

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	SECANG010b			Issued on Date	04/02/2021
Assessment Reference	001	Prop Type Ref	Det Br Ea Ga		
Property	Warwick, Plot 44				
SAP Rating	84 B	DER	17.11	TET	17.63
Environmental	85 B	% DER<TER	2.97		
CO ₂ Emissions (t/year)	1.75	DPEE	54.29	TPEE	58.88
General Requirements Compliance	Pass	% DPEE<TPEE	7.80		
Assessor Details	Mr. Stuart Harvey, Stuart Harvey, [REDACTED]			Assessor ID	T555-0001
Client	Persimmon 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 122 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) 17.63 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 17.11 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)58.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)54.3 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.27 (max. 0.30)	0.41 (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)	0.11 (max. 0.35)	OK
Openings	1.31 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

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

4 Heating efficiency

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

Secondary heating system:

None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls:

No cylinder

Boiler interlock

Yes

OK

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

9 Summertime temperature

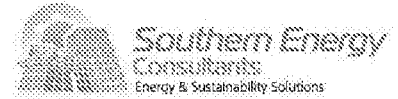
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 11.54 m², No overhang
Windows facing South: 0.51 m², No overhang
Windows facing West: 5.03 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key Features

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

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (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) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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) =	0.3262 (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	0.4159	0.4077	0.3995	0.3588	0.3506	0.3098	0.3098	0.3017	0.3262	0.3506	0.3669	0.3832 (22b)
Effective ac	0.5865	0.5831	0.5798	0.5644	0.5615	0.5480	0.5480	0.5455	0.5532	0.5615	0.5673	0.5734 (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)			17.0800	1.2357	21.1065		(27)
Heat Loss Floor 1			50.9800	0.2000	10.1960	75.0000	3823.5000 (28a)
Exposed Floor Over Garage			18.0600	0.1838	3.3187	20.0000	361.2000 (28b)
Brick Cavity	145.7100	19.2300	126.4800	0.2500	31.6200	60.0000	7588.8000 (29a)
Solid Garage Wall	21.8500		21.8500	0.4056	8.8615	9.0000	196.6500 (29a)
Main Plane	70.9300		70.9300	0.1100	7.8023	9.0000	638.3700 (30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.9150		(33)
Internal Wall 1			24.2700			75.0000	1820.2500 (32c)
Internal Wall 2			215.2700			9.0000	1937.4300 (32c)
Internal Floor 1			50.9800			18.0000	917.6400 (32d)
Internal Ceiling 1			50.9800			18.0000	917.6400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18201.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							149.3026 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8356 (36)
Total fabric heat loss						(33) + (36) =	100.7506 (37)

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

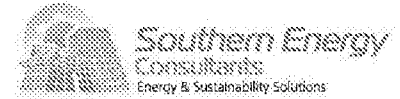
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	57.8947	57.5632	57.2383	55.7123	55.4268	54.0977	54.0977	53.8516	54.6097	55.4268	56.0044	56.6082 (38)
Heat transfer coeff	158.6452	158.3138	157.9889	156.4629	156.1774	154.8483	154.8483	154.6022	155.3603	156.1774	156.7550	157.3588 (39)
Average = Sum(39)m / 12 =												156.4615 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3013	1.2986	1.2959	1.2834	1.2811	1.2702	1.2702	1.2682	1.2744	1.2811	1.2858	1.2908 (40)
HLP (average)												1.2834 (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												2.8704 (42)
Average daily hot water use (litres/day)												102.3720 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (45)

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Energy content (annual)	Total = Sum(45)m = 1610.7108 (45)										
Distribution loss (46)m = 0.15 x (45)m											
25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590 (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	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702 (61)
Total heat required for water heating calculated for each month											
181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717 (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											
181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717 (64)
Heat gains from water heating, kWh/month											
59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104 (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	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.5099	24.4340	19.8711	15.0437	11.2453	9.4938	10.2584	13.3342	17.8972	22.7246	26.5229	28.2745	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	287.6793	290.6645	283.1419	267.1271	246.9112	227.9112	215.2181	212.2329	219.7555	235.7703	255.9861	274.9861	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains	463.6344	461.1748	444.1696	416.6393	388.2792	361.4103	344.2858	351.0377	365.4925	393.2571	425.0878	449.3467	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W		
East					11.5400	19.6403	0.4400	0.0000	0.7700	76.7886 (76)		
South					0.5100	46.7521	0.4400	0.0000	0.7700	8.0782 (78)		
West					5.0300	19.6403	0.4400	0.0000	0.7700	33.4702 (80)		
Solar gains	118.3370	228.9196	372.0627	537.0998	654.7413	669.0273	637.4191	549.6268	430.7286	270.2037	147.0552	97.6518 (83)
Total gains	581.9714	690.0943	816.2323	953.7391	1043.0205	1030.4376	981.7049	900.6644	796.2211	663.4607	572.1429	546.9985 (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	31.8696	31.9364	32.0020	32.3142	32.3732	32.6511	32.6511	32.7031	32.5435	32.3732	32.2539	32.1302
alpha	3.1246	3.1291	3.1335	3.1543	3.1582	3.1767	3.1767	3.1802	3.1696	3.1582	3.1503	3.1420
util living area	0.9931	0.9877	0.9743	0.9394	0.8675	0.7455	0.6090	0.6647	0.8590	0.9641	0.9890	0.9944 (86)
MIT	18.7498	18.9701	19.3730	19.9116	20.4020	20.7560	20.9086	20.8767	20.5755	19.9248	19.2407	18.7128 (87)
Th 2	19.8398	19.8419	19.8440	19.8538	19.8557	19.8643	19.8643	19.8659	19.8610	19.8557	19.8520	19.8481 (88)
util rest of house	0.9916	0.9849	0.9680	0.9235	0.8293	0.6653	0.4825	0.5428	0.8026	0.9519	0.9861	0.9931 (89)
MIT 2	16.8354	17.1577	17.7439	18.5221	19.2018	19.6564	19.8133	19.7905	19.4508	18.5537	17.5600	16.7862 (90)
Living area fraction	17.0567	17.3672	17.9322	18.6827	19.3405	19.7835	19.9399	19.9160	19.5808	18.7122	17.7542	17.0089 (91)
MIT	16.9067	17.2172	17.7822	18.5327	19.1905	19.6335	19.7899	19.7660	19.4308	18.5622	17.6042	16.8589 (92)
Temperature adjustment												-0.1500
adjusted MIT												16.8589 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	573.2007	672.5714	776.3724	856.5179	835.6193	665.8151	464.5989	477.6898	617.0021	617.5358	558.6124	540.1276	(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	1999.9855	1949.9793	1782.4631	1507.1651	1169.8529	779.4308	493.9538	520.3925	828.1962	1243.5171	1646.5872	1991.9866	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1061.5279	858.4181	748.5315	468.4660	248.6698	0.0000	0.0000	0.0000	0.0000	465.7301	783.3419	1080.1831	(98)
Space heating												5714.8683	(98)
Space heating per m2												46.8778	(99)

Regs Region: England

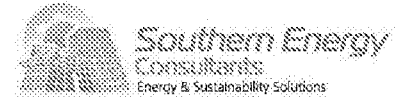
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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													6314.7716	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	1061.5279	858.4181	748.5315	468.4660	248.6698	0.0000	0.0000	0.0000	0.0000	465.7301	783.3419	1080.1831	(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)	1172.9590	948.5283	827.1066	517.6420	274.7733	0.0000	0.0000	0.0000	0.0000	514.6189	865.5711	1193.5725	(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	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(64)	
Efficiency of water heater (217)m	90.0190	89.9850	89.9053	89.7225	89.3200	87.3000	87.3000	87.3000	87.3000	89.6969	89.9334	90.0379	(217)	
Fuel for water heating, kWh/month	201.2393	176.5092	183.3430	161.6390	156.8828	140.1498	131.4963	148.5825	149.6726	167.8076	180.7994	195.3307	(219)	
Water heating fuel used												1993.4523	(219)	
Annual totals kWh/year														
Space heating fuel - main system												6314.7716	(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)													485.8334	(232)
Total delivered energy for all uses													8869.0573	(238)

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

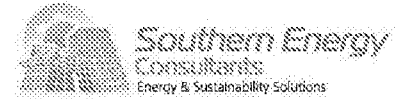
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	6314.7716	0.2160	1363.9907 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1993.4523	0.2160	430.5857 (264)
Space and water heating			1794.5764 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	485.8334	0.5190	252.1475 (268)
Total CO2, kg/year			2085.6489 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			17.1100 (273)

