

FULL SAP CALCULATION PRINTOUT

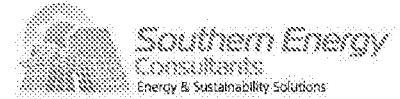
Calculation Type: New Build (As Designed)



Property Reference	SECANG006d			Issued on Date	04/02/2021
Assessment Reference	001	Prop Type Ref	Det Br Re Ea Ga		
Property	Derwent, Plot 80				
SAP Rating	83 B	DER	18.80	TET	19.05
Environmental	85 B	% DER<TER	1.30		
CO ₂ Emissions (t/year)	1.38	DEEE	54.34	TTEE	57.99
General Requirements Compliance	Pass	% DEEE<TTEE	6.30		
Assessor Details	Mr. Stuart Harvey, Stuart Harvey, [REDACTED]			Assessor ID	T555-0001
Client	Persimon Homes Thames Valley				

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

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DWELLING AS DESIGNED

Detached House, total floor area 89 m²

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

1a TER and DER

Fuel for main heating: Mains gas
Fuel factor: 1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 19.05 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 18.80 kgCO₂/m² OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 58.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE) 54.3 kWh/m²/yr OK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.30 (max. 0.35)	OK
Openings	1.35 (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:

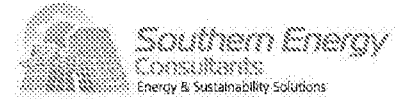
Overshading: Average
Windows facing North East: 7.72 m², No overhang
Windows facing South East: 0.60 m², No overhang
Windows facing South West: 5.22 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Thermal bridging y-value 0.039 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	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	45.1400 (1c)	x 2.5300 (2c)	= 114.2042 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	89.3600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 217.6790 (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) =	0.1838 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4338 (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) =		0.3687 (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	0.4701	0.4609	0.4516	0.4056	0.3963	0.3503	0.3503	0.3410	0.3687	0.3963	0.4148	0.4332 (22b)
Effective ac	0.6105	0.6062	0.6020	0.5822	0.5785	0.5613	0.5613	0.5582	0.5680	0.5785	0.5860	0.5938 (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)			13.5400	1.2357	16.7319		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			44.2200	0.2000	8.8440	75.0000	3316.5000 (28a)
Brick/Render Cavity	138.6600	17.8400	120.8200	0.2500	30.2050	60.0000	7249.2000 (29a)
Main Plane	44.2200		44.2200	0.1100	4.8642	9.0000	397.9800 (30)
Bay Roof/GRP	1.0000		1.0000	0.3000	0.3000	9.0000	9.0000 (30)
Total net area of external elements Aum(A, m ²)			228.1000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.3951		(33)
Internal Wall 1			51.8500			75.0000	3888.7500 (32c)
Internal Wall 2			163.4500			9.0000	1471.0500 (32c)
Internal Floor 1			44.2200			18.0000	795.9600 (32d)
Internal Ceiling 1			44.2200			18.0000	795.9600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17924.4000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							200.5864 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.8343 (36)
Total fabric heat loss						(33) + (36) =	76.2294 (37)

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

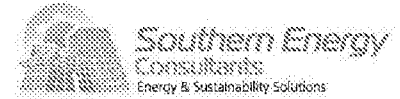
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	43.8539	43.5457	43.2436	41.8247	41.5592	40.3234	40.3234	40.0945	40.7994	41.5592	42.0963	42.6578 (38)
Heat transfer coeff	120.0833	119.7751	119.4730	118.0541	117.7886	116.5528	116.5528	116.3239	117.0288	117.7886	118.3257	118.8872 (39)
Average = Sum(39)m / 12 =												118.0528 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3438	1.3404	1.3370	1.3211	1.3181	1.3043	1.3043	1.3017	1.3096	1.3181	1.3241	1.3304 (40)
HLP (average)												1.3211 (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												2.6169 (42)
Average daily hot water use (litres/day)												96.3504 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	105.9854	102.1314	98.2774	94.4234	90.5694	86.7154	86.7154	90.5694	94.4234	98.2774	102.1314	105.9854 (44)
Energy conte	157.1733	137.4648	141.8514	123.6695	118.6638	102.3978	94.8866	108.8838	110.1842	128.4091	140.1686	152.2140 (45)

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1515.9669 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.5760	20.6197	21.2777	18.5504	17.7996	15.3597	14.2330	16.3326	16.5276	19.2614	21.0253	22.8321 (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	14.1338	12.7552	14.0911	13.5931	14.0145	13.5259	13.9540	13.9932	13.5625	14.0594	13.6492 (61)
Total heat required for water heating calculated for each month											
171.3071	150.2200	155.9425	137.2625	132.6783	115.9237	108.8407	122.8770	123.7467	142.4685	153.8178	166.3359 (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											
171.3071	150.2200	155.9425	137.2625	132.6783	115.9237	108.8407	122.8770	123.7467	142.4685	153.8178	166.3359 (64)
Heat gains from water heating, kWh/month											
55.7936	48.8958	50.6884	44.5184	42.9593	37.4288	35.0383	39.7022	40.0269	46.2109	50.0183	54.1416 (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	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.3723	19.8709	16.1601	12.2342	9.1452	7.7208	8.3426	10.8440	14.5548	18.4806	21.5696	22.9941	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	237.8954	240.3640	234.1432	220.8998	204.1824	188.4704	177.9738	175.5052	181.7260	194.9694	211.6868	227.3988	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	(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)	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	(71)
Water heating gains (Table 5)	74.9914	72.7617	68.1295	61.8311	57.7410	51.9844	47.0945	53.3631	55.5929	62.1114	69.4699	72.7710	(72)
Total internal gains	400.5119	398.2494	383.6856	360.2179	336.3215	313.4284	298.6638	304.9652	317.1266	340.8143	367.9792	388.4167	(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
Northeast													7.7200	11.2829	0.4400	0.0000	0.7700		29.5109 (75)
Southeast													0.6000	36.7938	0.4400	0.0000	0.7700		7.4795 (77)
Southwest													5.2200	36.7938	0.4400	0.0000	0.7700		65.0712 (79)
Solar gains	102.0616	183.6510	277.3161	387.2497	473.5860	487.6829	462.8867	395.7972	314.9641	209.9937	124.0314	86.1884	(83)						
Total gains	502.5735	581.9004	661.0017	747.4676	809.9075	801.1114	761.5504	700.7624	632.0907	550.8080	492.0106	474.6051	(84)						

7. Mean internal temperature (heating season)

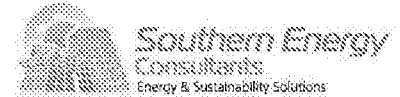
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	41.4629	41.5696	41.6747	42.1756	42.2706	42.7188	42.7188	42.8029	42.5451	42.2706	42.0788	41.8800
alpha	3.7642	3.7713	3.7783	3.8117	3.8180	3.8479	3.8479	3.8535	3.8363	3.8180	3.8053	3.7920
util living area	0.9959	0.9924	0.9836	0.9578	0.8927	0.7645	0.6171	0.6761	0.8777	0.9734	0.9929	0.9967 (86)
MIT	19.2008	19.3837	19.7043	20.1440	20.5523	20.8391	20.9483	20.9261	20.6957	20.1720	19.6120	19.1725 (87)
Th 2	19.8067	19.8093	19.8120	19.8243	19.8267	19.8375	19.8375	19.8395	19.8333	19.8267	19.8220	19.8171 (88)
util rest of house	0.9947	0.9901	0.9785	0.9433	0.8530	0.6750	0.4781	0.5407	0.8162	0.9617	0.9904	0.9958 (89)
MIT 2	17.4213	17.6897	18.1572	18.7959	19.3577	19.7144	19.8141	19.8020	19.5599	18.8459	18.0319	17.3867 (90)
Living area fraction	17.6941	17.9494	18.3944	19.0026	19.5408	19.8868	19.9880	19.9744	19.7340	19.0492	18.2742	17.6605 (91)
MIT	17.6941	17.9494	18.3944	19.0026	19.5408	19.8868	19.9880	19.9744	19.7340	19.0492	18.2742	17.6605 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.5441	17.7994	18.2444	18.8526	19.3908	19.7368	19.8380	19.8244	19.5840	18.8992	18.1242	17.5105 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation	0.9910	0.9842	0.9684	0.9268	0.8343	0.6659	0.4782	0.5387	0.7992	0.9479	0.9846	0.9927	(94)	
Useful gains	498.0570	572.6880	640.0830	692.7556	675.7298	533.4910	364.1856	377.4951	505.1828	522.0952	484.4418	471.1406	(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	1590.4010	1545.0240	1403.1390	1174.9395	905.8901	598.7092	377.4010	398.3342	641.7856	977.5570	1304.4443	1582.4420	(97)	
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)	
Space heating kWh	812.7039	653.4097	567.7136	347.1724	171.2393	0.0000	0.0000	0.0000	0.0000	338.8636	590.4018	826.8082	(98)	
Space heating												4308.3126	(98)	
Space heating per m2												(98) / (4) =	48.2130	(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													4760.5664	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	812.7039	653.4097	567.7136	347.1724	171.2393	0.0000	0.0000	0.0000	0.0000	338.8636	590.4018	826.8082	(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)	898.0154	721.9997	627.3079	383.6159	189.2147	0.0000	0.0000	0.0000	0.0000	374.4349	652.3777	913.6002	(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	171.3071	150.2200	155.9425	137.2625	132.6783	115.9237	108.8407	122.8770	123.7467	142.4685	153.8178	166.3359	(64)	
Efficiency of water heater (217)m	89.9262	89.8841	89.7907	89.5697	89.0746	87.3000	87.3000	87.3000	87.3000	89.5287	89.8195	89.9478	(217)	
Fuel for water heating, kWh/month	190.4975	167.1263	173.6732	153.2466	148.9519	132.7878	124.6743	140.7526	141.7488	159.1318	171.2520	184.9249	(219)	
Water heating fuel used												1888.7677	(219)	
Annual totals kWh/year														
Space heating fuel - main system													4760.5664	(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)													395.1014	(232)
Total delivered energy for all uses													7119.4355	(238)

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

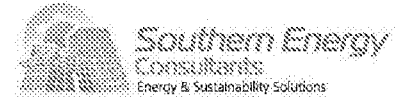
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4760.5664	0.2160	1028.2824 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1888.7677	0.2160	407.9738 (264)
Space and water heating			1436.2562 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	395.1014	0.5190	205.0576 (268)
Total CO2, kg/year			1680.2388 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			18.8000 (273)

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

DER		18.8000	ZC1
Total Floor Area	TFA	89.3600	
Assumed number of occupants	N	2.6169	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.7757	ZC2
CO2 emissions from cooking, equation (L16)		2.0345	ZC3
Total CO2 emissions		36.6102	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		36.6102	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	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	45.1400 (1c)	x 2.5300 (2c)	= 114.2042 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	89.3600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 217.6790 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1378 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3878 (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) =	0.3296 (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	0.4203	0.4121	0.4038	0.3626	0.3544	0.3132	0.3132	0.3049	0.3296	0.3544	0.3709	0.3873 (22b)
Effective ac	0.5883	0.5849	0.5815	0.5657	0.5628	0.5490	0.5490	0.5465	0.5543	0.5628	0.5688	0.5750 (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)			13.5400	1.3258	17.9508		(27)
Heat Loss Floor 1			44.2200	0.1300	5.7486		(28a)
Brick/Render Cavity	138.6600	17.8400	120.8200	0.1800	21.7476		(29a)
Main Plane	44.2200		44.2200	0.1300	5.7486		(30)
Bay Roof/GRP	1.0000		1.0000	0.1300	0.1300		(30)
Total net area of external elements Aum(A, m ²)			228.1000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		56.0556		(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)							11.0888 (36)
Total fabric heat loss						(33) + (36) =	67.1444 (37)

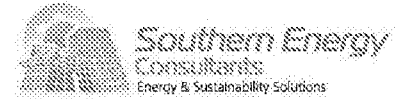
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	42.2618	42.0154	41.7739	40.6396	40.4274	39.4395	39.4395	39.2565	39.8200	40.4274	40.8567	41.3056 (38)
Heat transfer coeff	109.4061	109.1598	108.9183	107.7840	107.5717	106.5838	106.5838	106.4009	106.9643	107.5717	108.0011	108.4499 (39)
Average = Sum(39)m / 12 =												107.7830 (39)
HLP	1.2243	1.2216	1.2189	1.2062	1.2038	1.1927	1.1927	1.1907	1.1970	1.2038	1.2086	1.2136 (40)
HLP (average)												1.2062 (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												2.6169 (42)
Average daily hot water use (litres/day)												96.3504 (43)
Daily hot water use	105.9854	102.1314	98.2774	94.4234	90.5694	86.7154	86.7154	90.5694	94.4234	98.2774	102.1314	105.9854 (44)
Energy conte	157.1733	137.4648	141.8514	123.6695	118.6638	102.3978	94.8866	108.8838	110.1842	128.4091	140.1686	152.2140 (45)
Energy content (annual)										Total = Sum(45)m =		1515.9669 (45)
Distribution loss (46)m = 0.15 x (45)m												
23.5760	20.6197	21.2777	18.5504	17.7996	15.3597	14.2330	16.3326	16.5276	19.2614	21.0253	22.8321 (46)	
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
Combi 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 (57)
Total heat required for water heating calculated for each month	50.9589	46.0274	50.0811	46.5650	46.1532	42.7637	44.1892	46.1532	46.5650	50.0811	49.3151	50.9589 (61)
Solar input	208.1322	183.4922	191.9325	170.2344	164.8169	145.1616	139.0758	155.0370	156.7492	178.4902	189.4836	203.1729 (62)
Output from w/h	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)
Heat gains from water heating, kWh/month	208.1322	183.4922	191.9325	170.2344	164.8169	145.1616	139.0758	155.0370	156.7492	178.4902	189.4836	203.1729 (64)
	64.9999	57.2139	59.6859	52.7613	50.9940	44.7382	42.5971	47.7422	48.2775	55.2163	58.9348	63.3509 (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	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.3723	19.8709	16.1601	12.2342	9.1452	7.7208	8.3426	10.8440	14.5548	18.4806	21.5696	22.9941	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	237.8954	240.3640	234.1432	220.8998	204.1824	188.4704	177.9738	175.5052	181.7260	194.9694	211.6868	227.3988	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	(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)	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	(71)
Water heating gains (Table 5)	87.3654	85.1397	80.2229	73.2796	68.5403	62.1364	57.2542	64.1696	67.0521	74.2154	81.8539	85.1490	(72)
Total internal gains	412.8859	410.6274	395.7790	371.6665	347.1208	323.5805	308.8235	315.7716	328.5858	352.9184	380.3632	400.7948	(73)

6. Solar gains

[Jan]														
				Area m2	Solar flux Table 6a		g or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W	
					W/m2									
Northeast				7.7200	11.2829		0.6300		0.7000		0.7700		26.6202 (75)	
Southeast				0.6000	36.7938		0.6300		0.7000		0.7700		6.7468 (77)	
Southwest				5.2200	36.7938		0.6300		0.7000		0.7700		58.6972 (79)	
Solar gains	92.0642	165.6616	250.1517	349.3168	427.1961	439.9122	417.5448	357.0270	284.1120	189.4238	111.8819	77.7458	(83)	
Total gains	504.9501	576.2890	645.9308	720.9833	774.3169	763.4926	726.3683	672.7987	612.6977	542.3422	492.2452	478.5406	(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	56.7204	56.8484	56.9744	57.5740	57.6876	58.2223	58.2223	58.3224	58.0152	57.6876	57.4583	57.2205	
alpha	4.7814	4.7899	4.7983	4.8383	4.8458	4.8815	4.8815	4.8882	4.8677	4.8458	4.8306	4.8147	
util living area	0.9985	0.9968	0.9919	0.9738	0.9159	0.7801	0.6164	0.6780	0.8967	0.9843	0.9969	0.9988	(86)
MIT	19.6282	19.7726	20.0257	20.3736	20.6969	20.9097	20.9778	20.9653	20.8034	20.3913	19.9492	19.6037	(87)
Th 2	19.9006	19.9028	19.9049	19.9151	19.9170	19.9258	19.9258	19.9274	19.9224	19.9170	19.9131	19.9091	(88)
util rest of house	0.9979	0.9956	0.9888	0.9628	0.8788	0.6891	0.4804	0.5432	0.8363	0.9759	0.9956	0.9984	(89)
MIT 2	18.0737	18.2861	18.6562	19.1638	19.6069	19.8624	19.9173	19.9123	19.7539	19.1960	18.5519	18.0437	(90)
Living area fraction	18.3120	18.5140	18.8662	19.3492	19.7740	20.0230	20.0799	20.0738	19.9148	19.3792	18.7661	18.2829	(91)
MIT	18.3120	18.5140	18.8662	19.3492	19.7740	20.0230	20.0799	20.0738	19.9148	19.3792	18.7661	18.2829	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3120	18.5140	18.8662	19.3492	19.7740	20.0230	20.0799	20.0738	19.9148	19.3792	18.7661	18.2829	(93)

8. Space heating requirement

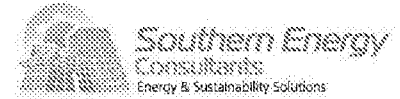
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	503.2736	572.4981	635.8998	688.6109	675.8335	533.1909	363.9457	378.8797	512.0611	525.9952	489.0305	477.3087	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1532.9984	1486.1043	1346.9051	1126.2603	868.5325	577.9990	370.9028	390.8922	621.9764	944.3987	1259.9535	1527.2870	(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	766.1152	613.9434	528.9879	315.1075	143.3681	0.0000	0.0000	0.0000	0.0000	311.2922	555.0645	781.1838	(98)
Space heating												4015.0627	(98)
Space heating per m ²												44.9313	(99)

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

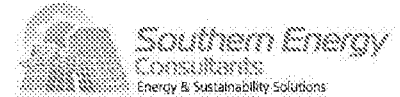
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												93.4000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												4298.7824 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	766.1152	613.9434	528.9879	315.1075	143.3681	0.0000	0.0000	0.0000	0.0000	311.2922	555.0645	781.1838 (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)	820.2519	657.3270	566.3683	337.3742	153.4990	0.0000	0.0000	0.0000	0.0000	333.2893	594.2875	836.3852 (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	208.1322	183.4922	191.9325	170.2344	164.8169	145.1616	139.0758	155.0370	156.7492	178.4902	189.4836	203.1729 (64)
Efficiency of water heater (217)m	88.0345	87.8572	87.4709	86.5803	84.7024	80.3000	80.3000	80.3000	80.3000	86.4379	87.5961	88.1125 (217)
Fuel for water heating, kWh/month	236.4213	208.8527	219.4243	196.6202	194.5836	180.7741	173.1953	193.0722	195.2045	206.4952	216.3153	230.5834 (219)
Water heating fuel used												2451.5419 (219)
Annual totals kWh/year												
Space heating fuel - main system												4298.7824 (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)												395.1014 (232)
Total delivered energy for all uses												7220.4257 (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	4298.7824	0.2160	928.5370 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2451.5419	0.2160	529.5331 (264)
Space and water heating			1458.0700 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	395.1014	0.5190	205.0576 (268)
Total CO2, kg/m2/year			1702.0527 (272)
Emissions per m2 for space and water heating			16.3168 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.2947 (272b)
Emissions per m2 for pumps and fans			0.4356 (272c)
Target Carbon Dioxide Emission Rate (TER) = (16.3168 * 1.00) + 2.2947 + 0.4356, rounded to 2 d.p.			19.0500 (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	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	45.1400 (1c)	x 2.5300 (2c)	= 114.2042 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	89.3600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 217.6790 (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) = 0.1378 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3878 (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) =				0.3296 (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	0.4203	0.4121	0.4038	0.3626	0.3544	0.3132	0.3132	0.3049	0.3296	0.3544	0.3709	0.3873 (22b)
Effective ac	0.5883	0.5849	0.5815	0.5657	0.5628	0.5490	0.5490	0.5465	0.5543	0.5628	0.5688	0.5750 (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)			13.5400	1.2357	16.7319		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			44.2200	0.2000	8.8440	75.0000	3316.5000 (28a)
Brick/Render Cavity	138.6600	17.8400	120.8200	0.2500	30.2050	60.0000	7249.2000 (29a)
Main Plane	44.2200		44.2200	0.1100	4.8642	9.0000	397.9800 (30)
Bay Roof/GRP	1.0000		1.0000	0.3000	0.3000	9.0000	9.0000 (30)
Total net area of external elements Aum(A, m ²)			228.1000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.3951		(33)
Internal Wall 1			51.8500			75.0000	3888.7500 (32c)
Internal Wall 2			163.4500			9.0000	1471.0500 (32c)
Internal Floor 1			44.2200			18.0000	795.9600 (32d)
Internal Ceiling 1			44.2200			9.0000	397.9800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17526.4200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							196.1327 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.8343 (36)
Total fabric heat loss						(33) + (36) =	76.2294 (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	42.2618	42.0154	41.7739	40.6396	40.4274	39.4395	39.4395	39.2565	39.8200	40.4274	40.8567	41.3056 (38)
Heat transfer coeff	118.4912	118.2448	118.0033	116.8690	116.6568	115.6688	115.6688	115.4859	116.0494	116.6568	117.0861	117.5349 (39)
Average = Sum(39)m / 12 =												116.8680 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3260	1.3232	1.3205	1.3078	1.3055	1.2944	1.2944	1.2924	1.2987	1.3055	1.3103	1.3153 (40)
HLP (average)												1.3078 (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												2.6169 (42)
Average daily hot water use (litres/day)												96.3504 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	105.9854	102.1314	98.2774	94.4234	90.5694	86.7154	86.7154	90.5694	94.4234	98.2774	102.1314	105.9854 (44)
Energy conte	157.1733	137.4648	141.8514	123.6695	118.6638	102.3978	94.8866	108.8838	110.1842	128.4091	140.1686	152.2140 (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 = 1515.9669 (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	33.3993	29.2113	30.1434	26.2798	25.2161	21.7595	20.1634	23.1378	23.4141	27.2869	29.7858	32.3455 (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	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.3723	19.8709	16.1601	12.2342	9.1452	7.7208	8.3426	10.8440	14.5548	18.4806	21.5696	22.9941	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	237.8954	240.3640	234.1432	220.8998	204.1824	188.4704	177.9738	175.5052	181.7260	194.9694	211.6868	227.3988	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	(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)	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	(71)
Water heating gains (Table 5)	44.8916	43.4692	40.5153	36.4997	33.8925	30.2216	27.1014	31.0992	32.5196	36.6760	41.3692	43.4751	(72)
Total internal gains	367.4121	365.9569	353.0714	331.8865	309.4730	288.6656	275.6706	279.7013	291.0533	312.3789	336.8785	356.1208	(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
Northeast			7.7200		11.2829		0.4400		0.0000		0.7700		29.5109 (75)
Southeast			0.6000		36.7938		0.4400		0.0000		0.7700		7.4795 (77)
Southwest			5.2200		36.7938		0.4400		0.0000		0.7700		65.0712 (79)
Solar gains	102.0616	183.6510	277.3161	387.2497	473.5860	487.6829	462.8867	395.7972	314.9641	209.9937	124.0314	86.1884	(83)
Total gains	469.4737	549.6079	630.3876	719.1362	783.0590	776.3486	738.5573	675.4985	606.0175	522.3726	460.9099	442.3092	(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	41.0870	41.1726	41.2569	41.6573	41.7331	42.0896	42.0896	42.1562	41.9515	41.7331	41.5801	41.4213	
alpha	3.7391	3.7448	3.7505	3.7772	3.7822	3.8060	3.8060	3.8104	3.7968	3.7822	3.7720	3.7614	
util living area	0.9965	0.9932	0.9849	0.9602	0.8973	0.7727	0.6268	0.6883	0.8855	0.9761	0.9938	0.9972	(86)
MIT	19.1572	19.3429	19.6689	20.1141	20.5318	20.8276	20.9435	20.9186	20.6760	20.1384	19.5690	19.1254	(87)
Th 2	19.8205	19.8227	19.8248	19.8347	19.8366	19.8452	19.8452	19.8468	19.8419	19.8366	19.8328	19.8289	(88)
util rest of house	0.9955	0.9912	0.9803	0.9467	0.8595	0.6852	0.4885	0.5543	0.8273	0.9656	0.9917	0.9964	(89)
MIT 2	18.1476	18.3342	18.6594	19.1037	19.4982	19.7535	19.8273	19.8178	19.6395	19.1345	18.5678	18.1221	(90)
Living area fraction	18.3023	18.4888	18.8142	19.2586	19.6567	19.9181	19.9984	19.9865	19.7984	19.2884	18.7213	18.2760	(91)
MIT	18.3023	18.4888	18.8142	19.2586	19.6567	19.9181	19.9984	19.9865	19.7984	19.2884	18.7213	18.2760	(92)
Temperature adjustment	18.3023	18.4888	18.8142	19.2586	19.6567	19.9181	19.9984	19.9865	19.7984	19.2884	18.7213	18.2760	(93)
adjusted MIT	18.3023	18.4888	18.8142	19.2586	19.6567	19.9181	19.9984	19.9865	19.7984	19.2884	18.7213	18.2760	(93)

8. Space heating requirement

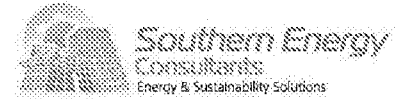
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	466.4664	543.0590	614.5167	674.6097	667.4122	536.9071	375.5674	386.7331	499.7168	500.8334	455.7446	440.0370	(94)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1659.1535	1606.8079	1453.1137	1210.5952	928.2028	615.1443	393.0889	414.1939	661.2969	1013.5651	1360.6921	1654.4162	(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	887.3592	714.8392	623.9161	385.9096	194.0282	0.0000	0.0000	0.0000	0.0000	381.4724	651.5622	903.4981	(98)
Space heating												4742.5850	(98)
Space heating per m2												53.0728	(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	1087.2872	855.9495	877.6928	0.0000	0.0000	0.0000	0.0000	(100)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

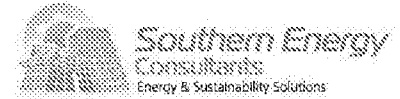


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7603	0.8348	0.7969	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	826.6761	714.5864	699.4395	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1006.4968	960.2819	888.4325	0.0000	0.0000	0.0000	0.0000 (103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	129.4709	182.7975	140.6108	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												452.8792 (104)
Cooled fraction									FC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)												
Intermittency factor	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	32.3677	45.6994	35.1527	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												113.2198 (107)
Space cooling per m2												1.2670 (108)
Energy for space heating												53.0728 (99)
Energy for space cooling												1.2670 (108)
Total												54.3398 (109)
Dwelling Fabric Energy Efficiency (DFEE)												54.3 (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	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	45.1400 (1c)	x 2.5300 (2c)	= 114.2042 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	89.3600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 217.6790 (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) = 0.1378 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3878 (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) =	0.3296 (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	0.4203	0.4121	0.4038	0.3626	0.3544	0.3132	0.3132	0.3049	0.3296	0.3544	0.3709	0.3873 (22b)
Effective ac	0.5883	0.5849	0.5815	0.5657	0.5628	0.5490	0.5490	0.5465	0.5543	0.5628	0.5688	0.5750 (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)			13.5400	1.3258	17.9508		(27)
Heat Loss Floor 1			44.2200	0.1300	5.7486		(28a)
Brick/Render Cavity	138.6600	17.8400	120.8200	0.1800	21.7476		(29a)
Main Plane	44.2200		44.2200	0.1300	5.7486		(30)
Bay Roof/GRP	1.0000		1.0000	0.1300	0.1300		(30)
Total net area of external elements Aum(A, m ²)			228.1000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	56.0556		(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)							11.0888 (36)
Total fabric heat loss						(33) + (36) =	67.1444 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	42.2618	42.0154	41.7739	40.6396	40.4274	39.4395	39.4395	39.2565	39.8200	40.4274	40.8567	41.3056 (38)
Heat transfer coeff	109.4061	109.1598	108.9183	107.7840	107.5717	106.5838	106.5838	106.4009	106.9643	107.5717	108.0011	108.4499 (39)
Average = Sum(39)m / 12 =												107.7830 (39)
HLP	1.2243	1.2216	1.2189	1.2062	1.2038	1.1927	1.1927	1.1907	1.1970	1.2038	1.2086	1.2136 (40)
HLP (average)												1.2062 (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												2.6169 (42)
Average daily hot water use (litres/day)												96.3504 (43)
Daily hot water use	105.9854	102.1314	98.2774	94.4234	90.5694	86.7154	86.7154	90.5694	94.4234	98.2774	102.1314	105.9854 (44)
Energy conte	157.1733	137.4648	141.8514	123.6695	118.6638	102.3978	94.8866	108.8838	110.1842	128.4091	140.1686	152.2140 (45)
Energy content (annual)										Total = Sum(45)m =		1515.9669 (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	33.3993	29.2113	30.1434	26.2798	25.2161	21.7595	20.1634	23.1378	23.4141	27.2869	29.7858	32.3455 (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	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	130.8429	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.3723	19.8709	16.1601	12.2342	9.1452	7.7208	8.3426	10.8440	14.5548	18.4806	21.5696	22.9941	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	237.8954	240.3640	234.1432	220.8998	204.1824	188.4704	177.9738	175.5052	181.7260	194.9694	211.6868	227.3988	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	36.0843	(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)	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	(71)
Water heating gains (Table 5)	44.8916	43.4692	40.5153	36.4997	33.8925	30.2216	27.1014	31.0992	32.5196	36.6760	41.3692	43.4751	(72)
Total internal gains	367.4121	365.9569	353.0714	331.8865	309.4730	288.6656	275.6706	279.7013	291.0533	312.3789	336.8785	356.1208	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	7.7200	11.2829	0.6300	0.7000	0.7700	26.6202 (75)
Southeast	0.6000	36.7938	0.6300	0.7000	0.7700	6.7468 (77)
Southwest	5.2200	36.7938	0.6300	0.7000	0.7700	58.6972 (79)

Solar gains	92.0642	165.6616	250.1517	349.3168	427.1961	439.9122	417.5448	357.0270	284.1120	189.4238	111.8819	77.7458	(83)
Total gains	459.4763	531.6184	603.2232	681.2034	736.6691	728.5778	693.2154	636.7283	575.1653	501.8028	448.7604	433.8667	(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	56.7204	56.8484	56.9744	57.5740	57.6876	58.2223	58.2223	58.3224	58.0152	57.6876	57.4583	57.2205	
alpha	4.7814	4.7899	4.7983	4.8383	4.8458	4.8815	4.8815	4.8882	4.8677	4.8458	4.8306	4.8147	
util living area	0.9990	0.9977	0.9939	0.9789	0.9282	0.8015	0.6404	0.7063	0.9147	0.9886	0.9979	0.9992	(86)
MIT	19.5814	19.7270	19.9830	20.3369	20.6704	20.8976	20.9739	20.9585	20.7791	20.3519	19.9046	19.5575	(87)
Th 2	19.9006	19.9028	19.9049	19.9151	19.9170	19.9258	19.9258	19.9274	19.9224	19.9170	19.9131	19.9091	(88)
util rest of house	0.9986	0.9969	0.9915	0.9698	0.8949	0.7130	0.5017	0.5703	0.8608	0.9822	0.9971	0.9990	(89)
MIT 2	18.6065	18.7536	19.0103	19.3672	19.6831	19.8756	19.9188	19.9147	19.7893	19.3868	18.9394	18.5894	(90)
Living area fraction									fLA = Living area / (4) =			0.1533	(91)
MIT	18.7560	18.9028	19.1594	19.5159	19.8345	20.0323	20.0806	20.0748	19.9411	19.5348	19.0874	18.7378	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7560	18.9028	19.1594	19.5159	19.8345	20.0323	20.0806	20.0748	19.9411	19.5348	19.0874	18.7378	(93)

8. Space heating requirement

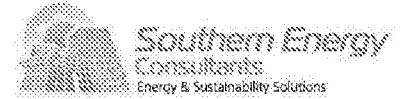
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9981	0.9958	0.9893	0.9654	0.8918	0.7230	0.5231	0.5909	0.8620	0.9790	0.9961	0.9985	(94)
Ext temp.	458.5916	529.4108	596.7448	657.6432	656.9313	526.7546	362.6118	376.2493	495.7838	491.2838	447.0011	433.2360	(95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Month fracti	1581.5728	1528.5420	1378.8401	1144.2226	875.0404	578.9912	370.9744	390.9991	624.7882	961.1300	1294.6484	1576.6267	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating	835.4980	671.4162	581.8789	350.3372	162.2731	0.0000	0.0000	0.0000	0.0000	349.5656	610.3060	850.6827	(98)
Space heating per m ²												4411.9577	(98)
											(98) / (4) =	49.3728	(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	1001.8878	788.7202	808.6465	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8075	0.8825	0.8470	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	809.0057	696.0084	684.9353	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	950.6609	907.2849	843.1168	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

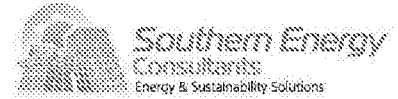


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	101.9917	157.1897	117.6870	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												376.8684 (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	25.4979	39.2974	29.4218	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												94.2171 (107)
Space cooling per m2												1.0544 (108)
Energy for space heating												49.3728 (99)
Energy for space cooling												1.0544 (108)
Total												50.4272 (109)
Target Fabric Energy Efficiency (TFEE)												58.0 (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	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	45.1400 (1c)	x 2.5300 (2c)	= 114.2042 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	89.3600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 217.6790 (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) = 0.1838 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4338 (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)	=	0.3687 (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	0.3871	0.3687	0.3687	0.3410	0.3410	0.3042	0.3134	0.2950	0.3042	0.3226	0.3226	0.3503 (22b)
Effective ac	0.5749	0.5680	0.5680	0.5582	0.5582	0.5463	0.5491	0.5435	0.5463	0.5520	0.5520	0.5613 (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)			13.5400	1.2357	16.7319		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			44.2200	0.2000	8.8440	75.0000	3316.5000 (28a)
Brick/Render Cavity	138.6600	17.8400	120.8200	0.2500	30.2050	60.0000	7249.2000 (29a)
Main Plane	44.2200		44.2200	0.1100	4.8642	9.0000	397.9800 (30)
Bay Roof/GRP	1.0000		1.0000	0.3000	0.3000	9.0000	9.0000 (30)
Total net area of external elements Aum(A, m ²)			228.1000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.3951		(33)
Internal Wall 1			51.8500			75.0000	3888.7500 (32c)
Internal Wall 2			163.4500			9.0000	1471.0500 (32c)
Internal Floor 1			44.2200			18.0000	795.9600 (32d)
Internal Ceiling 1			44.2200			18.0000	795.9600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17924.4000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							200.5864 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.8343 (36)
Total fabric heat loss						(33) + (36) =	76.2294 (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	41.2999	40.7994	40.7994	40.0945	40.0945	39.2401	39.4445	39.0418	39.2401	39.6551	39.6551	40.3234 (38)
Heat transfer coeff	117.5293	117.0288	117.0288	116.3239	116.3239	115.4695	115.6739	115.2712	115.4695	115.8845	115.8845	116.5528 (39)
Average = Sum(39)m / 12 =												116.2034 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3152	1.3096	1.3096	1.3017	1.3017	1.2922	1.2945	1.2900	1.2922	1.2968	1.2968	1.3043 (40)
HLP (average)												1.3004 (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												2.6169 (42)
Average daily hot water use (litres/day)												96.3504 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	105.9854	102.1314	98.2774	94.4234	90.5694	86.7154	86.7154	90.5694	94.4234	98.2774	102.1314	105.9854 (44)
Energy conte	157.1733	137.4648	141.8514	123.6695	118.6638	102.3978	94.8866	108.8838	110.1842	128.4091	140.1686	152.2140 (45)

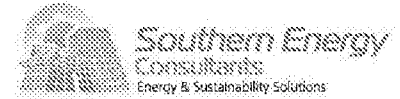
Regs Region: England

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 = 1515.9669 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.5760	20.6197	21.2777	18.5504	17.7996	15.3597	14.2330	16.3326	16.5276	19.2614	21.0253	22.8321 (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	14.1338	12.7552	14.0911	13.5931	14.0145	13.5259	13.9540	13.9932	13.5625	14.0594	13.6492 (61)
Total heat required for water heating calculated for each month											
171.3071	150.2200	155.9425	137.2625	132.6783	115.9237	108.8407	122.8770	123.7467	142.4685	153.8178	166.3359 (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											
171.3071	150.2200	155.9425	137.2625	132.6783	115.9237	108.8407	122.8770	123.7467	142.4685	153.8178	166.3359 (64)
RHI water heating demand											
Heat gains from water heating, kWh/month											
55.7936	48.8958	50.6884	44.5184	42.9593	37.4288	35.0383	39.7022	40.0269	46.2109	50.0183	54.1416 (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	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.9307	49.6771	40.4002	30.5855	22.8630	19.3019	20.8564	27.1100	36.3869	46.2016	53.9241	57.4852 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	355.0677	358.7522	349.4674	329.7012	304.7498	281.2991	265.6326	261.9481	271.2329	290.9991	315.9504	339.4012 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180 (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)	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743 (71)
Water heating gains (Table 5)	74.9914	72.7617	68.1295	61.8311	57.7410	51.9844	47.0945	53.3631	55.5929	62.1114	69.4699	72.7710 (72)
Total internal gains	594.6450	589.8462	566.6523	530.7729	494.0091	461.2406	442.2387	451.0764	471.8679	507.9673	547.9996	578.3125 (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			
Northeast				7.7200	12.9236	0.4400	0.0000	0.7700	33.8020 (75)			
Southeast				0.6000	40.4699	0.4400	0.0000	0.7700	8.2267 (77)			
Southwest				5.2200	40.4699	0.4400	0.0000	0.7700	71.5725 (79)			
Solar gains	113.6013	184.5195	276.7093	400.3237	478.2170	527.3306	494.9982	432.1041	341.4444	225.7031	141.5508	94.9364 (83)
Total gains	708.2462	774.3657	843.3616	931.0966	972.2261	988.5712	937.2369	883.1805	813.3123	733.6704	689.5504	673.2489 (84)

7. Mean internal temperature (heating season)

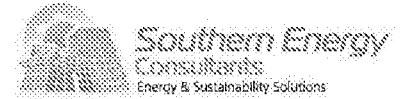
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.3639	42.5451	42.5451	42.8029	42.8029	43.1196	43.0434	43.1938	43.1196	42.9652	42.9652	42.7188
alpha	3.8243	3.8363	3.8363	3.8535	3.8535	3.8746	3.8696	3.8796	3.8746	3.8643	3.8643	3.8479
util living area	0.9847	0.9773	0.9569	0.9005	0.7762	0.5514	0.3768	0.4093	0.7115	0.9170	0.9729	0.9870 (86)
MIT	19.5912	19.7411	20.0552	20.4540	20.7878	20.9610	20.9934	20.9911	20.8900	20.4971	19.9911	19.5670 (87)
Th 2	19.8289	19.8333	19.8333	19.8395	19.8395	19.8470	19.8452	19.8487	19.8470	19.8433	19.8433	19.8375 (88)
util rest of house	0.9804	0.9710	0.9441	0.8700	0.7080	0.4380	0.2393	0.2662	0.6081	0.8843	0.9639	0.9833 (89)
MIT 2	18.0026	18.2216	18.6714	19.2281	19.6499	19.8270	19.8440	19.8469	19.7727	19.3013	18.5917	17.9735 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.2462	18.4546	18.8836	19.4160	19.8244	20.0009	20.0202	20.0223	19.9440	19.4847	18.8063	18.2178 (92)
Temperature adjustment												
adjusted MIT	18.0962	18.3046	18.7336	19.2660	19.6744	19.8509	19.8702	19.8723	19.7940	19.3347	18.6563	18.0678 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9709	0.9590	0.9278	0.8512	0.6968	0.4384	0.2424	0.2692	0.6028	0.8655	0.9506	0.9748 (94)
Useful gains	687.6428	742.6335	782.4851	792.5960	677.4527	433.3622	227.1733	237.7817	490.2323	635.0122	655.5116	656.2907 (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	1527.4330	1486.8046	1326.3537	1089.4918	776.3901	444.6618	227.8992	238.8752	530.4643	896.3279	1234.8959	1511.4379 (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	624.8039	500.0830	404.6383	213.7650	73.6094	0.0000	0.0000	0.0000	0.0000	194.4188	417.1567	636.2295 (98)
Space heating												3064.7046 (98)
RHI space heating demand												3065 (98)

FULL SAP CALCULATION PRINTOUT

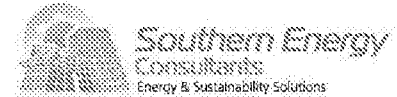
Calculation Type: New Build (As Designed)



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	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	45.1400 (1c)	x 2.5300 (2c)	= 114.2042 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	89.3600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 217.6790 (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) = 0.1838 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4338 (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)	=	0.3687 (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	0.4701	0.4609	0.4516	0.4056	0.3963	0.3503	0.3503	0.3410	0.3687	0.3963	0.4148	0.4332 (22b)
Effective ac	0.6105	0.6062	0.6020	0.5822	0.5785	0.5613	0.5613	0.5582	0.5680	0.5785	0.5860	0.5938 (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)			13.5400	1.2357	16.7319		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			44.2200	0.2000	8.8440	75.0000	3316.5000 (28a)
Brick/Render Cavity	138.6600	17.8400	120.8200	0.2500	30.2050	60.0000	7249.2000 (29a)
Main Plane	44.2200		44.2200	0.1100	4.8642	9.0000	397.9800 (30)
Bay Roof/GRP	1.0000		1.0000	0.3000	0.3000	9.0000	9.0000 (30)
Total net area of external elements Aum(A, m ²)			228.1000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.3951		(33)
Internal Wall 1			51.8500			75.0000	3888.7500 (32c)
Internal Wall 2			163.4500			9.0000	1471.0500 (32c)
Internal Floor 1			44.2200			18.0000	795.9600 (32d)
Internal Ceiling 1			44.2200			18.0000	795.9600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17924.4000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							200.5864 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.8343 (36)
Total fabric heat loss						(33) + (36) =	76.2294 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	43.8539	43.5457	43.2436	41.8247	41.5592	40.3234	40.3234	40.0945	40.7994	41.5592	42.0963	42.6578 (38)
Heat transfer coeff	120.0833	119.7751	119.4730	118.0541	117.7886	116.5528	116.5528	116.3239	117.0288	117.7886	118.3257	118.8872 (39)
Average = Sum(39)m / 12 =												118.0528 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3438	1.3404	1.3370	1.3211	1.3181	1.3043	1.3043	1.3017	1.3096	1.3181	1.3241	1.3304 (40)
HLP (average)												1.3211 (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												2.6169 (42)
Average daily hot water use (litres/day)												96.3504 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	105.9854	102.1314	98.2774	94.4234	90.5694	86.7154	86.7154	90.5694	94.4234	98.2774	102.1314	105.9854 (44)
Energy conte	157.1733	137.4648	141.8514	123.6695	118.6638	102.3978	94.8866	108.8838	110.1842	128.4091	140.1686	152.2140 (45)

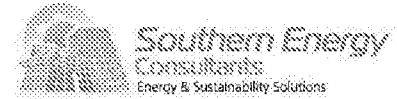
Regs Region: England

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 =	1515.9669 (45)
Distribution loss (46)m = 0.15 x (45)m													
23.5760	20.6197	21.2777	18.5504	17.7996	15.3597	14.2330	16.3326	16.5276	19.2614	21.0253	22.8321 (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	14.1338	12.7552	14.0911	13.5931	14.0145	13.5259	13.9540	13.9932	13.5625	14.0594	13.6492	14.1219 (61)	
Total heat required for water heating calculated for each month													
171.3071	150.2200	155.9425	137.2625	132.6783	115.9237	108.8407	122.8770	123.7467	142.4685	153.8178	166.3359 (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													
171.3071	150.2200	155.9425	137.2625	132.6783	115.9237	108.8407	122.8770	123.7467	142.4685	153.8178	166.3359 (64)		
												Total per year (kWh/year) = Sum(64)m =	1681.4207 (64)
Heat gains from water heating, kWh/month													
55.7936	48.8958	50.6884	44.5184	42.9593	37.4288	35.0383	39.7022	40.0269	46.2109	50.0183	54.1416 (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	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.9307	49.6771	40.4002	30.5855	22.8630	19.3019	20.8564	27.1100	36.3869	46.2016	53.9241	57.4852	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	355.0677	358.7522	349.4674	329.7012	304.7498	281.2991	265.6326	261.9481	271.2329	290.9991	315.9504	339.4012	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	(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)	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	(71)
Water heating gains (Table 5)	74.9914	72.7617	68.1295	61.8311	57.7410	51.9844	47.0945	53.3631	55.5929	62.1114	69.4699	72.7710	(72)
Total internal gains	594.6450	589.8462	566.6523	530.7729	494.0091	461.2406	442.2387	451.0764	471.8679	507.9673	547.9996	578.3125	(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
Northeast					7.7200	11.2829	0.4400	0.0000			0.7700	29.5109 (75)
Southeast					0.6000	36.7938	0.4400	0.0000			0.7700	7.4795 (77)
Southwest					5.2200	36.7938	0.4400	0.0000			0.7700	65.0712 (79)
Solar gains	102.0616	183.6510	277.3161	387.2497	473.5860	487.6829	462.8867	395.7972	314.9641	209.9937	124.0314	86.1884 (83)
Total gains	696.7066	773.4972	843.9684	918.0226	967.5951	948.9235	905.1254	846.8736	786.8320	717.9610	672.0310	664.5009 (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	41.4629	41.5696	41.6747	42.1756	42.2706	42.7188	42.7188	42.8029	42.5451	42.2706	42.0788	41.8800	
alpha	3.7642	3.7713	3.7783	3.8117	3.8180	3.8479	3.8479	3.8535	3.8363	3.8180	3.8053	3.7920	
util living area	0.9877	0.9806	0.9650	0.9248	0.8385	0.6894	0.5371	0.5874	0.8034	0.9417	0.9801	0.9897	(86)
MIT	19.4251	19.6003	19.9010	20.3039	20.6585	20.8894	20.9678	20.9546	20.7888	20.3403	19.8162	19.3938	(87)
Th 2	19.8067	19.8093	19.8120	19.8243	19.8267	19.8375	19.8375	19.8395	19.8333	19.8267	19.8220	19.8171	(88)
util rest of house	0.9844	0.9754	0.9550	0.9020	0.7882	0.5957	0.4084	0.4582	0.7259	0.9194	0.9737	0.9869	(89)
MIT 2	17.7469	18.0021	18.4364	19.0122	19.4840	19.7577	19.8239	19.8182	19.6572	19.0754	18.3257	17.7083	(90)
Living area fraction	18.0042	18.2471	18.6609	19.2103	19.6641	19.9312	19.9992	19.9924	19.8307	19.2693	18.5542	17.9667	(92)
MIT	17.8542	18.0971	18.5109	19.0603	19.5141	19.7812	19.8492	19.8424	19.6807	19.1193	18.4042	17.8167	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation	0.9761	0.9643	0.9398	0.8830	0.7722	0.5906	0.4098	0.4586	0.7138	0.9010	0.9624	0.9796	(94)	
Useful gains	680.0735	745.9159	793.1622	810.6336	747.1678	560.4467	370.8880	388.3398	561.6253	646.9110	646.7417	650.9266	(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	1627.6319	1580.6883	1434.9807	1199.4617	920.4133	603.8783	378.7091	400.4341	653.1060	1003.4780	1337.5827	1618.8526	(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	704.9834	560.9671	477.5130	279.9562	128.8947	0.0000	0.0000	0.0000	0.0000	265.2859	497.4056	720.1369	(98)	
Space heating												3635.1427	(98)	
Space heating per m2												(98) / (4) =	40.6798	(99)

Regs Region: England

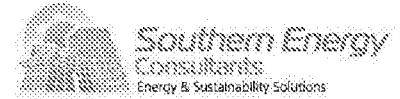
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Calculation Type: New Build (As Designed)



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													4016.7322	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	704.9834	560.9671	477.5130	279.9562	128.8947	0.0000	0.0000	0.0000	0.0000	265.2859	497.4056	720.1369	(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)	778.9872	619.8531	527.6386	309.3439	142.4250	0.0000	0.0000	0.0000	0.0000	293.1336	549.6194	795.7314	(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	171.3071	150.2200	155.9425	137.2625	132.6783	115.9237	108.8407	122.8770	123.7467	142.4685	153.8178	166.3359	(64)	
Efficiency of water heater (217)m	89.8561	89.8047	89.6907	89.4216	88.8481	87.3000	87.3000	87.3000	87.3000	89.3556	89.7232	89.8818	(217)	
Fuel for water heating, kWh/month	190.6460	167.2741	173.8671	153.5003	149.3316	132.7878	124.6743	140.7526	141.7488	159.4399	171.4359	185.0607	(219)	
Water heating fuel used												1890.5193	(219)	
Annual totals kWh/year														
Space heating fuel - main system													4016.7322	(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)													395.1014	(232)
Total delivered energy for all uses													6377.3529	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4016.7322	3.4800	139.7823 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1890.5193	3.4800	65.7901 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	395.1014	13.1900	52.1139 (250)
Additional standing charges			120.0000 (251)
Total energy cost			387.5787 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.2115 (257)
SAP value		83.0990
SAP rating (Section 12)		B (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4016.7322	0.2160	867.6142 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1890.5193	0.2160	408.3522 (264)
Space and water heating			1275.9663 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	395.1014	0.5190	205.0576 (268)
Total kg/year			1519.9489 (272)
CO2 emissions per m2			17.0100 (273)
EI value			84.8412
EI rating			B (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$, stars = 4
Water heating energy efficiency	$3.48 / 0.8882 = 3.918$, stars = 4
Water heating environmental impact	$0.216 / 0.8882 = 0.2432$, stars = 4

Regs Region: England

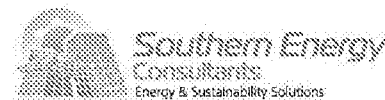
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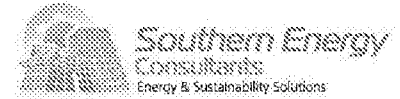
Calculation Type: New Build (As Designed)



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	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	45.1400 (1c)	x 2.5300 (2c)	= 114.2042 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	89.3600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 217.6790 (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) = 0.1838 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4338 (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)	=	0.3687 (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	0.3871	0.3687	0.3687	0.3410	0.3410	0.3042	0.3134	0.2950	0.3042	0.3226	0.3226	0.3503 (22b)
Effective ac	0.5749	0.5680	0.5680	0.5582	0.5582	0.5463	0.5491	0.5435	0.5463	0.5520	0.5520	0.5613 (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)			13.5400	1.2357	16.7319		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			44.2200	0.2000	8.8440	75.0000	3316.5000 (28a)
Brick/Render Cavity	138.6600	17.8400	120.8200	0.2500	30.2050	60.0000	7249.2000 (29a)
Main Plane	44.2200		44.2200	0.1100	4.8642	9.0000	397.9800 (30)
Bay Roof/GRP	1.0000		1.0000	0.3000	0.3000	9.0000	9.0000 (30)
Total net area of external elements Aum(A, m ²)			228.1000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.3951		(33)
Internal Wall 1			51.8500			75.0000	3888.7500 (32c)
Internal Wall 2			163.4500			9.0000	1471.0500 (32c)
Internal Floor 1			44.2200			18.0000	795.9600 (32d)
Internal Ceiling 1			44.2200			18.0000	795.9600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17924.4000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							200.5864 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.8343 (36)
Total fabric heat loss						(33) + (36) =	76.2294 (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	41.2999	40.7994	40.7994	40.0945	40.0945	39.2401	39.4445	39.0418	39.2401	39.6551	39.6551	40.3234 (38)
Heat transfer coeff	117.5293	117.0288	117.0288	116.3239	116.3239	115.4695	115.6739	115.2712	115.4695	115.8845	115.8845	116.5528 (39)
Average = Sum(39)m / 12 =												116.2034 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3152	1.3096	1.3096	1.3017	1.3017	1.2922	1.2945	1.2900	1.2922	1.2968	1.2968	1.3043 (40)
HLP (average)												1.3004 (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												2.6169 (42)
Average daily hot water use (litres/day)												96.3504 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	105.9854	102.1314	98.2774	94.4234	90.5694	86.7154	86.7154	90.5694	94.4234	98.2774	102.1314	105.9854 (44)
Energy conte	157.1733	137.4648	141.8514	123.6695	118.6638	102.3978	94.8866	108.8838	110.1842	128.4091	140.1686	152.2140 (45)

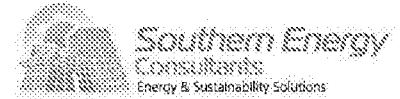
Regs Region: England

Elmhurst Energy Systems

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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 =	1515.9669 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.5760	20.6197	21.2777	18.5504	17.7996	15.3597	14.2330	16.3326	16.5276	19.2614	21.0253	22.8321	(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	14.1338	12.7552	14.0911	13.5931	14.0145	13.5259	13.9540	13.9932	13.5625	14.0594	13.6492	14.1219	(61)
Total heat required for water heating calculated for each month	171.3071	150.2200	155.9425	137.2625	132.6783	115.9237	108.8407	122.8770	123.7467	142.4685	153.8178	166.3359	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
												Solar input (sum of months) = Sum(63)m =	0.0000 (63)
Output from w/h	171.3071	150.2200	155.9425	137.2625	132.6783	115.9237	108.8407	122.8770	123.7467	142.4685	153.8178	166.3359	(64)
												Total per year (kWh/year) = Sum(64)m =	1681.4207 (64)
Heat gains from water heating, kWh/month	55.7936	48.8958	50.6884	44.5184	42.9593	37.4288	35.0383	39.7022	40.0269	46.2109	50.0183	54.1416	(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	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.9307	49.6771	40.4002	30.5855	22.8630	19.3019	20.8564	27.1100	36.3869	46.2016	53.9241	57.4852	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	355.0677	358.7522	349.4674	329.7012	304.7498	281.2991	265.6326	261.9481	271.2329	290.9991	315.9504	339.4012	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	(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)	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	(71)
Water heating gains (Table 5)	74.9914	72.7617	68.1295	61.8311	57.7410	51.9844	47.0945	53.3631	55.5929	62.1114	69.4699	72.7710	(72)
Total internal gains	594.6450	589.8462	566.6523	530.7729	494.0091	461.2406	442.2387	451.0764	471.8679	507.9673	547.9996	578.3125	(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		
Northeast			7.7200	12.9236		0.4400	0.0000		0.7700		33.8020 (75)		
Southeast			0.6000	40.4699		0.4400	0.0000		0.7700		8.2267 (77)		
Southwest			5.2200	40.4699		0.4400	0.0000		0.7700		71.5725 (79)		
Solar gains	113.6013	184.5195	276.7093	400.3237	478.2170	527.3306	494.9982	432.1041	341.4444	225.7031	141.5508	94.9364	(83)
Total gains	708.2462	774.3657	843.3616	931.0966	972.2261	988.5712	937.2369	883.1805	813.3123	733.6704	689.5504	673.2489	(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	42.3639	42.5451	42.5451	42.8029	42.8029	43.1196	43.0434	43.1938	43.1196	42.9652	42.9652	42.7188	
alpha	3.8243	3.8363	3.8363	3.8535	3.8535	3.8746	3.8696	3.8796	3.8746	3.8643	3.8643	3.8479	
util living area	0.9847	0.9773	0.9569	0.9005	0.7762	0.5514	0.3768	0.4093	0.7115	0.9170	0.9729	0.9870	(86)
MIT	19.5912	19.7411	20.0552	20.4540	20.7878	20.9610	20.9934	20.9911	20.8900	20.4971	19.9911	19.5670	(87)
Th 2	19.8289	19.8333	19.8333	19.8395	19.8395	19.8470	19.8452	19.8487	19.8470	19.8433	19.8433	19.8375	(88)
util rest of house	0.9804	0.9710	0.9441	0.8700	0.7080	0.4380	0.2393	0.2662	0.6081	0.8843	0.9639	0.9833	(89)
MIT 2	18.0026	18.2216	18.6714	19.2281	19.6499	19.8270	19.8440	19.8469	19.7727	19.3013	18.5917	17.9735	(90)
Living area fraction	18.2462	18.4546	18.8836	19.4160	19.8244	20.0009	20.0202	20.0223	19.9440	19.4847	18.8063	18.2178	(91)
MIT	18.0962	18.3046	18.7336	19.2660	19.6744	19.8509	19.8702	19.8723	19.7940	19.3347	18.6563	18.0678	(93)
Temperature adjustment													
adjusted MIT													

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	687.6428	742.6335	782.4851	792.5960	677.4527	433.3622	227.1733	237.7817	490.2323	635.0122	655.5116	656.2907	(94)
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	1527.4330	1486.8046	1326.3537	1089.4918	776.3901	444.6618	227.8992	238.8752	530.4643	896.3279	1234.8959	1511.4379	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	624.8039	500.0830	404.6383	213.7650	73.6094	0.0000	0.0000	0.0000	0.0000	194.4188	417.1567	636.2295	(98)
Space heating												3064.7046	(98)
Space heating per m2												34.2962	(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													3386.4140 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	624.8039	500.0830	404.6383	213.7650	73.6094	0.0000	0.0000	0.0000	0.0000	194.4188	417.1567	636.2295	(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)	690.3910	552.5779	447.1141	236.2044	81.3364	0.0000	0.0000	0.0000	0.0000	214.8275	460.9466	703.0160	(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	171.3071	150.2200	155.9425	137.2625	132.6783	115.9237	108.8407	122.8770	123.7467	142.4685	153.8178	166.3359	(64)
Efficiency of water heater (217)m	89.7918	89.7401	89.5865	89.2212	88.4156	87.3000	87.3000	87.3000	87.3000	89.1185	89.6151	89.8177	(216)
Fuel for water heating, kWh/month	190.7826	167.3944	174.0692	153.8452	150.0622	132.7878	124.6743	140.7526	141.7488	159.8641	171.6427	185.1928	(219)
Water heating fuel used													1892.8168 (219)
Annual totals kWh/year													
Space heating fuel - main system													3386.4140 (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)													395.1014 (232)
Total delivered energy for all uses													5749.3322 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3386.4140	3.8700	131.0542 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1892.8168	3.8700	73.2520 (247)
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)
Energy for lighting	395.1014	18.9000	74.6742 (250)
Additional standing charges			93.0000 (251)
Total energy cost			386.1554 (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	3386.4140	0.2160	731.4654 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1892.8168	0.2160	408.8484 (264)
Space and water heating			1140.3139 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	395.1014	0.5190	205.0576 (268)
Total kg/year			1384.2965 (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	3386.4140	1.2200	4131.4251 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1892.8168	1.2200	2309.2365 (264)
Space and water heating			6440.6616 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	395.1014	3.0700	1212.9612 (268)
Primary energy kWh/year			7883.8728 (272)
Primary energy kWh/m2/year			88.2260 (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	-£ 28	-186 kg (13.4%)
U Solar photovoltaic panels	+ 9.9	-£ 345	-947 kg (79.0%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£28	2.08 kg/m²	B 84 B 87
Solar photovoltaic panels	£345	10.59 kg/m²	A 94 A 96
Total Savings	£373	12.67 kg/m²	

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

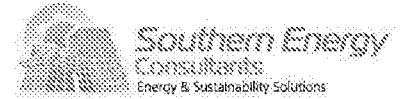
Fuel prices for cost data on this page from database revision number 470 TEST (21 Dec 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£89	£98	-£9
Mains gas	£297	£259	£38
Space heating	£238	£238	£0
Water heating	£73	£45	£28
Lighting	£75	£75	£0
Generated (PV)	-£0	-£345	£345
Total cost of fuels	£386	£12	£374
Total cost of uses	£386	£13	£373
Delivered energy	64 kWh/m²	34 kWh/m²	31 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	15 kg/m²	3 kg/m²	13 kg/m²
Primary energy	88 kWh/m²	14 kWh/m²	74 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	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	45.1400 (1c)	x 2.5300 (2c)	= 114.2042 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	89.3600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 217.6790 (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) = 0.1838 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4338 (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)	=	0.3687 (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	0.4701	0.4609	0.4516	0.4056	0.3963	0.3503	0.3503	0.3410	0.3687	0.3963	0.4148	0.4332 (22b)
Effective ac	0.6105	0.6062	0.6020	0.5822	0.5785	0.5613	0.5613	0.5582	0.5680	0.5785	0.5860	0.5938 (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)			13.5400	1.2357	16.7319		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			44.2200	0.2000	8.8440	75.0000	3316.5000 (28a)
Brick/Render Cavity	138.6600	17.8400	120.8200	0.2500	30.2050	60.0000	7249.2000 (29a)
Main Plane	44.2200		44.2200	0.1100	4.8642	9.0000	397.9800 (30)
Bay Roof/GRP	1.0000		1.0000	0.3000	0.3000	9.0000	9.0000 (30)
Total net area of external elements Aum(A, m ²)			228.1000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.3951		(33)
Internal Wall 1			51.8500			75.0000	3888.7500 (32c)
Internal Wall 2			163.4500			9.0000	1471.0500 (32c)
Internal Floor 1			44.2200			18.0000	795.9600 (32d)
Internal Ceiling 1			44.2200			18.0000	795.9600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17924.4000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							200.5864 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.8343 (36)
Total fabric heat loss						(33) + (36) =	76.2294 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	43.8539	43.5457	43.2436	41.8247	41.5592	40.3234	40.3234	40.0945	40.7994	41.5592	42.0963	42.6578 (38)
Heat transfer coeff	120.0833	119.7751	119.4730	118.0541	117.7886	116.5528	116.5528	116.3239	117.0288	117.7886	118.3257	118.8872 (39)
Average = Sum(39)m / 12 =												118.0528 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3438	1.3404	1.3370	1.3211	1.3181	1.3043	1.3043	1.3017	1.3096	1.3181	1.3241	1.3304 (40)
HLP (average)												1.3211 (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												2.6169 (42)
Average daily hot water use (litres/day)												96.3504 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	105.9854	102.1314	98.2774	94.4234	90.5694	86.7154	86.7154	90.5694	94.4234	98.2774	102.1314	105.9854 (44)
Energy conte	157.1733	137.4648	141.8514	123.6695	118.6638	102.3978	94.8866	108.8838	110.1842	128.4091	140.1686	152.2140 (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 = 1515.9669 (45)										
Distribution loss (46)m = 0.15 x (45)m											
23.5760	20.6197	21.2777	18.5504	17.7996	15.3597	14.2330	16.3326	16.5276	19.2614	21.0253	22.8321 (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	14.1338	12.7552	14.0911	13.5931	14.0145	13.5259	13.9540	13.9932	13.5625	14.0594	13.6492 (61)
Total heat required for water heating calculated for each month											
171.3071	150.2200	155.9425	137.2625	132.6783	115.9237	108.8407	122.8770	123.7467	142.4685	153.8178	166.3359 (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	-24.8845	-41.5251	-70.7220	-94.7815	-117.0945	-115.1225	-113.6012	-99.2539	-77.7357	-53.0843	-29.5166 (63)
Output from w/h											
146.4226	108.6949	85.2205	42.4811	15.5838	0.8012	0.0000	23.6231	46.0110	89.3842	124.3011	145.5118 (64)
Heat gains from water heating, kWh/month											
55.7936	48.8958	50.6884	44.5184	42.9593	37.4288	35.0383	39.7022	40.0269	46.2109	50.0183	54.1416 (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	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	55.9307	49.6771	40.4002	30.5855	22.8630	19.3019	20.8564	27.1100	36.3869	46.2016	53.9241	57.4852	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	355.0677	358.7522	349.4674	329.7012	304.7498	281.2991	265.6326	261.9481	271.2329	290.9991	315.9504	339.4012	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	(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)	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	(71)
Water heating gains (Table 5)	74.9914	72.7617	68.1295	61.8311	57.7410	51.9844	47.0945	53.3631	55.5929	62.1114	69.4699	72.7710	(72)
Total internal gains	594.6450	589.8462	566.6523	530.7729	494.0091	461.2406	442.2387	451.0764	471.8679	507.9673	547.9996	578.3125	(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
Northeast	7.7200	11.2829	0.4400	0.0000	0.7700	29.5109 (75)
Southeast	0.6000	36.7938	0.4400	0.0000	0.7700	7.4795 (77)
Southwest	5.2200	36.7938	0.4400	0.0000	0.7700	65.0712 (79)

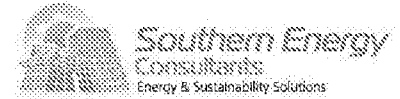
Solar gains	102.0616	183.6510	277.3161	387.2497	473.5860	487.6829	462.8867	395.7972	314.9641	209.9937	124.0314	86.1884 (83)
Total gains	696.7066	773.4972	843.9684	918.0226	967.5951	948.9235	905.1254	846.8736	786.8320	717.9610	672.0310	664.5009 (84)

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	41.4629	41.5696	41.6747	42.1756	42.2706	42.7188	42.7188	42.8029	42.5451	42.2706	42.0788	41.8800
alpha	3.7642	3.7713	3.7783	3.8117	3.8180	3.8479	3.8479	3.8535	3.8363	3.8180	3.8053	3.7920
util living area												
	0.9877	0.9806	0.9650	0.9248	0.8385	0.6894	0.5371	0.5874	0.8034	0.9417	0.9801	0.9897 (86)
MIT	19.4251	19.6003	19.9010	20.3039	20.6585	20.8894	20.9678	20.9546	20.7888	20.3403	19.8162	19.3938 (87)
Th 2	19.8067	19.8093	19.8120	19.8243	19.8267	19.8375	19.8375	19.8395	19.8333	19.8267	19.8220	19.8171 (88)
util rest of house												
	0.9844	0.9754	0.9550	0.9020	0.7882	0.5957	0.4084	0.4582	0.7259	0.9194	0.9737	0.9869 (89)
MIT 2	17.7469	18.0021	18.4364	19.0122	19.4840	19.7577	19.8239	19.8182	19.6572	19.0754	18.3257	17.7083 (90)
Living area fraction												
MIT	18.0042	18.2471	18.6609	19.2103	19.6641	19.9312	19.9992	19.9924	19.8307	19.2693	18.5542	17.9667 (92)
Temperature adjustment												
adjusted MIT	17.8542	18.0971	18.5109	19.0603	19.5141	19.7812	19.8492	19.8424	19.6807	19.1193	18.4042	17.8167 (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	0.9761	0.9643	0.9398	0.8830	0.7722	0.5906	0.4098	0.4586	0.7138	0.9010	0.9624	0.9796	(94)
Useful gains	680.0735	745.9159	793.1622	810.6336	747.1678	560.4467	370.8880	388.3398	561.6253	646.9110	646.7417	650.9266	(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	1627.6319	1580.6883	1434.9807	1199.4617	920.4133	603.8783	378.7091	400.4341	653.1060	1003.4780	1337.5827	1618.8526	(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	704.9834	560.9671	477.5130	279.9562	128.8947	0.0000	0.0000	0.0000	0.0000	265.2859	497.4056	720.1369	(98)
Space heating												3635.1427	(98)
Space heating per m2											(98) / (4) =	40.6798	(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													4016.7322	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	704.9834	560.9671	477.5130	279.9562	128.8947	0.0000	0.0000	0.0000	0.0000	265.2859	497.4056	720.1369	(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)	778.9872	619.8531	527.6386	309.3439	142.4250	0.0000	0.0000	0.0000	0.0000	293.1336	549.6194	795.7314	(211)	
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating														
Water heating requirement	146.4226	108.6949	85.2205	42.4811	15.5838	0.8012	0.0000	23.6231	46.0110	89.3842	124.3011	145.5118	(64)	
Efficiency of water heater	89.9331	89.9647	90.0004	90.0650	90.1436	87.3000	87.3000	87.3000	87.3000	89.6716	89.8416	89.9458	(217)	
Fuel for water heating, kWh/month	162.8128	120.8194	94.6890	47.1671	17.2877	0.9177	0.0000	27.0597	52.7045	99.6795	138.3559	161.7772	(219)	
Water heating fuel used												923.2706	(219)	
Annual totals kWh/year														
Space heating fuel - main system													4016.7322	(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)													395.1014	(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													3732.8648	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4016.7322	3.4800	139.7823	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	923.2706	3.4800	32.1298	(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	395.1014	13.1900	52.1139	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			132.6906	(255)

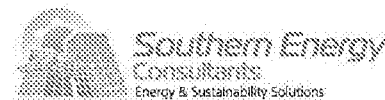
11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4148	(257)
SAP value		94.2138	
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)

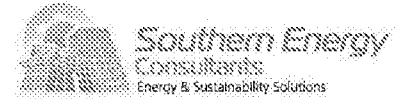


CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	4016.7322	0.2160	867.6142 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	923.2706	0.2160	199.4264 (264)
Space and water heating			1067.0406 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	395.1014	0.5190	205.0576 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			440.5360 (272)
CO2 emissions per m2			4.9300 (273)
EI value			95.6064
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	44.2200 (1b)	x 2.3400 (2b)	= 103.4748 (1b) - (3b)
First floor	45.1400 (1c)	x 2.5300 (2c)	= 114.2042 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	89.3600		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 217.6790 (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) =	0.1838 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.4338 (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) =		0.3687 (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	0.3871	0.3687	0.3687	0.3410	0.3410	0.3042	0.3134	0.2950	0.3042	0.3226	0.3226	0.3503 (22b)
Effective ac	0.5749	0.5680	0.5680	0.5582	0.5582	0.5463	0.5491	0.5435	0.5463	0.5520	0.5520	0.5613 (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)			13.5400	1.2357	16.7319		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			44.2200	0.2000	8.8440	75.0000	3316.5000 (28a)
Brick/Render Cavity	138.6600	17.8400	120.8200	0.2500	30.2050	60.0000	7249.2000 (29a)
Main Plane	44.2200		44.2200	0.1100	4.8642	9.0000	397.9800 (30)
Bay Roof/GRP	1.0000		1.0000	0.3000	0.3000	9.0000	9.0000 (30)
Total net area of external elements Aum(A, m ²)			228.1000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.3951		(33)
Internal Wall 1			51.8500			75.0000	3888.7500 (32c)
Internal Wall 2			163.4500			9.0000	1471.0500 (32c)
Internal Floor 1			44.2200			18.0000	795.9600 (32d)
Internal Ceiling 1			44.2200			18.0000	795.9600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17924.4000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							200.5864 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.8343 (36)
Total fabric heat loss						(33) + (36) =	76.2294 (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	41.2999	40.7994	40.7994	40.0945	40.0945	39.2401	39.4445	39.0418	39.2401	39.6551	39.6551	40.3234 (38)
Heat transfer coeff	117.5293	117.0288	117.0288	116.3239	116.3239	115.4695	115.6739	115.2712	115.4695	115.8845	115.8845	116.5528 (39)
Average = Sum(39)m / 12 =												116.2034 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3152	1.3096	1.3096	1.3017	1.3017	1.2922	1.2945	1.2900	1.2922	1.2968	1.2968	1.3043 (40)
HLP (average)												1.3004 (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	2.6169 (42)
Average daily hot water use (litres/day)	96.3504 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	105.9854	102.1314	98.2774	94.4234	90.5694	86.7154	86.7154	90.5694	94.4234	98.2774	102.1314	105.9854 (44)
Energy conte	157.1733	137.4648	141.8514	123.6695	118.6638	102.3978	94.8866	108.8838	110.1842	128.4091	140.1686	152.2140 (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 =	1515.9669 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.5760	20.6197	21.2777	18.5504	17.7996	15.3597	14.2330	16.3326	16.5276	19.2614	21.0253	22.8321	(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	14.1338	12.7552	14.0911	13.5931	14.0145	13.5259	13.9540	13.9932	13.5625	14.0594	13.6492	14.1219	(61)
Total heat required for water heating calculated for each month													
	171.3071	150.2200	155.9425	137.2625	132.6783	115.9237	108.8407	122.8770	123.7467	142.4685	153.8178	166.3359	(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	-26.9261	-40.4698	-68.1563	-94.2129	-113.4640	-119.4160	-116.5485	-104.0786	-81.2337	-55.2618	-32.7293	-22.3084	(63)
Solar input (sum of months) = Sum(63)m =													
Output from w/h													
	144.3810	109.7502	87.7862	43.0496	19.2143	0.0000	0.0000	18.7985	42.5130	87.2068	121.0884	144.0274	(64)
Total per year (kWh/year) = Sum(64)m =													
Heat gains from water heating, kWh/month													
	55.7936	48.8958	50.6884	44.5184	42.9593	37.4288	35.0383	39.7022	40.0269	46.2109	50.0183	54.1416	(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	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	157.0115	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	55.9307	49.6771	40.4002	30.5855	22.8630	19.3019	20.8564	27.1100	36.3869	46.2016	53.9241	57.4852	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	355.0677	358.7522	349.4674	329.7012	304.7498	281.2991	265.6326	261.9481	271.2329	290.9991	315.9504	339.4012	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	53.3180	(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)													
	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	-104.6743	(71)
Water heating gains (Table 5)													
	74.9914	72.7617	68.1295	61.8311	57.7410	51.9844	47.0945	53.3631	55.5929	62.1114	69.4699	72.7710	(72)
Total internal gains													
	594.6450	589.8462	566.6523	530.7729	494.0091	461.2406	442.2387	451.0764	471.8679	507.9673	547.9996	578.3125	(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
Northeast	7.7200	12.9236	0.4400	0.0000	0.7700	33.8020 (75)
Southeast	0.6000	40.4699	0.4400	0.0000	0.7700	8.2267 (77)
Southwest	5.2200	40.4699	0.4400	0.0000	0.7700	71.5725 (79)

Solar gains	113.6013	184.5195	276.7093	400.3237	478.2170	527.3306	494.9982	432.1041	341.4444	225.7031	141.5508	94.9364	(83)
Total gains	708.2462	774.3657	843.3616	931.0966	972.2261	988.5712	937.2369	883.1805	813.3123	733.6704	689.5504	673.2489	(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	42.3639	42.5451	42.5451	42.8029	42.8029	43.1196	43.0434	43.1938	43.1196	42.9652	42.9652	42.7188	
alpha	3.8243	3.8363	3.8363	3.8535	3.8535	3.8746	3.8696	3.8796	3.8746	3.8643	3.8643	3.8479	
util living area	0.9847	0.9773	0.9569	0.9005	0.7762	0.5514	0.3768	0.4093	0.7115	0.9170	0.9729	0.9870	(86)
MIT	19.5912	19.7411	20.0552	20.4540	20.7878	20.9610	20.9934	20.9911	20.8900	20.4971	19.9911	19.5670	(87)
Th 2	19.8289	19.8333	19.8333	19.8395	19.8395	19.8470	19.8452	19.8487	19.8470	19.8433	19.8433	19.8375	(88)
util rest of house	0.9804	0.9710	0.9441	0.8700	0.7080	0.4380	0.2393	0.2662	0.6081	0.8843	0.9639	0.9833	(89)
MIT 2	18.0026	18.2216	18.6714	19.2281	19.6499	19.8270	19.8440	19.8469	19.7727	19.3013	18.5917	17.9735	(90)
Living area fraction													
	18.2462	18.4546	18.8836	19.4160	19.8244	20.0009	20.0202	20.0223	19.9440	19.4847	18.8063	18.2178	(92)
Temperature adjustment													
adjusted MIT	18.0962	18.3046	18.7336	19.2660	19.6744	19.8509	19.8702	19.8723	19.7940	19.3347	18.6563	18.0678	(93)

Southern Energy Consultants
Energy & Sustainability Solutions

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9709	0.9590	0.9278	0.8512	0.6968	0.4384	0.2424	0.2692	0.6028	0.8655	0.9506	0.9748 (94)
Useful gains	687.6428	742.6335	782.4851	792.5960	677.4527	433.3622	227.1733	237.7817	490.2323	635.0122	655.5116	656.2907 (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	1527.4330	1486.8046	1326.3537	1089.4918	776.3901	444.6618	227.8992	238.8752	530.4643	896.3279	1234.8959	1511.4379 (97)
Month fractl	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	624.8039	500.0830	404.6383	213.7650	73.6094	0.0000	0.0000	0.0000	0.0000	194.4188	417.1567	636.2295 (98)
Space heating												3064.7046 (98)
Space heating per m2												34.2962 (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												3386.4140	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	624.8039	500.0830	404.6383	213.7650	73.6094	0.0000	0.0000	0.0000	0.0000	194.4188	417.1567	636.2295	(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)	690.3910	552.5779	447.1141	236.2044	81.3364	0.0000	0.0000	0.0000	0.0000	214.8275	460.9466	703.0160	(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	144.3810	109.7502	87.7862	43.0496	19.2143	0.0000	0.0000	18.7985	42.5130	87.2068	121.0884	144.0274	(64)
Efficiency of water heater (217)m	89.8816	89.9069	89.9125	89.9473	89.8185	87.3000	87.3000	87.3000	87.3000	89.4843	89.7598	89.8918	(216)
Fuel for water heating, kWh/month	160.6347	122.0709	97.6352	47.8609	21.3923	0.0000	0.0000	21.5332	48.6976	97.4548	134.9027	160.2232	(217)
Water heating fuel used												912.4055	(219)
Annual totals kWh/year													
Space heating fuel - main system												3386.4140	(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)												395.1014	(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										2994.7613		2994.7613	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3386.4140	3.8700	131.0542 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	912.4055	3.8700	35.3101 (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	395.1014	18.9000	74.6742 (250)
Additional standing charges			93.0000 (251)
Energy saving/generation technologies			
PV Unit	-1824.1596	18.9000	-344.7662 (252)
Total energy cost			12.8973 (252)

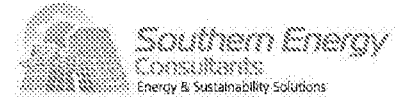
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating - main system 1	3386.4140	0.2160	731.4654 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	912.4055	0.2160	197.0796 (264)
Space and water heating			928.5450 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	395.1014	0.5190	205.0576 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	0.5190	-946.7389 (269)

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Total kg/year 251.7388 (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	3386.4140	1.2200	4131.4251 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	912.4055	1.2200	1113.1348 (264)
Space and water heating			5244.5598 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	395.1014	3.0700	1212.9612 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	3.0700	-5600.1701 (269)
Primary energy kWh/year			1241.1010 (272)
Primary energy kWh/m2/year			13.8888 (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	South West
Overshading	Average or unknown
Thermal mass parameter	200.6 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	287.34 (P1)
Transmission heat loss coefficient	76.23 (37)
Summer heat loss coefficient	363.57 (P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	7.7200	98.8453	0.4400	0.0000	0.9000	302.1819
South East	0.6000	119.9223	0.4400	0.0000	0.9000	28.4935
South West	5.2200	119.9223	0.4400	0.0000	0.9000	247.8939

total: 578.5693

	Jun	Jul	Aug	
Solar gains	616	579	505	(P4)
Internal gains	458	439	448	
Total summer gains	1075	1018	953	(P5)

Summer gain/loss ratio	2.96	2.80	2.62	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 200.6)	0.60	0.60	0.60	
Threshold temperature	19.55	21.30	21.02	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight