0000	0.7700	46.3792 (76)
South	5.1600	46.7521	0.4400	0.0000	0.7700	81.7323 (78)
West	0.4800	19.6403	0.4400	0.0000	0.7700	3.1940 (80)

Solar gains	145.4637	257.8892	376.1911	499.4832	585.7541	591.9715	566.4554	501.2305	419.1396	291.6545	176.1586	123.1938 (83)
Total gains	746.7604	854.5309	949.5867	1036.7602	1085.9223	1058.9756	1014.1249	957.6244	896.3600	805.2152	730.1202	707.8454 (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	39.6597	39.7589	39.8565	40.3216	40.4099	40.8258	40.8258	40.9037	40.6646	40.4099	40.2318	40.0473
alpha	3.6440	3.6506	3.6571	3.6881	3.6940	3.7217	3.7217	3.7269	3.7110	3.6940	3.6821	3.6698
util living area	0.9843	0.9735	0.9511	0.9000	0.8029	0.6497	0.4992	0.5434	0.7586	0.9222	0.9741	0.9869 (86)
MIT	19.4035	19.6131	19.9397	20.3484	20.6878	20.9002	20.9714	20.9607	20.8142	20.3716	19.8144	19.3646 (87)
Th 2	19.7994	19.8020	19.8046	19.8167	19.8189	19.8295	19.8295	19.8314	19.8254	19.8189	19.8144	19.8096 (88)
util rest of house	0.9802	0.9666	0.9382	0.8725	0.7483	0.5566	0.3768	0.4199	0.6766	0.8949	0.9662	0.9835 (89)
MIT 2	17.7164	18.0201	18.4887	19.0662	19.5103	19.7582	19.8174	19.8131	19.6740	19.1128	18.3226	17.6668 (90)
Living area fraction	fLA = Living area / (4) =											0.1914 (91)
MIT	18.0394	18.3251	18.7665	19.3116	19.7357	19.9768	20.0383	20.0328	19.8923	19.3538	18.6082	17.9918 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.8894	18.1751	18.6165	19.1616	19.5857	19.8268	19.8883	19.8828	19.7423	19.2038	18.4582	17.8418 (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	0.9706	0.9536	0.9211	0.8538	0.7358	0.5564	0.3832	0.4257	0.6699	0.8764	0.9532	0.9751	(94)
Useful gains	724.8192	814.8404	874.6176	885.1594	799.0219	589.1967	388.6512	407.6452	600.4428	705.6798	695.9417	690.2030	(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	1684.7615	1641.6941	1494.7423	1251.3157	959.4924	629.4951	396.0308	418.6551	682.2264	1046.8612	1388.1206	1674.8967	(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	714.1971	555.6457	461.3728	263.6326	119.3901	0.0000	0.0000	0.0000	0.0000	253.8390	498.3688	732.6121	(98)
Space heating												3599.0581	(98)
Space heating per m2											(98) / (4) =	39.2825	(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													3976.8598	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	714.1971	555.6457	461.3728	263.6326	119.3901	0.0000	0.0000	0.0000	0.0000	253.8390	498.3688	732.6121	(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)	789.1681	613.9731	509.8042	291.3067	131.9227	0.0000	0.0000	0.0000	0.0000	280.4851	550.6837	809.5162	(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	147.5233	109.5944	86.0621	43.1087	16.1022	1.2034	0.0000	24.1250	46.5916	90.1810	125.2594	146.5882	(64)	
Efficiency of water heater	89.9356	89.9568	89.9815	90.0362	90.1075	87.3000	87.3000	87.3000	87.3000	89.6387	89.8386	87.3000	(216)	
(217)m	89.9356	89.9568	89.9815	90.0362	90.1075	87.3000	87.3000	87.3000	87.3000	89.6387	89.8386	89.9503	(217)	
Fuel for water heating, kWh/month	164.0321	121.8301	95.6442	47.8793	17.8700	1.3784	0.0000	27.6346	53.3696	100.6050	139.4272	162.9659	(219)	
Water heating fuel used												932.6363	(219)	
Annual totals kWh/year														
Space heating fuel - main system												3976.8598	(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)												389.0105	(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												3696.2672	(238)	

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3976.8598	3.4800	138.3947	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	932.6363	3.4800	32.4557	(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	389.0105	13.1900	51.3105	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			130.8256	(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] =	0.4022	(257)
SAP value		94.3895	
SAP rating (Section 12)		94	(258)
SAP band		A	

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	3976.8598	0.2160	859.0017	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	932.6363	0.2160	201.4494	(264)
Space and water heating			1060.4512	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	389.0105	0.5190	201.8964	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			430.7854	(272)
CO2 emissions per m2			4.7000	(273)
EI value			95.7748	
EI rating			96	(274)
EI band			A	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	45.5700 (1b)	x 2.3100 (2b)	= 105.2667 (1b) - (3b)
First floor	46.0500 (1c)	x 2.5300 (2c)	= 116.5065 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.6200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.7732 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					4 * 10 = 40.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.1804 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4304 (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) =		0.3658 (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	0.3841	0.3658	0.3658	0.3384	0.3384	0.3018	0.3109	0.2926	0.3018	0.3201	0.3201	0.3475 (22b)
Effective ac	0.5738	0.5669	0.5669	0.5572	0.5572	0.5455	0.5483	0.5428	0.5455	0.5512	0.5512	0.5604 (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)			16.5400	1.2357	20.4392		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			45.5700	0.2000	9.1140	75.0000	3417.7500 (28a)
Brick/Render Cavity	135.2400	20.8400	114.4000	0.2500	28.6000	60.0000	6864.0000 (29a)
Main Plane	45.5700		45.5700	0.1100	5.0127	9.0000	410.1300 (30)
Bay Roof/GRP	0.5300		0.5300	0.3000	0.1590	9.0000	4.7700 (30)
Total net area of external elements Aum(A, m ²)			226.9100				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.7749		(33)
Internal Wall 1			52.0200			75.0000	3901.5000 (32c)
Internal Wall 2			162.4500			9.0000	1462.0500 (32c)
Internal Floor 1			45.5700			18.0000	820.2600 (32d)
Internal Ceiling 1			45.5700			18.0000	820.2600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17700.7200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1971 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.6487 (36)
Total fabric heat loss						(33) + (36) =	79.4235 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	41.9912	41.4893	41.4893	40.7823	40.7823	39.9254	40.1304	39.7265	39.9254	40.3416	40.3416	41.0119 (38)
Heat transfer coeff	121.4147	120.9128	120.9128	120.2059	120.2059	119.3489	119.5540	119.1500	119.3489	119.7652	119.7652	120.4354 (39)
Average = Sum(39)m / 12 =												120.0850 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3252	1.3197	1.3197	1.3120	1.3120	1.3027	1.3049	1.3005	1.3027	1.3072	1.3072	1.3145 (40)
HLP (average)												1.3107 (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												2.6473 (42)
Average daily hot water use (litres/day)												97.0722 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	106.7794	102.8965	99.0137	95.1308	91.2479	87.3650	87.3650	91.2479	95.1308	99.0137	102.8965	106.7794 (44)
Energy conte	158.3508	138.4946	142.9141	124.5959	119.5528	103.1650	95.5975	109.6995	111.0097	129.3711	141.2187	153.3543 (45)

Regs Region: England

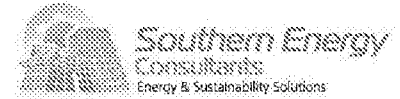
Elmhurst Energy Systems

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 = 1527.3239 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.7526	20.7742	21.4371	18.6894	17.9329	15.4747	14.3396	16.4549	16.6515	19.4057	21.1828	23.0031 (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	14.1366	12.7577	14.0962	13.5973	14.0184	13.5291	13.9570	13.9968	13.5663	14.0640	13.6517 (61)
Total heat required for water heating calculated for each month											
172.4874	151.2523	157.0102	138.1932	133.5711	116.6941	109.5545	123.6963	124.5759	143.4351	154.8704	167.4789 (62)
Aperture area of solar collector											
Zero-loss collector efficiency											
Collector heat loss coefficient											
Collector 2nd order heat loss coefficient											
Collector effective heat loss coefficient											
Collector performance ratio											
Annual solar radiation per m2											
Overshading factor											
Solar energy available											
Adjustment factor for showers											
Solar-to-load ratio											
Utilisation factor											
Collector performance factor											
Dedicated solar storage volume											
Effective solar volume											
Daily hot water demand											
Volume ratio Veff/V											
Solar storage volume factor											
Solar input											
Solar input	-27.0155	-40.6042	-68.3826	-94.5257	-113.8407	-119.8124	-116.9355	-104.4241	-81.5034	-55.4452	-32.8380 (63)
Solar input (sum of months) = Sum(63)m =											
Output from w/h											
145.4719	110.6481	88.6276	43.6675	19.7304	0.0000	0.0000	19.2722	43.0725	87.9898	122.0324	145.0964 (64)
Total per year (kWh/year) = Sum(64)m =											
Heat gains from water heating, kWh/month											
56.1858	49.2389	51.0430	44.8275	43.2559	37.6846	35.2754	39.9743	40.3023	46.5319	50.3681	54.5215 (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	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	158.8351	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.0685	48.9113	39.7774	30.1140	22.5106	19.0044	20.5349	26.6920	35.8260	45.4893	53.0928	56.5990	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	361.2339	364.9824	355.5364	335.4268	310.0422	286.1842	270.2456	266.4971	275.9432	296.0527	321.4373	345.2953	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	53.5308	(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)	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	-105.8900	(71)
Water heating gains (Table 5)	75.5185	73.2721	68.6061	62.2604	58.1396	52.3398	47.4132	53.7289	55.9754	62.5429	69.9557	73.2815	(72)
Total internal gains	601.2967	596.6416	573.3956	537.2770	500.1682	467.0041	447.6695	456.3939	477.2204	513.5607	553.9616	584.6516	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	3.9300	11.9814	0.4400	0.0000	0.7700	15.9531 (74)
East	6.9700	22.3313	0.4400	0.0000	0.7700	52.7340 (76)
South	5.1600	50.9848	0.4400	0.0000	0.7700	89.1321 (78)
West	0.4800	22.3313	0.4400	0.0000	0.7700	3.6316 (80)

Solar gains	161.4508	257.8650	372.5663	511.7584	586.4964	635.1253	600.8511	542.3625	450.6128	311.6373	200.3604	135.3821 (83)
Total gains	762.7475	854.5066	945.9619	1049.0354	1086.6646	1102.1295	1048.5206	998.7563	927.8332	825.1980	754.3220	720.0337 (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	40.4965	40.6646	40.6646	40.9037	40.9037	41.1974	41.1267	41.2662	41.1974	41.0542	41.0542	40.8258
alpha	3.6998	3.7110	3.7110	3.7269	3.7269	3.7465	3.7418	3.7511	3.7465	3.7369	3.7369	3.7217
util living area	0.9803	0.9692	0.9411	0.8716	0.7378	0.5151	0.3488	0.3753	0.6619	0.8914	0.9645	0.9835 (86)
MIT	19.5774	19.7551	20.0919	20.4935	20.8072	20.9649	20.9940	20.9922	20.9056	20.5289	19.9986	19.5452 (87)
Th 2	19.8211	19.8254	19.8254	19.8314	19.8314	19.8388	19.8370	19.8405	19.8388	19.8352	19.8352	19.8295 (88)
util rest of house	0.9750	0.9610	0.9250	0.8362	0.6671	0.4065	0.2203	0.2425	0.5586	0.8529	0.9534	0.9790 (89)
MIT 2	17.9826	18.2402	18.7189	19.2721	19.6615	19.8208	19.8359	19.8388	19.7763	19.3357	18.6003	17.9420 (90)
Living area fraction												
MIT	18.2879	18.5302	18.9818	19.5059	19.8808	20.0398	20.0576	20.0596	19.9925	19.5641	18.6680	18.2489 (92)
Temperature adjustment												
adjusted MIT	18.1379	18.3802	18.8318	19.3559	19.7308	19.8898	19.9076	19.9096	19.8425	19.4141	18.7180	18.0989 (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	0.9641	0.9472	0.9072	0.8189	0.6603	0.4115	0.2282	0.2506	0.5590	0.8355	0.9385	0.9692	(94)
Useful gains	735.3362	809.3489	858.1732	859.0115	717.5335	453.5382	239.2729	250.2981	518.6612	689.4245	707.9234	697.8683	(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	1582.9992	1545.2951	1382.2472	1136.6574	809.0809	464.2470	240.0172	251.3635	554.0734	935.8626	1283.6470	1565.5298	(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	630.6613	494.5559	389.9111	199.9050	68.1112	0.0000	0.0000	0.0000	0.0000	183.3499	414.5210	645.5401	(98)
Space heating												3026.5556	(98)
Space heating per m2												33.0338	(99)
												(98) / (4) =	

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													3344.2603 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	630.6613	494.5559	389.9111	199.9050	68.1112	0.0000	0.0000	0.0000	0.0000	183.3499	414.5210	645.5401	(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)	696.8633	546.4706	430.8410	220.8895	75.2610	0.0000	0.0000	0.0000	0.0000	202.5966	458.0343	713.3040	(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	145.4719	110.6481	88.6276	43.6675	19.7304	0.0000	0.0000	19.2722	43.0725	87.9898	122.0324	145.0964	(64)
Efficiency of water heater	89.8825	89.8975	89.8898	89.9092	89.7610	87.3000	87.3000	87.3000	87.3000	89.4369	89.7518	87.3000	(216)
(217)m	89.8825	89.8975	89.8898	89.9092	89.7610	87.3000	87.3000	87.3000	87.3000	89.4369	89.7518	89.8953	(217)
Fuel for water heating, kWh/month	161.8468	123.0825	98.5959	48.5685	21.9810	0.0000	0.0000	22.0758	49.3385	98.3820	135.9665	161.4061	(219)
Water heating fuel used												921.2436	(219)
Annual totals kWh/year													
Space heating fuel - main system												3344.2603	(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)												389.0105	(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												2955.3548	(238)

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

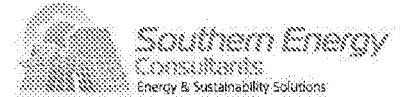
	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3344.2603	3.8700	129.4229	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	921.2436	3.8700	35.6521	(247)
Pumps and fans for heating	75.0000	18.9000	14.1750	(249)
Pump for solar water heating	50.0000	18.9000	9.4500	(249)
Energy for lighting	389.0105	18.9000	73.5230	(250)
Additional standing charges			93.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	18.9000	-344.7662	(252)
Total energy cost			10.4568	(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	3344.2603	0.2160	722.3602	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	921.2436	0.2160	198.9886	(264)
Space and water heating			921.3489	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	389.0105	0.5190	201.8964	(268)
Energy saving/generation technologies				

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

PV Unit	-1824.1596	0.5190	-946.7389 (269)
Total kg/year			241.3814 (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	3344.2603	1.2200	4079.9976 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	921.2436	1.2200	1123.9172 (264)
Space and water heating			5203.9148 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	389.0105	3.0700	1194.2622 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	3.0700	-5600.1701 (269)
Primary energy kWh/year			1181.7569 (272)
Primary energy kWh/m2/year			12.8985 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	193.2 (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	292.74 (P1)
Transmission heat loss coefficient	79.42 (37)
Summer heat loss coefficient	372.16 (P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	3.9300	81.1852	0.4400	0.0000	0.9000	126.3469
East	6.9700	117.5071	0.4400	0.0000	0.9000	324.3336
South	5.1600	112.2060	0.4400	0.0000	0.9000	229.2772
West	0.4800	117.5071	0.4400	0.0000	0.9000	22.3357

total:						702.2935
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	Jun	Jul	Aug	
Solar gains	742	702	634	(P4)
Internal gains	464	445	453	
Total summer gains	1206	1147	1087	(P5)
Summer gain/loss ratio	3.24	3.08	2.92	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 193.2)	0.65	0.65	0.65	
Threshold temperature	19.89	21.63	21.37	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			