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

DER		17.1100	ZC1
Total Floor Area	TFA	121.9100	
Assumed number of occupants	N	2.8704	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.9835	ZC2
CO2 emissions from cooking, equation (L16)		1.5412	ZC3
Total CO2 emissions		32.6347	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		32.6347	ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (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) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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) =	0.3262 (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	0.4159	0.4077	0.3995	0.3588	0.3506	0.3098	0.3098	0.3017	0.3262	0.3506	0.3669	0.3832 (22b)
Effective ac	0.5865	0.5831	0.5798	0.5644	0.5615	0.5480	0.5480	0.5455	0.5532	0.5615	0.5673	0.5734 (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 Opening Type (Uw = 1.40)			17.0800	1.3258	22.6439		(27)
Heat Loss Floor 1			50.9800	0.1300	6.6274		(28a)
Exposed Floor Over Garage			18.0600	0.1300	2.3478		(28b)
Brick Cavity	145.7100	19.2300	126.4800	0.1800	22.7664		(29a)
Solid Garage Wall	21.8500		21.8500	0.1800	3.9330		(29a)
Main Plane	70.9300		70.9300	0.1300	9.2209		(30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.6894		(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)							17.6246 (36)
Total fabric heat loss						(33) + (36) =	87.3140 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	57.8947	57.5632	57.2383	55.7123	55.4268	54.0977	54.0977	53.8516	54.6097	55.4268	56.0044	56.6082 (38)
Heat transfer coeff	145.2087	144.8772	144.5524	143.0264	142.7409	141.4118	141.4118	141.1656	141.9237	142.7409	143.3184	143.9223 (39)
Average = Sum(39)m / 12 =												143.0250 (39)
HLP	1.1911	1.1884	1.1857	1.1732	1.1709	1.1600	1.1600	1.1579	1.1642	1.1709	1.1756	1.1806 (40)
HLP (average)												1.1732 (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												2.8704 (42)
Average daily hot water use (litres/day)												102.3720 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (45)
Energy content (annual)												1610.7108 (45)
Distribution loss (46)m = 0.15 x (45)m												
25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590 (46)	
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	50.9589	46.0274	50.9589	49.3151	49.0376	45.4364	46.9509	49.0376	49.3151	50.9589	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month	217.9552	192.0834	201.6756	180.7135	175.1176	154.2338	147.7677	164.7264	166.3855	187.3932	198.2438	212.6859 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	217.9552	192.0834	201.6756	180.7135	175.1176	154.2338	147.7677	164.7264	166.3855	187.3932	198.2438	212.6859 (64)
Heat gains from water heating, kWh/month	68.2660	60.0705	62.8530	56.0188	54.1810	47.5342	45.2593	50.7259	51.2547	58.1041	61.8476	66.5139 (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	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.5099	24.4340	19.8711	15.0437	11.2453	9.4938	10.2584	13.3342	17.8972	22.7246	26.5229	28.2745	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	287.6793	290.6645	283.1419	267.1271	246.9112	227.9112	215.2181	212.2329	219.7555	235.7703	255.9861	274.9861	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	91.7553	89.3906	84.4799	77.8038	72.8239	66.0198	60.8324	68.1800	71.1871	78.0970	85.8994	89.4005	(72)
Total internal gains	476.0005	473.5451	456.5489	429.0306	400.0365	372.4808	355.3649	362.8031	377.8958	405.6478	437.4645	461.7171	(73)

6. Solar gains

[Jan]														
					Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c		Access factor Table 6d		Gains W	
East					11.5400	19.6403		0.6300	0.7000		0.7700		69.2668 (76)	
South					0.5100	46.7521		0.6300	0.7000		0.7700		7.2869 (78)	
West					5.0300	19.6403		0.6300	0.7000		0.7700		30.1917 (80)	
Solar gains	106.7453	206.4959	335.6175	484.4885	590.6064	603.4930	574.9810	495.7883	388.5367	243.7360	132.6504	88.0863	(83)	
Total gains	582.7459	680.0410	792.1663	913.5191	990.6429	975.9738	930.3459	858.5914	766.4325	649.3838	570.1149	549.8034	(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	58.3021	58.4355	58.5668	59.1917	59.3101	59.8675	59.8675	59.9719	59.6516	59.3101	59.0711	58.8232	
alpha	4.8868	4.8957	4.9045	4.9461	4.9540	4.9912	4.9912	4.9981	4.9768	4.9540	4.9381	4.9215	
util living area	0.9993	0.9983	0.9947	0.9795	0.9278	0.8002	0.6361	0.7002	0.9165	0.9906	0.9985	0.9995	(86)
MIT	19.5910	19.7349	19.9988	20.3588	20.6866	20.9046	20.9766	20.9629	20.7873	20.3544	19.9090	19.5686	(87)
Th 2	19.9271	19.9293	19.9314	19.9415	19.9434	19.9522	19.9522	19.9538	19.9488	19.9434	19.9396	19.9356	(88)
util rest of house	0.9990	0.9977	0.9927	0.9708	0.8949	0.7129	0.5007	0.5671	0.8641	0.9853	0.9979	0.9993	(89)
MIT 2	18.0378	18.2498	18.6364	19.1635	19.6172	19.8834	19.9429	19.9371	19.7599	19.1634	18.5119	18.0109	(90)
Living area fraction	18.2173	18.4214	18.7939	19.3017	19.7408	20.0014	20.0624	20.0557	19.8786	19.3011	18.6733	18.1909	(91)
MIT	18.2173	18.4214	18.7939	19.3017	19.7408	20.0014	20.0624	20.0557	19.8786	19.3011	18.6733	18.1909	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2173	18.4214	18.7939	19.3017	19.7408	20.0014	20.0624	20.0557	19.8786	19.3011	18.6733	18.1909	(93)

8. Space heating requirement

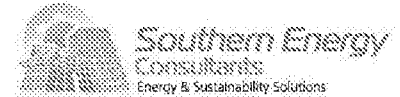
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9984	0.9963	0.9894	0.9634	0.8869	0.7176	0.5159	0.5813	0.8596	0.9804	0.9966	0.9988	(94)
Useful gains	581.7935	677.5367	783.7476	880.0805	878.6137	700.3494	480.0033	499.0887	658.7968	636.6417	568.1938	549.1315	(95)
Ext temp.	4.3000	4.9000	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	2020.9118	1958.9452	1777.1127	1487.7106	1147.7505	763.8207	489.6267	516.0543	820.1253	1242.0013	1658.6712	2013.6070	(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	1070.7040	861.1065	739.0636	437.4937	200.2378	0.0000	0.0000	0.0000	0.0000	450.3876	785.1437	1089.5697	(98)
Space heating												5633.7067	(98)
Space heating per m2												(98) / (4) =	46.2120 (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

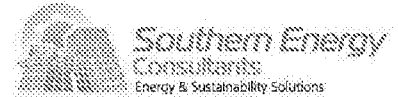
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												93.4000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												6031.8059 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1070.7040	861.1065	739.0636	437.4937	200.2378	0.0000	0.0000	0.0000	0.0000	450.3876	785.1437	1089.5697 (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)	1146.3640	921.9556	791.2887	468.4087	214.3874	0.0000	0.0000	0.0000	0.0000	482.2137	840.6250	1166.5629 (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	217.9552	192.0834	201.6756	180.7135	175.1176	154.2338	147.7677	164.7264	166.3855	187.3932	198.2438	212.6859 (64)
Efficiency of water heater (217)m	88.5170	88.3727	88.0264	87.1941	85.3893	80.3000	80.3000	80.3000	80.3000	87.1782	88.1645	80.3000 (216)
Fuel for water heating, kWh/month	246.2298	217.3559	229.1080	207.2543	205.0813	192.0719	184.0196	205.1387	207.2049	214.9542	224.8567	88.5804 (217)
Water heating fuel used												240.1050 (219)
Annual totals kWh/year												2573.3803 (219)
Space heating fuel - main system												6031.8059 (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)												485.8334 (232)
Total delivered energy for all uses												9166.0196 (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	6031.8059	0.2160	1302.8701 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2573.3803	0.2160	555.8502 (264)
Space and water heating			1858.7202 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	485.8334	0.5190	252.1475 (268)
Total CO2, kg/m2/year			2149.7928 (272)
Emissions per m2 for space and water heating			15.2467 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.0683 (272b)
Emissions per m2 for pumps and fans			0.3193 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.2467 * 1.00) + 2.0683 + 0.3193, rounded to 2 d.p.			17.6300 (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	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (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) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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) =	0.3262 (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	0.4159	0.4077	0.3995	0.3588	0.3506	0.3098	0.3098	0.3017	0.3262	0.3506	0.3669	0.3832 (22b)
Effective ac	0.5865	0.5831	0.5798	0.5644	0.5615	0.5480	0.5480	0.5455	0.5532	0.5615	0.5673	0.5734 (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)			17.0800	1.2357	21.1065		(27)
Heat Loss Floor 1			50.9800	0.2000	10.1960	75.0000	3823.5000 (28a)
Exposed Floor Over Garage			18.0600	0.1838	3.3187	20.0000	361.2000 (28b)
Brick Cavity	145.7100	19.2300	126.4800	0.2500	31.6200	60.0000	7588.8000 (29a)
Solid Garage Wall	21.8500		21.8500	0.4056	8.8615	9.0000	196.6500 (29a)
Main Plane	70.9300		70.9300	0.1100	7.8023	9.0000	638.3700 (30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.9150		(33)
Internal Wall 1			24.2700			75.0000	1820.2500 (32c)
Internal Wall 2			215.2700			9.0000	1937.4300 (32c)
Internal Floor 1			50.9800			18.0000	917.6400 (32d)
Internal Ceiling 1			50.9800			9.0000	458.8200 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	17742.6600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							145.5390 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8356 (36)
Total fabric heat loss						(33) + (36) =	100.7506 (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	57.8947	57.5632	57.2383	55.7123	55.4268	54.0977	54.0977	53.8516	54.6097	55.4268	56.0044	56.6082 (38)
Heat transfer coeff	158.6452	158.3138	157.9889	156.4629	156.1774	154.8483	154.8483	154.6022	155.3603	156.1774	156.7550	157.3588 (39)
Average = Sum(39)m / 12 =												156.4615 (39)

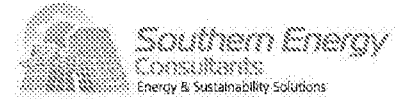
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3013	1.2986	1.2959	1.2834	1.2811	1.2702	1.2702	1.2682	1.2744	1.2811	1.2858	1.2908 (40)
HLP (average)												1.2834 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8704 (42)
Average daily hot water use (litres/day)												102.3720 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (45)

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 = 1610.7108 (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	35.4867	31.0369	32.0273	27.9222	26.7920	23.1195	21.4236	24.5839	24.8775	28.9923	31.6474	34.3670 (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	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.5099	24.4340	19.8711	15.0437	11.2453	9.4938	10.2584	13.3342	17.8972	22.7246	26.5229	28.2745	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	287.6793	290.6645	283.1419	267.1271	246.9112	227.9112	215.2181	212.2329	219.7555	235.7703	255.9861	274.9861	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	47.6972	46.1859	43.0474	38.7808	36.0107	32.1103	28.7951	33.0428	34.5520	38.9681	43.9547	46.1922	(72)
Total internal gains	428.9424	427.3404	412.1164	387.0076	360.2234	335.5714	320.3276	324.6659	338.2607	363.5190	392.5197	415.5088	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
East				11.5400	19.6403		0.4400		0.0000		0.7700		76.7886 (76)
South				0.5100	46.7521		0.4400		0.0000		0.7700		8.0782 (78)
West				5.0300	19.6403		0.4400		0.0000		0.7700		33.4702 (80)
Solar gains	118.3370	228.9196	372.0627	537.0998	654.7413	669.0273	637.4191	549.6268	430.7286	270.2037	147.0552	97.6518	(83)
Total gains	547.2794	656.2600	784.1791	924.1074	1014.9647	1004.5987	957.7467	874.2927	768.9893	633.7227	539.5749	513.1606	(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	31.0663	31.1313	31.1953	31.4996	31.5572	31.8280	31.8280	31.8787	31.7231	31.5572	31.4409	31.3202	
alpha	3.0711	3.0754	3.0797	3.1000	3.1038	3.1219	3.1219	3.1252	3.1149	3.1038	3.0961	3.0880	
util living area	0.9937	0.9885	0.9755	0.9415	0.8714	0.7522	0.6174	0.6746	0.8652	0.9664	0.9900	0.9949	(86)
MIT	18.6736	18.8991	19.3117	19.8642	20.3691	20.7378	20.8997	20.8647	20.5475	19.8761	19.1754	18.6367	(87)
Th 2	19.8398	19.8419	19.8440	19.8538	19.8557	19.8643	19.8643	19.8659	19.8610	19.8557	19.8520	19.8481	(88)
util rest of house	0.9923	0.9859	0.9696	0.9262	0.8344	0.6734	0.4913	0.5536	0.8110	0.9550	0.9873	0.9937	(89)
MIT 2	17.7159	17.9418	18.3527	18.9015	19.3815	19.7098	19.8253	19.8081	19.5590	18.9223	18.2254	17.6849	(90)
Living area fraction	17.8266	18.0525	18.4635	19.0127	19.4957	19.8286	19.9495	19.9303	19.6733	19.0326	18.3352	17.7949	(91)
MIT	17.8266	18.0525	18.4635	19.0127	19.4957	19.8286	19.9495	19.9303	19.6733	19.0326	18.3352	17.7949	(92)
Temperature adjustment	17.8266	18.0525	18.4635	19.0127	19.4957	19.8286	19.9495	19.9303	19.6733	19.0326	18.3352	17.7949	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	541.1189	643.2454	752.7622	842.5451	832.4973	673.6346	480.5776	490.8976	615.0823	597.9932	529.8919	508.3985	(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	2145.9365	2082.2173	1890.1015	1582.2680	1217.5102	809.6430	518.6618	545.7856	865.8652	1316.9739	1761.1671	2139.2798	(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	1193.9843	966.9891	846.1804	532.6005	286.4496	0.0000	0.0000	0.0000	0.0000	534.9216	886.5182	1213.3757	(98)
Space heating												6461.0194	(98)
Space heating per m2												52.9983	(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	1455.5741	1145.8775	1174.9766	0.0000	0.0000	0.0000	0.0000	(100)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

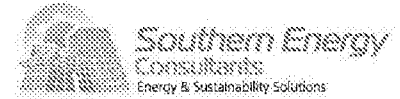


CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7100	0.7844	0.7454	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1033.5272	898.8762	875.7880	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1290.4916	1233.1983	1138.0656	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	185.0144	248.7356	195.1345	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction												628.8845 (104)
Intermittency factor (Table 10b)												1.0000 (105)
	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	46.2536	62.1839	48.7836	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												157.2211 (107)
Energy for space heating												1.2896 (108)
Energy for space cooling												52.9983 (99)
Total												1.2896 (108)
Dwelling Fabric Energy Efficiency (DFEE)												54.2879 (109)
												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	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (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) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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) =	0.3262 (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	0.4159	0.4077	0.3995	0.3588	0.3506	0.3098	0.3098	0.3017	0.3262	0.3506	0.3669	0.3832 (22b)
Effective ac	0.5865	0.5831	0.5798	0.5644	0.5615	0.5480	0.5480	0.5455	0.5532	0.5615	0.5673	0.5734 (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 Opening Type (Uw = 1.40)			17.0800	1.3258	22.6439		(27)
Heat Loss Floor 1			50.9800	0.1300	6.6274		(28a)
Exposed Floor Over Garage			18.0600	0.1300	2.3478		(28b)
Brick Cavity	145.7100	19.2300	126.4800	0.1800	22.7664		(29a)
Solid Garage Wall	21.8500		21.8500	0.1800	3.9330		(29a)
Main Plane	70.9300		70.9300	0.1300	9.2209		(30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	69.6894		(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)							17.6246 (36)
Total fabric heat loss						(33) + (36) =	87.3140 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	57.8947	57.5632	57.2383	55.7123	55.4268	54.0977	54.0977	53.8516	54.6097	55.4268	56.0044	56.6082 (38)
Heat transfer coeff	145.2087	144.8772	144.5524	143.0264	142.7409	141.4118	141.4118	141.1656	141.9237	142.7409	143.3184	143.9223 (39)
Average = Sum(39)m / 12 =												143.0250 (39)
HLP	1.1911	1.1884	1.1857	1.1732	1.1709	1.1600	1.1600	1.1579	1.1642	1.1709	1.1756	1.1806 (40)
HLP (average)												1.1732 (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												2.8704 (42)
Average daily hot water use (litres/day)												102.3720 (43)
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (45)
Energy content (annual)										Total = Sum(45)m =		1610.7108 (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	35.4867	31.0369	32.0273	27.9222	26.7920	23.1195	21.4236	24.5839	24.8775	28.9923	31.6474	34.3670 (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	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	27.5099	24.4340	19.8711	15.0437	11.2453	9.4938	10.2584	13.3342	17.8972	22.7246	26.5229	28.2745	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	287.6793	290.6645	283.1419	267.1271	246.9112	227.9112	215.2181	212.2329	219.7555	235.7703	255.9861	274.9861	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	47.6972	46.1859	43.0474	38.7808	36.0107	32.1103	28.7951	33.0428	34.5520	38.9681	43.9547	46.1922	(72)
Total internal gains	428.9424	427.3404	412.1164	387.0076	360.2234	335.5714	320.3276	324.6659	338.2607	363.5190	392.5197	415.5088	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W	
East	11.5400	19.6403	0.6300		0.7000	0.7700	69.2668	(76)
South	0.5100	46.7521	0.6300		0.7000	0.7700	7.2869	(78)
West	5.0300	19.6403	0.6300		0.7000	0.7700	30.1917	(80)

Solar gains	106.7453	206.4959	335.6175	484.4885	590.6064	603.4930	574.9810	495.7883	388.5367	243.7360	132.6504	88.0863	(83)
Total gains	535.6877	633.8363	747.7339	871.4960	950.8298	939.0644	895.3086	820.4542	726.7975	607.2550	525.1702	503.5951	(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	58.3021	58.4355	58.5668	59.1917	59.3101	59.8675	59.8675	59.9719	59.6516	59.3101	59.0711	58.8232	
alpha	4.8868	4.8957	4.9045	4.9461	4.9540	4.9912	4.9912	4.9981	4.9768	4.9540	4.9381	4.9215	
util living area	0.9995	0.9988	0.9959	0.9830	0.9371	0.8173	0.6561	0.7235	0.9297	0.9929	0.9990	0.9996	(86)
MIT	19.5552	19.6999	19.9657	20.3296	20.6650	20.8943	20.9732	20.9571	20.7667	20.3234	19.8747	19.5333	(87)
Th 2	19.9271	19.9293	19.9314	19.9415	19.9434	19.9522	19.9522	19.9538	19.9488	19.9434	19.9396	19.9356	(88)
util rest of house	0.9993	0.9983	0.9943	0.9756	0.9071	0.7325	0.5188	0.5900	0.8828	0.9888	0.9985	0.9995	(89)
MIT 2	18.6013	18.7476	19.0144	19.3823	19.7023	19.8991	19.9448	19.9403	19.8040	19.3807	18.9307	18.5862	(90)
Living area fraction									fLA = Living area / (4) =			0.1156	(91)
MIT	18.7116	18.8577	19.1244	19.4918	19.8135	20.0141	20.0637	20.0578	19.9152	19.4896	19.0398	18.6957	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7116	18.8577	19.1244	19.4918	19.8135	20.0141	20.0637	20.0578	19.9152	19.4896	19.0398	18.6957	(93)

8. Space heating requirement

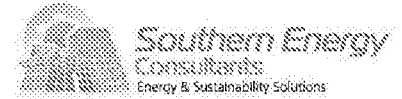
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9990	0.9977	0.9925	0.9714	0.9025	0.7383	0.5345	0.6048	0.8809	0.9863	0.9980	0.9993	(94)
Ext temp.	535.1764	632.3487	742.1541	846.5362	858.1137	693.3125	478.5727	496.1854	640.2088	598.9294	524.1029	503.2450	(95)
Ext temp.	4.3000	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	2092.6852	2022.1494	1824.8822	1514.8999	1158.1328	765.6216	489.8052	516.3519	825.3203	1268.9147	1711.1892	2086.2492	(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	(98)
Space heating kWh	1158.7865	933.9461	805.5496	481.2218	223.2142	0.0000	0.0000	0.0000	0.0000	498.4691	854.7021	1177.7552	(98)
Space heating												6133.6447	(98)
Space heating per m ²												50.3129	(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	1329.2706	1046.4471	1072.8589	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7931	0.8730	0.8342	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1054.2802	913.5109	894.9402	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1213.8931	1160.2187	1075.1375	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)

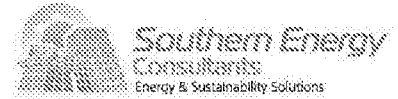


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	114.9213	183.5506	134.0668	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												432.5387 (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	28.7303	45.8876	33.5167	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												108.1347 (107)
Space cooling per m2												0.8870 (108)
Energy for space heating												50.3129 (99)
Energy for space cooling												0.8870 (108)
Total												51.1999 (109)
Target Fabric Energy Efficiency (TFEE)												58.9 (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	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (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) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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) = 0.3262 (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	0.3425	0.3262	0.3262	0.3017	0.3017	0.2691	0.2772	0.2609	0.2691	0.2854	0.2854	0.3098 (22b)
Effective ac	0.5586	0.5532	0.5532	0.5455	0.5455	0.5362	0.5384	0.5340	0.5362	0.5407	0.5407	0.5480 (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)			17.0800	1.2357	21.1065		(27)
Heat Loss Floor 1			50.9800	0.2000	10.1960	75.0000	3823.5000 (28a)
Exposed Floor Over Garage			18.0600	0.1838	3.3187	20.0000	361.2000 (28b)
Brick Cavity	145.7100	19.2300	126.4800	0.2500	31.6200	60.0000	7588.8000 (29a)
Solid Garage Wall	21.8500		21.8500	0.4056	8.8615	9.0000	196.6500 (29a)
Main Plane	70.9300		70.9300	0.1100	7.8023	9.0000	638.3700 (30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.9150		(33)
Internal Wall 1			24.2700			75.0000	1820.2500 (32c)
Internal Wall 2			215.2700			9.0000	1937.4300 (32c)
Internal Floor 1			50.9800			18.0000	917.6400 (32d)
Internal Ceiling 1			50.9800			18.0000	917.6400 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 18201.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							149.3026 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8356 (36)
Total fabric heat loss							(33) + (36) = 100.7506 (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	55.1479	54.6097	54.6097	53.8516	53.8516	52.9327	53.1526	52.7194	52.9327	53.3790	53.3790	54.0977 (38)
Heat transfer coeff	155.8985	155.3603	155.3603	154.6022	154.6022	153.6833	153.9032	153.4700	153.6833	154.1296	154.1296	154.8483 (39)
Average = Sum(39)m / 12 =												154.4726 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2788	1.2744	1.2744	1.2682	1.2682	1.2606	1.2624	1.2589	1.2606	1.2643	1.2643	1.2702 (40)
HLP (average)												1.2671 (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	2.8704 (42)
Average daily hot water use (litres/day)	102.3720 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (45)

Regs Region: England

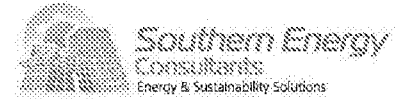
Elmhurst Energy Systems

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 =	1610.7108 (45)
Distribution loss (46)m = 0.15 x (45)m													
25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590 (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	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702	14.1447 (61)	
Total heat required for water heating calculated for each month													
181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717 (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													
181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717 (64)		
												Total per year (kWh/year) = Sum(64)m =	1776.4874 (64)
RHI water heating demand												1776 (64)	
Heat gains from water heating, kWh/month													
59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104 (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	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.7747	61.0851	49.6778	37.6093	28.1134	23.7345	25.6459	33.3356	44.7429	56.8114	66.3073	70.6862	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	429.3721	433.8276	422.5998	398.6971	368.5243	340.1660	321.2210	316.7655	327.9933	351.8960	382.0688	410.4270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains	693.0369	687.4337	659.8790	617.2197	573.2050	534.3506	512.1211	522.0165	547.0209	589.9144	637.3997	673.6442	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
East					11.5400	22.3313		0.4400	0.0000	0.7700		87.3099 (76)	
South					0.5100	50.9848		0.4400	0.0000	0.7700		8.8096 (78)	
West					5.0300	22.3313		0.4400	0.0000	0.7700		38.0562 (80)	

Solar gains	134.1757	233.5479	374.4813	555.8733	659.1274	720.3588	679.0627	599.4862	469.5203	294.2344	170.8288	109.6400	(83)
Total gains	827.2126	920.9817	1034.3603	1173.0930	1232.3324	1254.7094	1191.1838	1121.5026	1016.5412	884.1488	808.2285	783.2842	(84)

7. Mean internal temperature (heating season)

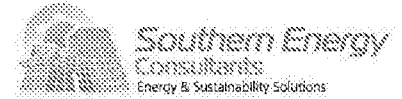
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	32.4312	32.5435	32.5435	32.7031	32.7031	32.8986	32.8516	32.9443	32.8986	32.8033	32.8033	32.6511	
alpha	3.1621	3.1696	3.1696	3.1802	3.1802	3.1932	3.1901	3.1963	3.1932	3.1869	3.1869	3.1767	
util living area	0.9791	0.9696	0.9441	0.8815	0.7622	0.5556	0.3873	0.4198	0.7093	0.9075	0.9662	0.9819	(86)
MIT	19.1765	19.3596	19.7569	20.2527	20.6739	20.9217	20.9827	20.9777	20.8130	20.2910	19.6589	19.1460	(87)
Th 2	19.8575	19.8610	19.8610	19.8659	19.8659	19.8718	19.8704	19.8732	19.8718	19.8689	19.8689	19.8643	(88)
util rest of house	0.9744	0.9629	0.9311	0.8526	0.7013	0.4502	0.2522	0.2801	0.6172	0.8781	0.9573	0.9779	(89)
MIT 2	17.4655	17.7320	18.3022	18.9963	19.5493	19.8232	19.8657	19.8666	19.7262	19.0688	18.1731	17.4258	(90)
Living area fraction												fLA = Living area / (4) =	0.1156 (91)
MIT	17.6633	17.9201	18.4704	19.1433	19.6793	19.9502	19.9948	19.9950	19.8518	19.2101	18.3448	17.6247	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.5133	17.7701	18.3204	18.9933	19.5293	19.8002	19.8448	19.8450	19.7018	19.0601	18.1948	17.4747	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9599	0.9448	0.9068	0.8246	0.6803	0.4429	0.2490	0.2764	0.6012	0.8501	0.9378	0.9647	(94)
Useful gains	794.0162	870.1229	937.9878	967.2996	838.3172	555.7207	296.5734	309.9736	611.0954	751.5975	757.9477	755.6195	(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	1935.2110	1890.7477	1696.5902	1405.8386	1009.4419	584.0245	299.3162	313.8500	691.8574	1149.8174	1571.3277	1916.1944	(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	849.0490	685.8599	564.4002	315.7481	127.3168	0.0000	0.0000	0.0000	0.0000	296.2757	585.6336	863.4677	(98)
Space heating												4287.7598	(98)
RHI space heating demand												4288	(98)

FULL SAP CALCULATION PRINTOUT

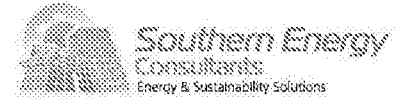
Calculation Type: New Build (As Designed)



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	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (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) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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)	=	0.3262 (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	0.4159	0.4077	0.3995	0.3588	0.3506	0.3098	0.3098	0.3017	0.3262	0.3506	0.3669	0.3832 (22b)
Effective ac	0.5865	0.5831	0.5798	0.5644	0.5615	0.5480	0.5480	0.5455	0.5532	0.5615	0.5673	0.5734 (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)			17.0800	1.2357	21.1065		(27)
Heat Loss Floor 1			50.9800	0.2000	10.1960	75.0000	3823.5000 (28a)
Exposed Floor Over Garage			18.0600	0.1838	3.3187	20.0000	361.2000 (28b)
Brick Cavity	145.7100	19.2300	126.4800	0.2500	31.6200	60.0000	7588.8000 (29a)
Solid Garage Wall	21.8500		21.8500	0.4056	8.8615	9.0000	196.6500 (29a)
Main Plane	70.9300		70.9300	0.1100	7.8023	9.0000	638.3700 (30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.9150		(33)
Internal Wall 1			24.2700			75.0000	1820.2500 (32c)
Internal Wall 2			215.2700			9.0000	1937.4300 (32c)
Internal Floor 1			50.9800			18.0000	917.6400 (32d)
Internal Ceiling 1			50.9800			18.0000	917.6400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18201.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							149.3026 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8356 (36)
Total fabric heat loss						(33) + (36) =	100.7506 (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	57.8947	57.5632	57.2383	55.7123	55.4268	54.0977	54.0977	53.8516	54.6097	55.4268	56.0044	56.6082 (38)
Heat transfer coeff	158.6452	158.3138	157.9889	156.4629	156.1774	154.8483	154.8483	154.6022	155.3603	156.1774	156.7550	157.3588 (39)
Average = Sum(39)m / 12 =												156.4615 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3013	1.2986	1.2959	1.2834	1.2811	1.2702	1.2702	1.2682	1.2744	1.2811	1.2858	1.2908 (40)
HLP (average)												1.2834 (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												2.8704 (42)
Average daily hot water use (litres/day)												102.3720 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (45)

Regs Region: England

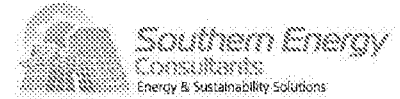
Elmhurst Energy Systems

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 =	1610.7108 (45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590	(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	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702	14.1447	(61)
Total heat required for water heating calculated for each month	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(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	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(64)
Heat gains from water heating, kWh/month	59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104	(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	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.7747	61.0851	49.6778	37.6093	28.1134	23.7345	25.6459	33.3356	44.7429	56.8114	66.3073	70.6862	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	429.3721	433.8276	422.5998	398.6971	368.5243	340.1660	321.2210	316.7655	327.9933	351.8960	382.0688	410.4270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains	693.0369	687.4337	659.8790	617.2197	573.2050	534.3506	512.1211	522.0165	547.0209	589.9144	637.3997	673.6442	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2		g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W		
East					11.5400	19.6403		0.4400	0.0000	0.7700	76.7886 (76)		
South					0.5100	46.7521		0.4400	0.0000	0.7700	8.0782 (78)		
West					5.0300	19.6403		0.4400	0.0000	0.7700	33.4702 (80)		
Solar gains	118.3370	228.9196	372.0627	537.0998	654.7413	669.0273	637.4191	549.6268	430.7286	270.2037	147.0552	97.6518	(83)
Total gains	811.3739	916.3533	1031.9417	1154.3196	1227.9463	1203.3779	1149.5402	1071.6432	977.7495	860.1181	784.4549	771.2959	(84)

7. Mean internal temperature (heating season)

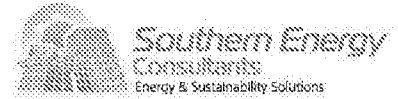
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	31.8696	31.9364	32.0020	32.3142	32.3732	32.6511	32.6511	32.7031	32.5435	32.7332	32.2539	32.1302	
alpha	3.1246	3.1291	3.1335	3.1543	3.1582	3.1767	3.1767	3.1802	3.1696	3.1582	3.1503	3.1420	
util living area	0.9827	0.9735	0.9531	0.9060	0.8190	0.6824	0.5411	0.5897	0.7939	0.9320	0.9740	0.9851	(86)
MIT	18.9880	19.1989	19.5779	20.0752	20.5121	20.8140	20.9350	20.9132	20.6765	20.1017	19.4569	18.9480	(87)
Th 2	19.8398	19.8419	19.8440	19.8538	19.8557	19.8643	19.8643	19.8659	19.8610	19.8557	19.8520	19.8481	(88)
util rest of house	0.9790	0.9679	0.9426	0.8836	0.7732	0.5985	0.4210	0.4708	0.7256	0.9112	0.9674	0.9820	(89)
MIT 2	17.1810	17.4876	18.0348	18.7447	19.3371	19.7119	19.8297	19.8157	19.5636	18.7971	17.8710	17.1279	(90)
Living area fraction	17.3899	17.6854	18.2131	18.8985	19.4729	19.8393	19.9575	19.9425	19.6922	18.9479	18.0543	17.3382	(91)
MIT	17.2399	17.5354	18.0631	18.7485	19.3229	19.6893	19.8075	19.7925	19.5422	18.7979	17.9043	17.1882	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9660	0.9509	0.9198	0.8557	0.7476	0.5839	0.4145	0.4623	0.7024	0.8845	0.9505	0.9703	(94)
Ext temp.	783.7878	871.4035	949.1364	987.6992	918.0495	702.6022	476.4511	495.4208	686.7348	760.7451	745.5862	748.4179	(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	2052.8508	2000.3616	1826.8440	1540.9191	1190.5205	788.0702	496.6743	524.4887	845.5027	1280.3282	1693.6318	2043.8145	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating per m2	944.1829	758.6599	653.0144	398.3183	202.7185	0.0000	0.0000	0.0000	0.0000	386.5698	682.5929	963.7751	(98)
												4989.8317	(98)
												(98) / (4) =	40.9305 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Calculation of Energy Ratings 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													5513.6261 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	944.1829	758.6599	653.0144	398.3183	202.7185	0.0000	0.0000	0.0000	0.0000	386.5698	682.5929	963.7751	(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)	1043.2960	838.2982	721.5629	440.1307	223.9983	0.0000	0.0000	0.0000	0.0000	427.1489	754.2462	1064.9448	(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	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(64)
Efficiency of water heater (217)m	89.9691	89.9293	89.8363	89.6231	89.1642	87.3000	87.3000	87.3000	87.3000	89.5798	89.8663	89.9910	(216)
Fuel for water heating, kWh/month	201.3509	176.6184	183.4837	161.8183	157.1570	140.1498	131.4963	148.5825	149.6726	168.0271	180.9343	195.4326	(219)
Water heating fuel used												1994.7235	(219)
Annual totals kWh/year													
Space heating fuel - main system												5513.6261	(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)												485.8334	(232)
Total delivered energy for all uses												8069.1830	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5513.6261	3.4800	191.8742 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1994.7235	3.4800	69.4164 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	485.8334	13.1900	64.0814 (250)
Additional standing charges			120.0000 (251)
Total energy cost			455.2645 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200 (256)
Energy cost factor (ECF)	1.1456 (257)
SAP value	84.0190
SAP rating (Section 12)	84 (258)
SAP band	B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	5513.6261	0.2160	1190.9432 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1994.7235	0.2160	430.8603 (264)
Space and water heating			1621.8035 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	485.8334	0.5190	252.1475 (268)
Total kg/year			1912.8761 (272)
CO2 emissions per m2			15.6900 (273)
EI value			84.6429
EI rating			85 (274)
EI band			B

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9050 = 3.845$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9050 = 0.2387$, stars = 4
Water heating energy efficiency	$3.48 / 0.8893 = 3.913$, stars = 4
Water heating environmental impact	$0.216 / 0.8893 = 0.2429$, stars = 4

Regs Region: England

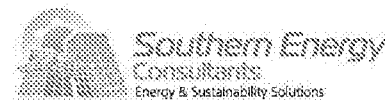
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
Calculation of EPC Costs, Emissions and Primary Energy 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (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) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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)	=	0.3262 (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	0.3425	0.3262	0.3262	0.3017	0.3017	0.2691	0.2772	0.2609	0.2691	0.2854	0.2854	0.3098 (22b)
Effective ac	0.5586	0.5532	0.5532	0.5455	0.5455	0.5362	0.5384	0.5340	0.5362	0.5407	0.5407	0.5480 (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)			17.0800	1.2357	21.1065		(27)
Heat Loss Floor 1			50.9800	0.2000	10.1960	75.0000	3823.5000 (28a)
Exposed Floor Over Garage			18.0600	0.1838	3.3187	20.0000	361.2000 (28b)
Brick Cavity	145.7100	19.2300	126.4800	0.2500	31.6200	60.0000	7588.8000 (29a)
Solid Garage Wall	21.8500		21.8500	0.4056	8.8615	9.0000	196.6500 (29a)
Main Plane	70.9300		70.9300	0.1100	7.8023	9.0000	638.3700 (30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.9150		(33)
Internal Wall 1			24.2700			75.0000	1820.2500 (32c)
Internal Wall 2			215.2700			9.0000	1937.4300 (32c)
Internal Floor 1			50.9800			18.0000	917.6400 (32d)
Internal Ceiling 1			50.9800			18.0000	917.6400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18201.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							149.3026 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8356 (36)
Total fabric heat loss						(33) + (36) =	100.7506 (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	55.1479	54.6097	54.6097	53.8516	53.8516	52.9327	53.1526	52.7194	52.9327	53.3790	53.3790	54.0977 (38)
Heat transfer coeff	155.8985	155.3603	155.3603	154.6022	154.6022	153.6833	153.9032	153.4700	153.6833	154.1296	154.1296	154.8483 (39)
Average = Sum(39)m / 12 =												154.4726 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2788	1.2744	1.2744	1.2682	1.2682	1.2606	1.2624	1.2589	1.2606	1.2643	1.2643	1.2702 (40)
HLP (average)												1.2671 (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												2.8704 (42)
Average daily hot water use (litres/day)												102.3720 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (45)

Regs Region: England

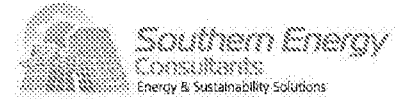
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

Energy content (annual)	Total = Sum(45)m = 1610.7108 (45)										
Distribution loss (46)m = 0.15 x (45)m											
25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590 (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	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702 (61)
Total heat required for water heating calculated for each month											
181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717 (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											
181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717 (64)
Heat gains from water heating, kWh/month											
59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104 (65)
Total per year (kWh/year) = Sum(64)m =											1776.4874 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.7747	61.0851	49.6778	37.6093	28.1134	23.7345	25.6459	33.3356	44.7429	56.8114	66.3073	70.6862	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	429.3721	433.8276	422.5998	398.6971	368.5243	340.1660	321.2210	316.7655	327.9933	351.8960	382.0688	410.4270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains	693.0369	687.4337	659.8790	617.2197	573.2050	534.3506	512.1211	522.0165	547.0209	589.9144	637.3997	673.6442	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East	11.5400	22.3313	0.4400	0.0000	0.7700	87.3099 (76)
South	0.5100	50.9848	0.4400	0.0000	0.7700	8.8096 (78)
West	5.0300	22.3313	0.4400	0.0000	0.7700	38.0562 (80)

Solar gains	134.1757	233.5479	374.4813	555.8733	659.1274	720.3588	679.0627	599.4862	469.5203	294.2344	170.8288	109.6400	(83)
Total gains	827.2126	920.9817	1034.3603	1173.0930	1232.3324	1254.7094	1191.1838	1121.5026	1016.5412	884.1488	808.2285	783.2842	(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	32.4312	32.5435	32.5435	32.7031	32.7031	32.8986	32.8516	32.9443	32.8986	32.8033	32.8033	32.6511
alpha	3.1621	3.1696	3.1696	3.1802	3.1802	3.1932	3.1901	3.1963	3.1932	3.1869	3.1869	3.1767
util living area	0.9791	0.9696	0.9441	0.8815	0.7622	0.5556	0.3873	0.4198	0.7093	0.9075	0.9662	0.9819 (86)
MIT	19.1765	19.3596	19.7569	20.2527	20.6739	20.9217	20.9827	20.9777	20.8130	20.2910	19.6589	19.1460 (87)
Th 2	19.8575	19.8610	19.8610	19.8659	19.8659	19.8718	19.8704	19.8732	19.8718	19.8689	19.8689	19.8643 (88)
util rest of house	0.9744	0.9629	0.9311	0.8526	0.7013	0.4502	0.2522	0.2801	0.6172	0.8781	0.9573	0.9779 (89)
MIT 2	17.4655	17.7320	18.3022	18.9983	19.5493	19.8232	19.8657	19.8666	19.7262	19.0688	18.1731	17.4258 (90)
Living area fraction	17.6633	17.9201	18.4704	19.1433	19.6793	19.9502	19.9948	19.9950	fLA = Living area / (4) =	19.8518	19.2101	18.3448
MIT	17.6633	17.9201	18.4704	19.1433	19.6793	19.9502	19.9948	19.9950	19.8518	19.2101	18.3448	17.6247 (91)
Temperature adjustment												-0.1500
adjusted MIT	17.5133	17.7701	18.3204	18.9933	19.5293	19.8002	19.8448	19.8450	19.7018	19.0601	18.1948	17.4747 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9599	0.9448	0.9068	0.8246	0.6803	0.4429	0.2490	0.2764	0.6012	0.8501	0.9378	0.9647	(94)
Useful gains	794.0162	870.1229	937.9878	967.2996	838.3172	555.7207	296.5734	309.9736	611.0954	751.5975	757.9477	755.6195	(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	1935.2110	1890.7477	1696.5902	1405.8386	1009.4419	584.0245	299.3162	313.8500	691.8574	1149.8174	1571.3277	1916.1944	(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	849.0490	685.8599	564.4002	315.7481	127.3168	0.0000	0.0000	0.0000	0.0000	296.2757	585.6336	863.4677	(98)
Space heating												4287.7508	(98)
Space heating per m2												(98) / (4) =	35.1714 (99)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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													4737.8462 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	849.0490	685.8599	564.4002	315.7481	127.3168	0.0000	0.0000	0.0000	0.0000	296.2757	585.6336	863.4677	(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)	938.1756	757.8562	623.6466	348.8929	140.6815	0.0000	0.0000	0.0000	0.0000	327.3764	647.1090	954.1079	(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	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(64)
Efficiency of water heater (217)m	89.9204	89.8805	89.7563	89.4678	88.7947	87.3000	87.3000	87.3000	87.3000	89.3961	89.7848	89.9421	(217)
Fuel for water heating, kWh/month	201.4599	176.7144	183.6472	162.0992	157.8110	140.1498	131.4963	148.5825	149.6726	168.3724	181.0985	195.5387	(219)
Water heating fuel used												1996.6426	(219)
Annual totals kWh/year													
Space heating fuel - main system												4737.8462	(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)												485.8334	(232)
Total delivered energy for all uses												7295.3222	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4737.8462	3.8700	183.3546 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1996.6426	3.8700	77.2701 (247)
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)
Energy for lighting	485.8334	18.9000	91.8225 (250)
Additional standing charges			93.0000 (251)
Total energy cost			459.6222 (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	4737.8462	0.2160	1023.3748 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1996.6426	0.2160	431.2748 (264)
Space and water heating			1454.6496 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	485.8334	0.5190	252.1475 (268)
Total kg/year			1745.7221 (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	4737.8462	1.2200	5780.1724 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1996.6426	1.2200	2435.9039 (264)
Space and water heating			8216.0764 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	485.8334	3.0700	1491.5085 (268)
Primary energy kWh/year			9937.8349 (272)
Primary energy kWh/m2/year			81.5178 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 84
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	+ 1.0	-£ 30	-193 kg (11.0%)
U Solar photovoltaic panels	+ 8.0	-£ 345	-947 kg (61.0%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£30	1.58 kg/m²	B 85 B 86
Solar photovoltaic panels	£345	7.77 kg/m²	A 93 A 93
Total Savings	£374	9.35 kg/m²	

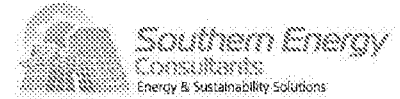
Potential energy efficiency rating: A 93
Potential environmental impact rating: A 93

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	£106	£115	-£9
Mains gas	£354	£314	£39
Space heating	£291	£291	£0
Water heating	£77	£48	£30
Lighting	£92	£92	£0
Generated (PV)	-£0	-£345	£345
Total cost of fuels	£460	£84	£375
Total cost of uses	£460	£86	£375
Delivered energy	60 kWh/m²	37 kWh/m²	23 kWh/m²
Carbon dioxide emissions	1.7 tonnes	0.6 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	5 kg/m²	9 kg/m²
Primary energy	82 kWh/m²	27 kWh/m²	55 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	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (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) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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) =		0.3262 (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	0.4159	0.4077	0.3995	0.3588	0.3506	0.3098	0.3098	0.3017	0.3262	0.3506	0.3669	0.3832 (22b)
Effective ac	0.5865	0.5831	0.5798	0.5644	0.5615	0.5480	0.5480	0.5455	0.5532	0.5615	0.5673	0.5734 (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)			17.0800	1.2357	21.1065		(27)
Heat Loss Floor 1			50.9800	0.2000	10.1960	75.0000	3823.5000 (28a)
Exposed Floor Over Garage			18.0600	0.1838	3.3187	20.0000	361.2000 (28b)
Brick Cavity	145.7100	19.2300	126.4800	0.2500	31.6200	60.0000	7588.8000 (29a)
Solid Garage Wall	21.8500		21.8500	0.4056	8.8615	9.0000	196.6500 (29a)
Main Plane	70.9300		70.9300	0.1100	7.8023	9.0000	638.3700 (30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.9150		(33)
Internal Wall 1			24.2700			75.0000	1820.2500 (32c)
Internal Wall 2			215.2700			9.0000	1937.4300 (32c)
Internal Floor 1			50.9800			18.0000	917.6400 (32d)
Internal Ceiling 1			50.9800			18.0000	917.6400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18201.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							149.3026 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8356 (36)
Total fabric heat loss						(33) + (36) =	100.7506 (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	57.8947	57.5632	57.2383	55.7123	55.4268	54.0977	54.0977	53.8516	54.6097	55.4268	56.0044	56.6082 (38)
Heat transfer coeff	158.6452	158.3138	157.9889	156.4629	156.1774	154.8483	154.8483	154.6022	155.3603	156.1774	156.7550	157.3588 (39)
Average = Sum(39)m / 12 =												156.4615 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3013	1.2986	1.2959	1.2834	1.2811	1.2702	1.2702	1.2682	1.2744	1.2811	1.2858	1.2908 (40)
HLP (average)												1.2834 (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												2.8704 (42)
Average daily hot water use (litres/day)												102.3720 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (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 = 1610.7108 (45)										
Distribution loss (46)m = 0.15 x (45)m											
25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590 (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	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702 (61)
Total heat required for water heating calculated for each month											
181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717 (62)
Aperture area of solar collector											
Zero-loss collector efficiency											
Collector heat loss coefficient											
Collector 2nd order heat loss coefficient											
Collector effective heat loss coefficient											
Collector performance ratio											
Annual solar radiation per m2											
Overshading factor											
Solar energy available											
Adjustment factor for showers											
Solar-to-load ratio											
Utilisation factor											
Collector performance factor											
Dedicated solar storage volume											
Effective solar volume											
Daily hot water demand											
Volume ratio Veff/V											
Solar storage volume factor											
Solar input											
Solar input	-25.5237	-42.5918	-72.5387	-97.2161	-120.1023	-118.0797	-116.5192	-101.8034	-79.7325	-54.4479	-30.2748
Output from w/h											
155.6299	116.2400	92.2963	47.8105	20.0254	4.2711	0.0000	27.9091	50.9317	96.0704	132.3241	154.5127 (64)
Heat gains from water heating, kWh/month											
59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104 (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	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	68.7747	61.0551	49.6778	37.6093	28.1134	23.7345	25.6459	33.3356	44.7429	56.8114	66.3073	70.6862	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	429.3721	433.8276	422.5998	398.6971	368.5243	340.1660	321.2210	316.7655	327.9933	351.8960	382.0688	410.4270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains	693.0369	687.4337	659.8790	617.2197	573.2050	534.3506	512.1211	522.0165	547.0209	589.9144	637.3997	673.6442	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	FF	Access factor Table 6d	Gains W
East	11.5400	19.6403	0.4400	0.0000	0.7700	76.7886	(76)
South	0.5100	46.7521	0.4400	0.0000	0.7700	8.0782	(78)
West	5.0300	19.6403	0.4400	0.0000	0.7700	33.4702	(80)

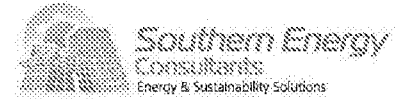
Solar gains	118.3370	228.9196	372.0627	537.0998	654.7413	669.0273	637.4191	549.6268	430.7286	270.2037	147.0552	97.6518	(83)
Total gains	811.3739	916.3533	1031.9417	1154.3196	1227.9463	1203.3779	1149.5402	1071.6432	977.7495	860.1181	784.4549	771.2959	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
alpha	31.8696	31.9364	32.0020	32.3142	32.3732	32.6511	32.6511	32.7031	32.5435	32.3732	32.2539	32.1302	
util living area	3.1246	3.1291	3.1335	3.1543	3.1582	3.1767	3.1767	3.1802	3.1696	3.1582	3.1503	3.1420	
0.9827	0.9735	0.9531	0.9060	0.8190	0.6824	0.5411	0.5897	0.7939	0.9320	0.9740	0.9851	0.9851	(86)
MIT	18.9880	19.1989	19.5779	20.0752	20.5121	20.8140	20.9350	20.9132	20.6765	20.1017	19.4569	18.9480	(87)
Th 2	19.8398	19.8419	19.8440	19.8538	19.8557	19.8643	19.8643	19.8659	19.8610	19.8557	19.8520	19.8481	(88)
util rest of house	0.9790	0.9679	0.9426	0.8836	0.7732	0.5985	0.4210	0.4708	0.7256	0.9112	0.9674	0.9820	(89)
MIT 2	17.1810	17.4876	18.0348	18.7447	19.3371	19.7119	19.8297	19.8157	19.5636	18.7971	17.8710	17.1279	(90)
Living area fraction	17.3899	17.6854	18.2131	18.8985	19.4729	19.8393	19.9575	19.9425	19.6922	18.9479	18.0543	17.3382	(91)
MIT	17.3899	17.6854	18.2131	18.8985	19.4729	19.8393	19.9575	19.9425	19.6922	18.9479	18.0543	17.3382	(92)
Temperature adjustment	17.2399	17.5354	18.0631	18.7485	19.3229	19.6893	19.8075	19.7925	19.5422	18.7979	17.9043	17.1882	(93)
adjusted MIT	17.2399	17.5354	18.0631	18.7485	19.3229	19.6893	19.8075	19.7925	19.5422	18.7979	17.9043	17.1882	(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	0.9660	0.9509	0.9198	0.8557	0.7476	0.5839	0.4145	0.4623	0.7024	0.8845	0.9505	0.9703	(94)
Useful gains	783.7878	871.4035	949.1364	987.6992	918.0495	702.6022	476.4511	495.4208	686.7348	760.7451	745.5862	748.4179	(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	2052.8508	2000.3616	1826.8440	1540.9191	1190.5205	788.0702	496.6743	524.4887	845.5027	1280.3282	1693.6318	2043.8145	(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	944.1829	758.6599	653.0144	398.3183	202.7185	0.0000	0.0000	0.0000	0.0000	386.5698	682.5929	963.7751	(98)
Space heating												4989.8317	(98)
Space heating per m2											(98) / (4) =	40.9305	(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													5513.6261 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	944.1829	758.6599	653.0144	398.3183	202.7185	0.0000	0.0000	0.0000	0.0000	386.5698	682.5929	963.7751	(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)	1043.2960	838.2982	721.5629	440.1307	223.9983	0.0000	0.0000	0.0000	0.0000	427.1489	754.2462	1064.9448	(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	155.6299	116.2400	92.2963	47.8105	20.0254	4.2711	0.0000	27.9091	50.9317	96.0704	132.3241	154.5127	(64)
Efficiency of water heater	90.0330	90.0614	90.0911	90.1459	90.2027	87.3000	87.3000	87.3000	87.3000	89.8445	89.9645	90.0440	(217)
Fuel for water heating, kWh/month	172.8587	129.0675	102.4478	53.0368	22.2004	4.8924	0.0000	31.9691	58.3410	106.9297	147.0848	171.5969	(219)
Water heating fuel used												1000.4253	(219)
Annual totals kWh/year													
Space heating fuel - main system												5513.6261	(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)													485.8334 (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												5397.6454	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5513.6261	3.4800	191.8742	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1000.4253	3.4800	34.8148	(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	485.8334	13.1900	64.0814	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			199.4350	(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] =	0.5018 (257)
SAP value		92.9993
SAP rating (Section 12)		93 (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	5513.6261	0.2160	1190.9432 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1000.4253	0.2160	216.0919 (264)
Space and water heating			1407.0351 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	485.8334	0.5190	252.1475 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			827.6204 (272)
CO2 emissions per m2			6.7900 (273)
EI value			93.3556
EI rating			93 (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	50.9800 (1b)	x 2.3200 (2b)	= 118.2736 (1b) - (3b)
First floor	70.9300 (1c)	x 2.5500 (2c)	= 180.8715 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 299.1451 (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) = 0.1337 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3837 (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) =	0.3262 (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	0.3425	0.3262	0.3262	0.3017	0.3017	0.2691	0.2772	0.2609	0.2691	0.2854	0.2854	0.3098 (22b)
Effective ac	0.5586	0.5532	0.5532	0.5455	0.5455	0.5362	0.5384	0.5340	0.5362	0.5407	0.5407	0.5480 (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)			17.0800	1.2357	21.1065		(27)
Heat Loss Floor 1			50.9800	0.2000	10.1960	75.0000	3823.5000 (28a)
Exposed Floor Over Garage			18.0600	0.1838	3.3187	20.0000	361.2000 (28b)
Brick Cavity	145.7100	19.2300	126.4800	0.2500	31.6200	60.0000	7588.8000 (29a)
Solid Garage Wall	21.8500		21.8500	0.4056	8.8615	9.0000	196.6500 (29a)
Main Plane	70.9300		70.9300	0.1100	7.8023	9.0000	638.3700 (30)
Total net area of external elements Aum(A, m ²)			307.5300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	85.9150		(33)
Internal Wall 1			24.2700			75.0000	1820.2500 (32c)
Internal Wall 2			215.2700			9.0000	1937.4300 (32c)
Internal Floor 1			50.9800			18.0000	917.6400 (32d)
Internal Ceiling 1			50.9800			18.0000	917.6400 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	18201.4800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							149.3026 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8356 (36)
Total fabric heat loss						(33) + (36) =	100.7506 (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	55.1479	54.6097	54.6097	53.8516	53.8516	52.9327	53.1526	52.7194	52.9327	53.3790	53.3790	54.0977 (38)
Heat transfer coeff	155.8985	155.3603	155.3603	154.6022	154.6022	153.6833	153.9032	153.4700	153.6833	154.1296	154.1296	154.8483 (39)
Average = Sum(39)m / 12 =												154.4726 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2788	1.2744	1.2744	1.2682	1.2682	1.2606	1.2624	1.2589	1.2606	1.2643	1.2643	1.2702 (40)
HLP (average)												1.2671 (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												2.8704 (42)
Average daily hot water use (litres/day)												102.3720 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092 (44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270 (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 =											1610.7108 (45)
Distribution loss (46)m = 0.15 x (45)m												
25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590	(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	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702	(61)
Total heat required for water heating calculated for each month												
181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(62)
Aperture area of solar collector												
Zero-loss collector efficiency												3.0000 (H1)
Collector heat loss coefficient												0.7000 (H2)
Collector 2nd order heat loss coefficient												1.8000 (H3)
Collector effective heat loss coefficient												0.0050 (H3a)
Collector performance ratio												1.8063 (H3b)
Annual solar radiation per m2												2.5804 (H4)
Overshading factor												1140.0998 (H5)
Solar energy available												0.8000 (H6)
Adjustment factor for showers												1915.3676 (H7)
Solar-to-load ratio												1.0000 (H7a)
Utilisation factor												1.1891 (H8)
Collector performance factor												0.5687 (H9)
Dedicated solar storage volume												0.8793 (H10)
Effective solar volume												75.0000 (H11)
Daily hot water demand												75.0000 (H13)
Volume ratio Veff/V												102.3720 (H14)
Solar storage volume factor												0.7326 (H15)
Solar input												0.9378 (H16)
Solar input	-27.6456	-41.5513	-69.9776	-96.7305	-116.4960	-122.6070	-119.6629	-106.8597	-83.4044	-56.7385	-33.6039	-898.1819 (H17)
Output from w/h												
153.5080	117.2805	94.8574	48.2962	23.6317	0.0000	0.0000	22.8528	47.2598	93.7799	128.9950	152.9671	(64)
Heat gains from water heating, kWh/month												
59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104	(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	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	66.7747	61.0551	49.6778	37.6093	28.1134	23.7345	25.6459	33.3356	44.7429	56.8114	66.3073	70.6862	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	429.3721	433.8276	422.5998	398.6971	368.5243	340.1660	321.2210	316.7655	327.9933	351.8960	382.0688	410.4270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	(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)	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains	693.0369	687.4337	659.8790	617.2197	573.2050	534.3506	512.1211	522.0165	547.0209	589.9144	637.3997	673.6442	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East	11.5400	22.3313	0.4400	0.0000	0.7700	87.3099	(76)
South	0.5100	50.9848	0.4400	0.0000	0.7700	8.8096	(78)
West	5.0300	22.3313	0.4400	0.0000	0.7700	38.0562	(80)

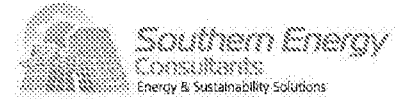
Solar gains	134.1757	233.5479	374.4813	555.8733	659.1274	720.3588	679.0627	599.4862	469.5203	294.2344	170.8288	109.6400	(83)
Total gains	827.2126	920.9817	1034.3603	1173.0930	1232.3324	1254.7094	1191.1838	1121.5026	1016.5412	884.1488	808.2285	783.2842	(84)

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	32.4312	32.5435	32.5435	32.7031	32.7031	32.8986	32.8516	32.9443	32.8986	32.8033	32.8033	32.6511
alpha	3.1621	3.1696	3.1696	3.1802	3.1802	3.1932	3.1901	3.1963	3.1932	3.1869	3.1869	3.1767
util living area												
	0.9791	0.9696	0.9441	0.8815	0.7622	0.5556	0.3873	0.4198	0.7093	0.9075	0.9662	0.9819 (86)
MIT	19.1765	19.3596	19.7569	20.2527	20.6739	20.9217	20.9827	20.9777	20.8130	20.2910	19.6589	19.1460 (87)
Th 2	19.8575	19.8610	19.8610	19.8659	19.8659	19.8718	19.8704	19.8732	19.8718	19.8689	19.8689	19.8643 (88)
util rest of house												
	0.9744	0.9629	0.9311	0.8526	0.7013	0.4502	0.2522	0.2801	0.6172	0.8781	0.9573	0.9779 (89)
MIT 2	17.4655	17.7320	18.3022	18.9983	19.5493	19.8232	19.8657	19.8666	19.7262	19.0688	18.1731	17.4258 (90)
Living area fraction												
MIT	17.6633	17.9201	18.4704	19.1433	19.6793	19.9502	19.9948	19.9950	19.8518	19.2101	18.3448	17.6247 (91)
Temperature adjustment												
adjusted MIT	17.5133	17.7701	18.3204	18.9933	19.5293	19.8002	19.8448	19.8450	19.7018	19.0601	18.1948	-0.1500 (93)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9599	0.9448	0.9068	0.8246	0.6803	0.4429	0.2490	0.2764	0.6012	0.8501	0.9378	0.9647	(94)
Useful gains	794.0162	870.1229	937.9878	967.2996	838.3172	555.7207	296.5734	309.9736	611.0954	751.5975	757.9477	755.6195	(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													
	1935.2110	1890.7477	1696.5902	1405.8386	1009.4419	584.0245	299.3162	313.8500	691.8574	1149.8174	1571.3277	1916.1944	(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													
	849.0490	685.8599	564.4002	315.7481	127.3168	0.0000	0.0000	0.0000	0.0000	296.2757	585.6336	863.4677	(98)
Space heating													
Space heating per m2													(98) / (4) = 35.1714 (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													4737.8462 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	849.0490	685.8599	564.4002	315.7481	127.3168	0.0000	0.0000	0.0000	0.0000	296.2757	585.6336	863.4677	(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)	938.1756	757.8562	623.6466	348.8929	140.6815	0.0000	0.0000	0.0000	0.0000	327.3764	647.1090	954.1079	(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	153.5080	117.2805	94.8574	48.2962	23.6317	0.0000	0.0000	22.8528	47.2598	93.7799	128.9950	152.9671	(64)
Efficiency of water heater	89.9949	90.0182	90.0252	90.0620	89.9836	87.3000	87.3000	87.3000	87.3000	89.7094	89.9051	90.0035	(217)
Fuel for water heating, kWh/month	170.5741	130.2854	105.3676	53.6254	26.2622	0.0000	0.0000	26.1773	54.1350	104.5374	143.4790	169.9568	(219)
Water heating fuel used												984.4002	(219)
Annual totals kWh/year													
Space heating fuel - main system													4737.8462 (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)													485.8334 (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													4508.9202 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4737.8462	3.8700	183.3546	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	984.4002	3.8700	38.0963	(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	485.8334	18.9000	91.8225	(250)
Additional standing charges			93.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	18.9000	-344.7662	(252)
Total energy cost			85.1323	(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	4737.8462	0.2160	1023.3748	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	984.4002	0.2160	212.6304	(264)
Space and water heating			1236.0052	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	485.8334	0.5190	252.1475	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)

Regs Region: England

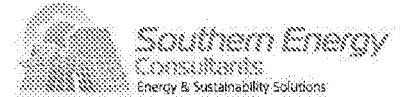
Elmhurst Energy Systems

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

Total kg/year

606.2889 (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	4737.8462	1.2200	5780.1724 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	984.4002	1.2200	1200.9683 (264)
Space and water heating			6981.1407 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	485.8334	3.0700	1491.5085 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	3.0700	-5600.1701 (269)
Primary energy kWh/year			3256.2291 (272)
Primary energy kWh/m2/year			26.7101 (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	West
Overshading	Average or unknown
Thermal mass parameter	149.3 (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	394.87 (P1)
Transmission heat loss coefficient	100.75 (37)
Summer heat loss coefficient	495.62 (P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	11.5400	117.5071	0.4400	0.0000	0.9000	536.9885
South	0.5100	112.2060	0.4400	0.0000	0.9000	22.6611
West	5.0300	117.5071	0.4400	0.0000	0.9000	234.0600

total: 793.7096

	Jun	Jul	Aug	
Solar gains	842	794	701	(P4)
Internal gains	531	509	519	
Total summer gains	1373	1303	1220	(P5)

Summer gain/loss ratio	2.77	2.63	2.46	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 149.3)	0.95	0.95	0.95	
Threshold temperature	19.73	21.48	21.22	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight