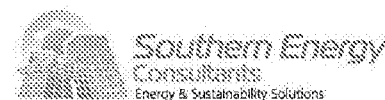


FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	SECANG003a		Issued on Date	04/02/2021	
Assessment Reference	001	Prop Type Ref	Det Br Ea Ga		
Property	Coniston+, Plot 82				
SAP Rating	84 B	DER	16.89	TET	17.38
Environmental	85 B	% DER<TER	2.84		
CO ₂ Emissions (t/year)	1.56	DPEE	51.27	TPEE	55.87
General Requirements Compliance	Pass	% DPEE<TPEE	8.23		
Assessor Details	Mr. Stuart Harvey, Stuart Harvey [REDACTED]			Assessor ID	T555-0001
Client	Persimon Homes Thames Valley				

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

DWELLING AS DESIGNED

Detached House, total floor area 113 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) 17.38 kgCO₂/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.89 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)55.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.3 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.19 (max. 0.25)	0.19 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.34 (max. 2.00)	1.60 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

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

4 Heating efficiency

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

Secondary heating system:

None

5 Cylinder insulation

Hot water storage No cylinder

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls:

No cylinder

Boiler interlock

Yes OK

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK

Based on:

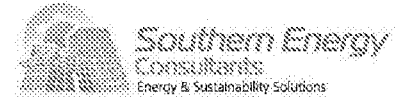
Overshading: Average
Windows facing North: 0.84 m², No overhang
Windows facing East: 7.24 m², No overhang
Windows facing South: 1.44 m², No overhang
Windows facing West: 8.32 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K
Roof U-value 0.11 W/m²K
Roof U-value 0.11 W/m²K
Thermal bridging y-value 0.039 W/m²K

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	56.8600 (1b)	x 2.3500 (2b)	= 133.6210 (1b) - (3b)
First floor	55.8100 (1c)	x 2.5200 (2c)	= 140.6412 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.6700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 274.2622 (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) = 0.1458 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3958 (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)	=	0.3365 (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	0.4290	0.4206	0.4122	0.3701	0.3617	0.3196	0.3196	0.3112	0.3365	0.3617	0.3785	0.3954 (22b)
Effective ac	0.5920	0.5884	0.5849	0.5685	0.5654	0.5511	0.5511	0.5484	0.5566	0.5654	0.5716	0.5782 (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)			17.8400	1.2357	22.0456		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			56.8600	0.1900	10.8034	75.0000	4264.5000 (28a)
Brick Cavity	149.5100	22.1400	127.3700	0.2500	31.8425	60.0000	7642.2000 (29a)
Main Plane	55.8100		55.8100	0.1100	6.1391	9.0000	502.2900 (30)
Bay Roof	1.5000		1.5000	0.1100	0.1650	9.0000	13.5000 (30)
Total net area of external elements Aum(A, m ²)			263.6800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	77.4456		(33)
Internal Wall 1			73.8800			75.0000	5541.0000 (32c)
Internal Wall 2			199.2400			9.0000	1793.1600 (32c)
Internal Floor 1			55.8100			18.0000	1004.5800 (32d)
Internal Ceiling 1			55.8100			18.0000	1004.5800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21765.8100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1819 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.3899 (36)
Total fabric heat loss						(33) + (36) =	87.8355 (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	53.5816	53.2582	52.9412	51.4523	51.1737	49.8769	49.8769	49.6368	50.3764	51.1737	51.7373	52.3265 (38)
Heat transfer coeff	141.4171	141.0937	140.7767	139.2878	139.0092	137.7124	137.7124	137.4723	138.2119	139.0092	139.5728	140.1619 (39)
Average = Sum(39)m / 12 =												139.2865 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2551	1.2523	1.2495	1.2362	1.2338	1.2223	1.2223	1.2201	1.2267	1.2338	1.2388	1.2440 (40)
HLP (average)												1.2362 (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												2.8299 (42)
Average daily hot water use (litres/day)												101.4110 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.5521	107.4957	103.4392	99.3828	95.3264	91.2699	91.2699	95.3264	99.3828	103.4392	107.4957	111.5521 (44)
Energy conte	165.4286	144.6849	149.3019	130.1650	124.8964	107.7761	99.8704	114.6027	115.9715	135.1535	147.5307	160.2088 (45)

Regs Region: England

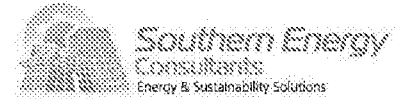
Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1595.5903 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8143	21.7027	22.3953	19.5247	18.7345	16.1664	14.9806	17.1904	17.3957	20.2730	22.1296	24.0313	(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	14.1536	12.7725	14.1149	13.6233	14.0423	13.5489	13.9753	14.0188	13.5894	14.0809	13.6669	14.1411	(61)
Total heat required for water heating calculated for each month	179.5822	157.4574	163.4167	143.7882	138.9387	121.3250	113.8457	128.6215	129.5609	149.2345	161.1975	174.3498	(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	179.5822	157.4574	163.4167	143.7882	138.9387	121.3250	113.8457	128.6215	129.5609	149.2345	161.1975	174.3498	(64)
Heat gains from water heating, kWh/month	58.5434	51.3009	53.1716	46.6857	45.0386	39.2228	36.7007	41.6101	41.9579	48.4588	52.4707	56.8047	(65)
Total per year (kWh/year) = Sum(64)m =												1761.3181	(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	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.6620	22.7928	18.5363	14.0332	10.4900	8.8561	9.5693	12.4386	16.6950	21.1981	24.7414	26.3753	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.3376	278.1948	270.9948	255.6671	236.3186	218.1337	205.9850	203.1279	210.3278	225.6556	245.0041	263.1890	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	(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)	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	(71)
Water heating gains (Table 5)	78.6874	76.3406	71.4672	64.8412	60.5358	54.4761	49.3289	55.9275	58.2748	65.1328	72.8759	76.3504	(72)
Total internal gains	448.1361	445.7772	429.4474	402.9906	375.7934	349.9149	333.3324	339.9431	353.7467	380.4355	411.0704	434.3637	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				0.8400	10.6334	0.4400	0.0000	0.7700	3.0262 (74)			
East				7.2400	19.6403	0.4400	0.0000	0.7700	48.1758 (76)			
South				1.4400	46.7521	0.4400	0.0000	0.7700	22.8090 (78)			
West				8.3200	19.6403	0.4400	0.0000	0.7700	55.3623 (80)			
Solar gains	129.3733	245.6810	390.9698	556.0405	673.4999	687.0070	654.9890	567.1414	449.4650	287.5091	159.8695	107.3766 (83)
Total gains	577.5094	691.4582	820.4172	959.0311	1049.2933	1036.9219	988.3213	907.0845	803.2117	667.9447	570.9400	541.7403 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.7534	42.8514	42.9479	43.4069	43.4939	43.9035	43.9035	43.9802	43.7448	43.4939	43.3183	43.1362	
alpha	3.8502	3.8568	3.8632	3.8938	3.8996	3.9269	3.9269	3.9320	3.9163	3.8996	3.8879	3.8757	
util living area	0.9967	0.9929	0.9821	0.9488	0.8696	0.7278	0.5749	0.6357	0.8587	0.9729	0.9939	0.9974	(86)
MIT	19.2265	19.4252	19.7717	20.2268	20.6206	20.8733	20.9623	20.9442	20.7363	20.2061	19.6322	19.1941	(87)
Th 2	19.8761	19.8784	19.8806	19.8911	19.8931	19.9022	19.9022	19.9039	19.8987	19.8931	19.8891	19.8850	(88)
util rest of house	0.9957	0.9909	0.9768	0.9327	0.8272	0.6403	0.4481	0.5094	0.7957	0.9616	0.9919	0.9967	(89)
MIT 2	17.5090	17.8001	18.3048	18.9618	19.4972	19.8052	19.8848	19.8752	19.6612	18.9441	18.1104	17.4672	(90)
Living area fraction	17.7285	18.0078	18.4922	19.1234	19.6407	19.9417	20.0225	20.0118	19.7986	19.1054	18.3049	17.6879	(91)
MIT	17.7285	18.0078	18.4922	19.1234	19.6407	19.9417	20.0225	20.0118	19.7986	19.1054	18.3049	17.6879	(92)
Temperature adjustment	17.5785	17.8578	18.3422	18.9734	19.4907	19.7917	19.8725	19.8618	19.6486	18.9554	18.1549	17.5379	(93)
adjusted MIT	17.5785	17.8578	18.3422	18.9734	19.4907	19.7917	19.8725	19.8618	19.6486	18.9554	18.1549	17.5379	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9926	0.9852	0.9661	0.9148	0.8083	0.6303	0.4444	0.5041	0.7778	0.9474	0.9867	0.9941	(94)
Useful gains	573.2268	681.2561	792.6046	877.3672	848.1254	653.5723	439.1989	457.2180	624.7049	632.7906	563.3431	538.5681	(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	1877.8096	1828.2651	1667.1118	1403.1086	1082.9854	714.9588	450.6639	475.9024	766.8810	1161.4733	1542.9672	1869.4654	(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	970.6096	770.7900	650.6333	378.5338	174.7358	0.0000	0.0000	0.0000	0.0000	393.3399	705.3294	990.1875	(98)
Space heating												5034.1594	(98)
Space heating per m2													(98) / (4) = 44.6806 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													5562.6071 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	970.6096	770.7900	650.6333	378.5338	174.7358	0.0000	0.0000	0.0000	0.0000	393.3399	705.3294	990.1875	(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)	1072.4968	851.7017	718.9319	418.2694	193.0783	0.0000	0.0000	0.0000	0.0000	434.6298	779.3695	1094.1299	(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	179.5822	157.4574	163.4167	143.7882	138.9387	121.3250	113.8457	128.6215	129.5609	149.2345	161.1975	174.3498	(64)
Efficiency of water heater (217)m	89.9850	89.9408	89.8389	89.5959	89.0541	87.3000	87.3000	87.3000	87.3000	89.5967	89.8871	87.3000	(216)
Fuel for water heating, kWh/month	199.5690	175.0679	181.8997	160.4853	156.0160	138.9748	130.4075	147.3327	148.4088	166.5625	179.3334	193.7090	(219)
Water heating fuel used												1977.7665	(219)
Annual totals kWh/year													
Space heating fuel - main system												5562.6071	(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)												453.1995	(232)
Total delivered energy for all uses												8068.5731	(238)

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

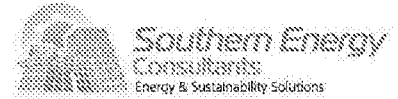
	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5562.6071	0.2160	1201.5231	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1977.7665	0.2160	427.1976	(264)
Space and water heating			1628.7207	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	453.1995	0.5190	235.2106	(268)
Total CO2, kg/year			1902.8562	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.8900	(273)

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

DER		16.8900	ZC1
Total Floor Area	TFA	112.6700	
Assumed number of occupants	N	2.8299	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.4812	ZC2
CO2 emissions from cooking, equation (L16)		1.6590	ZC3
Total CO2 emissions		33.0302	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		33.0302	ZC8

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	56.8600 (1b)	x 2.3500 (2b)	= 133.6210 (1b) - (3b)
First floor	55.8100 (1c)	x 2.5200 (2c)	= 140.6412 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.6700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 274.2622 (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) = 0.1458 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3958 (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) =	0.3365 (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	0.4290	0.4206	0.4122	0.3701	0.3617	0.3196	0.3196	0.3112	0.3365	0.3617	0.3785	0.3954 (22b)
Effective ac	0.5920	0.5884	0.5849	0.5685	0.5654	0.5511	0.5511	0.5484	0.5566	0.5654	0.5716	0.5782 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1500	1.0000	2.1500		(26)
TER Semi-glazed door			2.1500	1.2000	2.5800		(26a)
TER Opening Type (Uw = 1.40)			17.8400	1.3258	23.6515		(27)
Heat Loss Floor 1			56.8600	0.1300	7.3918		(28a)
Brick Cavity	149.5100	22.1400	127.3700	0.1800	22.9266		(29a)
Main Plane	55.8100		55.8100	0.1300	7.2553		(30)
Bay Roof	1.5000		1.5000	0.1300	0.1950		(30)
Total net area of external elements Aum(A, m ²)			263.6800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.1502		(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)							12.6831 (36)
Total fabric heat loss						(33) + (36) =	78.8333 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	53.5816	53.2582	52.9412	51.4523	51.1737	49.8769	49.8769	49.6368	50.3764	51.1737	51.7373	52.3265 (38)
Heat transfer coeff	132.4150	132.0916	131.7746	130.2856	130.0071	128.7103	128.7103	128.4701	129.2098	130.0071	130.5706	131.1598 (39)
Average = Sum(39)m / 12 =												130.2843 (39)
HLP	1.1752	1.1724	1.1696	1.1563	1.1539	1.1424	1.1424	1.1402	1.1468	1.1539	1.1589	1.1641 (40)
HLP (average)												1.1563 (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												2.8299 (42)
Average daily hot water use (litres/day)												101.4110 (43)
Daily hot water use	111.5521	107.4957	103.4392	99.3828	95.3264	91.2699	91.2699	95.3264	99.3828	103.4392	107.4957	111.5521 (44)
Energy conte	165.4286	144.6849	149.3019	130.1650	124.8964	107.7761	99.8704	114.6027	115.9715	135.1535	147.5307	160.2088 (45)
Energy content (annual)										Total = Sum(45)m =		1595.5903 (45)
Distribution loss (46)m = 0.15 x (45)m												
24.8143	21.7027	22.3953	19.5247	18.7345	16.1664	14.9806	17.1904	17.3957	20.2730	22.1296	24.0313 (46)	
Water storage loss:												
Total storage loss												

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Calculation Type: New Build (As Designed)



CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Total heat required for water heating calculated for each month	50.9589	46.0274	50.9589	49.0107	48.5773	45.0098	46.5102	48.5773	49.0107	50.9589	49.3151	50.9589 (61)
Solar input	216.3875	190.7123	200.2608	179.1757	173.4737	152.7859	146.3805	163.1800	164.9822	186.1125	196.8457	211.1677 (62)
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Heat gains from water heating, kWh/month	216.3875	190.7123	200.2608	179.1757	173.4737	152.7859	146.3805	163.1800	164.9822	186.1125	196.8457	211.1677 (64)
	67.7447	59.6146	62.3826	55.5325	53.6724	47.0880	44.8344	50.2497	50.8132	57.6783	61.3827	66.0091 (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	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.6620	22.7928	18.5363	14.0332	10.4900	8.8561	9.5693	12.4386	16.6950	21.1981	24.7414	26.3753	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.3376	278.1948	270.9948	255.6671	236.3186	218.1337	205.9850	203.1279	210.3278	225.6556	245.0041	263.1890	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	(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)	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	(71)
Water heating gains (Table 5)	91.0547	88.7122	83.8476	77.1285	72.1403	65.4000	60.2613	67.5400	70.5739	77.5246	85.2538	88.7220	(72)
Total internal gains	460.5035	458.1488	441.8278	415.2779	387.3979	360.8388	344.2648	351.5555	366.0457	392.8273	423.4483	446.7353	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	g Specific data or Table 6c	FF	Access factor Table 6d	Gains W
North	0.8400	10.6334	0.6300	0.7000	0.7700	2.7298	(74)
East	7.2400	19.6403	0.6300	0.7000	0.7700	43.4568	(76)
South	1.4400	46.7521	0.6300	0.7000	0.7700	20.5748	(78)
West	8.3200	19.6403	0.6300	0.7000	0.7700	49.9393	(80)

Solar gains	116.7006	221.6155	352.6725	501.5738	607.5275	619.7116	590.8298	511.5874	405.4379	259.3463	144.2096	96.8586	(83)
Total gains	577.2041	679.7642	794.5003	916.8517	994.9254	980.5504	935.0946	863.1428	771.4836	652.1736	567.6579	543.5938	(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	59.0893	59.2340	59.3765	60.0550	60.1837	60.7901	60.7901	60.9037	60.5551	60.1837	59.9239	59.6548	
alpha	4.9393	4.9489	4.9584	5.0037	5.0122	5.0527	5.0527	5.0602	5.0370	5.0122	4.9949	4.9770	
util living area	0.9990	0.9976	0.9924	0.9711	0.9034	0.7546	0.5857	0.6494	0.8884	0.9864	0.9979	0.9993	(86)
MIT	19.6436	19.7975	20.0679	20.4288	20.7416	20.9300	20.9845	20.9746	20.8281	20.4096	19.9610	19.6196	(87)
Th 2	19.9399	19.9422	19.9444	19.9551	19.9571	19.9664	19.9664	19.9681	19.9628	19.9571	19.9530	19.9488	(88)
util rest of house	0.9987	0.9967	0.9896	0.9594	0.8637	0.6641	0.4582	0.5207	0.8266	0.9791	0.9970	0.9990	(89)
MIT 2	18.1236	18.3501	18.7456	19.2713	19.6958	19.9181	19.9605	19.9572	19.8165	19.2520	18.5973	18.0948	(90)
Living area fraction	18.3179	18.5351	18.9146	19.4193	19.8294	20.0474	20.0914	20.0872	19.9458	19.4000	18.7716	18.2897	(92)
Temperature adjustment	18.3179	18.5351	18.9146	19.4193	19.8294	20.0474	20.0914	20.0872	19.9458	19.4000	18.7716	18.2897	(93)
adjusted MIT	18.3179	18.5351	18.9146	19.4193	19.8294	20.0474	20.0914	20.0872	19.9458	19.4000	18.7716	18.2897	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9978	0.9950	0.9855	0.9514	0.8578	0.6720	0.4743	0.5366	0.8254	0.9734	0.9955	0.9984	(94)
Useful gains	575.9615	676.3475	782.9673	872.2536	853.4492	658.9005	443.5494	463.1562	636.7847	634.8186	565.0839	542.7241	(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	1856.1797	1801.0757	1635.9328	1370.5075	1056.8833	701.1401	449.3748	473.6964	755.3292	1144.0569	1523.9718	1847.9980	(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	952.4824	755.8174	634.6063	358.7428	151.3549	0.0000	0.0000	0.0000	0.0000	378.8733	690.3993	971.1238	(98)
Space heating												4893.4001	(98)
Space heating per m2												(98) / (4) =	43.4313 (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													5239.1864 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	952.4824	755.8174	634.6063	358.7428	151.3549	0.0000	0.0000	0.0000	0.0000	378.8733	690.3993	971.1238	(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)	1019.7884	809.2263	679.4500	384.0929	162.0502	0.0000	0.0000	0.0000	0.0000	405.6459	739.1855	1039.7471	(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	216.3875	190.7123	200.2608	179.1757	173.4737	152.7859	146.3805	163.1800	164.9822	186.1125	196.8457	211.1677	(64)
Efficiency of water heater (217)m	88.3430	88.1657	87.7525	86.7649	84.7099	80.3000	80.3000	80.3000	80.3000	86.8035	87.9458	88.4138	(216)
Fuel for water heating, kWh/month	244.9403	216.3113	228.2110	206.5070	204.7856	190.2689	182.2921	203.2130	205.4572	214.4066	223.8261	238.8402	(219)
Water heating fuel used												2559.0593	(219)
Annual totals kWh/year													
Space heating fuel - main system												5239.1864	(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)												453.1995	(232)
Total delivered energy for all uses												8326.4452	(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	5239.1864	0.2160	1131.6643 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2559.0593	0.2160	552.7568 (264)
Space and water heating			1684.4211 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	453.1995	0.5190	235.2106 (268)
Total CO2, kg/m2/year			1958.5566 (272)
Emissions per m2 for space and water heating			14.9500 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.0876 (272b)
Emissions per m2 for pumps and fans			0.3455 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.9500 * 1.00) + 2.0876 + 0.3455, rounded to 2 d.p.			17.3800 (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	56.8600 (1b)	x 2.3500 (2b)	= 133.6210 (1b) - (3b)
First floor	55.8100 (1c)	x 2.5200 (2c)	= 140.6412 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.6700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 274.2622 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					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) = 0.1458 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3958 (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)	=	0.3365 (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	0.4290	0.4206	0.4122	0.3701	0.3617	0.3196	0.3196	0.3112	0.3365	0.3617	0.3785	0.3954 (22b)
Effective ac	0.5920	0.5884	0.5849	0.5685	0.5654	0.5511	0.5511	0.5484	0.5566	0.5654	0.5716	0.5782 (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)			17.8400	1.2357	22.0456		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			56.8600	0.1900	10.8034	75.0000	4264.5000 (28a)
Brick Cavity	149.5100	22.1400	127.3700	0.2500	31.8425	60.0000	7642.2000 (29a)
Main Plane	55.8100		55.8100	0.1100	6.1391	9.0000	502.2900 (30)
Bay Roof	1.5000		1.5000	0.1100	0.1650	9.0000	13.5000 (30)
Total net area of external elements Aum(A, m ²)			263.6800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	77.4456		(33)
Internal Wall 1			73.8800			75.0000	5541.0000 (32c)
Internal Wall 2			199.2400			9.0000	1793.1600 (32c)
Internal Floor 1			55.8100			18.0000	1004.5800 (32d)
Internal Ceiling 1			55.8100			9.0000	502.2900 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21263.5200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							188.7239 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.3899 (36)
Total fabric heat loss						(33) + (36) =	87.8355 (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	53.5816	53.2582	52.9412	51.4523	51.1737	49.8769	49.8769	49.6368	50.3764	51.1737	51.7373	52.3265 (38)
Heat transfer coeff	141.4171	141.0937	140.7767	139.2878	139.0092	137.7124	137.7124	137.4723	138.2119	139.0092	139.5728	140.1619 (39)
Average = Sum(39)m / 12 =												139.2865 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2551	1.2523	1.2495	1.2362	1.2338	1.2223	1.2223	1.2201	1.2267	1.2338	1.2388	1.2440 (40)
HLP (average)												1.2362 (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												2.8299 (42)
Average daily hot water use (litres/day)												101.4110 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.5521	107.4957	103.4392	99.3828	95.3264	91.2699	91.2699	95.3264	99.3828	103.4392	107.4957	111.5521 (44)
Energy conte	165.4286	144.6849	149.3019	130.1650	124.8964	107.7761	99.8704	114.6027	115.9715	135.1535	147.5307	160.2088 (45)

Regs Region: England

Elmhurst Energy Systems

SAP2012 Calculator (Design

System) version 4.14r16

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1595.5903 (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	35.1536	30.7455	31.7266	27.6601	26.5405	22.9024	21.2225	24.3531	24.6439	28.7201	31.3503	34.0444 (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	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.6620	22.7928	18.5363	14.0332	10.4900	8.8561	9.5693	12.4386	16.6950	21.1981	24.7414	26.3753	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.3376	278.1948	270.9948	255.6671	236.3186	218.1337	205.9850	203.1279	210.3278	225.6556	245.0041	263.1890	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	(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)	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	(71)
Water heating gains (Table 5)	47.2494	45.7523	42.6433	38.4167	35.6727	31.8089	28.5248	32.7326	34.2277	38.6023	43.5420	45.7585	(72)
Total internal gains	413.6981	412.1889	397.6236	373.5661	347.9303	324.2477	309.5282	313.7482	326.6996	350.9051	378.7366	400.7719	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		Gains W	
North					0.8400	10.6334	0.4400	0.0000	0.7700		3.0262 (74)	
East					7.2400	19.6403	0.4400	0.0000	0.7700		48.1758 (76)	
South					1.4400	46.7521	0.4400	0.0000	0.7700		22.8090 (78)	
West					8.3200	19.6403	0.4400	0.0000	0.7700		55.3623 (80)	
Solar gains	129.3733	245.6810	390.9698	556.0405	673.4999	687.0070	654.9890	567.1414	449.4650	287.5091	159.8695	107.3766 (83)
Total gains	543.0715	657.8699	788.5934	929.6066	1021.4302	1011.2548	964.5172	880.8896	776.1646	638.4142	538.6061	508.1484 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	41.7667	41.8625	41.9567	42.4052	42.4902	42.8903	42.8903	42.9653	42.7353	42.4902	42.3187	42.1408	
alpha	3.7844	3.7908	3.7971	3.8270	3.8327	3.8594	3.8594	3.8644	3.8490	3.8327	3.8212	3.8094	
util living area	0.9970	0.9935	0.9832	0.9512	0.8748	0.7364	0.5849	0.6476	0.8666	0.9752	0.9946	0.9977	(86)
MIT	19.1618	19.3650	19.7200	20.1876	20.5949	20.8610	20.9574	20.9370	20.7144	20.1648	19.5766	19.1294	(87)
Th 2	19.8761	19.8784	19.8806	19.8911	19.8931	19.9022	19.9022	19.9039	19.8987	19.8931	19.8891	19.8850	(88)
util rest of house	0.9962	0.9917	0.9784	0.9360	0.8339	0.6502	0.4574	0.5214	0.8063	0.9649	0.9928	0.9971	(89)
MIT 2	18.1980	18.4021	18.7561	19.2210	19.6017	19.8283	19.8884	19.8812	19.7202	19.2073	18.6219	18.1723	(90)
Living area fraction	18.3212	18.5251	18.8793	19.3445	19.7286	19.9603	20.0251	20.0161	19.8473	19.3297	18.7439	18.2946	(92)
Temperature adjustment	18.3212	18.5251	18.8793	19.3445	19.7286	19.9603	20.0251	20.0161	19.8473	19.3297	18.7439	18.2946	(93)
adjusted MIT	18.3212	18.5251	18.8793	19.3445	19.7286	19.9603	20.0251	20.0161	19.8473	19.3297	18.7439	18.2946	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	540.1321	650.3992	766.8466	861.2847	844.3723	662.6591	455.9454	471.8103	623.1502	611.3966	533.2878	506.0050	(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	1982.8344	1922.4225	1742.7128	1454.7961	1116.0552	738.1762	471.6746	497.1140	794.3426	1213.5094	1625.1719	1975.5243	(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	1073.3706	854.7996	726.0444	427.3282	202.1321	0.0000	0.0000	0.0000	0.0000	447.9719	786.1566	1093.3224	(98)
Space heating												5611.1258	(98)
Space heating per m2												49.8014	(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													

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Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	1294.4968	1019.0719	1044.7893	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.7940	0.8633	0.8280	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1027.8771	879.7341	865.0416	0.0000	0.0000	0.0000	0.0000 (102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1293.9253	1236.8683	1141.3059	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	191.5547	265.7079	205.5406	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									FC = cooled area / (4) =			662.8032 (104)
Intermittency factor (Table 10b)												1.0000 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling	0.0000	0.0000	0.0000	0.0000	0.0000	47.8887	66.4270	51.3852	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												165.7008 (107)
Energy for space heating												1.4707 (108)
Energy for space cooling												49.8014 (99)
Total												1.4707 (108)
Dwelling Fabric Energy Efficiency (DFEE)												51.2721 (109)
												51.3 (109)

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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	56.8600 (1b)	x 2.3500 (2b)	= 133.6210 (1b) - (3b)
First floor	55.8100 (1c)	x 2.5200 (2c)	= 140.6412 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.6700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 274.2622 (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) = 0.1458 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3958 (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) =	0.3365 (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	0.4290	0.4206	0.4122	0.3701	0.3617	0.3196	0.3196	0.3112	0.3365	0.3617	0.3785	0.3954 (22b)
Effective ac	0.5920	0.5884	0.5849	0.5685	0.5654	0.5511	0.5511	0.5484	0.5566	0.5654	0.5716	0.5782 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			2.1500	1.0000	2.1500		(26)
TER Semi-glazed door			2.1500	1.2000	2.5800		(26a)
TER Opening Type (Uw = 1.40)			17.8400	1.3258	23.6515		(27)
Heat Loss Floor 1			56.8600	0.1300	7.3918		(28a)
Brick Cavity	149.5100	22.1400	127.3700	0.1800	22.9266		(29a)
Main Plane	55.8100		55.8100	0.1300	7.2553		(30)
Bay Roof	1.5000		1.5000	0.1300	0.1950		(30)
Total net area of external elements Aum(A, m ²)			263.6800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.1502		(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)							12.6831 (36)
Total fabric heat loss						(33) + (36) =	78.8333 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	53.5816	53.2582	52.9412	51.4523	51.1737	49.8769	49.8769	49.6368	50.3764	51.1737	51.7373	52.3265 (38)
Heat transfer coeff	132.4150	132.0916	131.7746	130.2856	130.0071	128.7103	128.7103	128.4701	129.2098	130.0071	130.5706	131.1598 (39)
Average = Sum(39)m / 12 =												130.2843 (39)
HLP	1.1752	1.1724	1.1696	1.1563	1.1539	1.1424	1.1424	1.1402	1.1468	1.1539	1.1589	1.1641 (40)
HLP (average)												1.1563 (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												2.8299 (42)
Average daily hot water use (litres/day)												101.4110 (43)
Daily hot water use	111.5521	107.4957	103.4392	99.3828	95.3264	91.2699	91.2699	95.3264	99.3828	103.4392	107.4957	111.5521 (44)
Energy conte	165.4286	144.6849	149.3019	130.1650	124.8964	107.7761	99.8704	114.6027	115.9715	135.1535	147.5307	160.2088 (45)
Energy content (annual)										Total = Sum(45)m =		1595.5903 (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												

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	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	35.1536	30.7455	31.7266	27.6601	26.5405	22.9024	21.2225	24.3531	24.6439	28.7201	31.3503	34.0444 (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	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	141.4969	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.6620	22.7928	18.5363	14.0332	10.4900	8.8561	9.5693	12.4386	16.6950	21.1981	24.7414	26.3753	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	275.3376	278.1948	270.9948	255.6671	236.3186	218.1337	205.9850	203.1279	210.3278	225.6556	245.0041	263.1890	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	37.1497	(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)	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	(71)
Water heating gains (Table 5)	47.2494	45.7523	42.6433	38.4167	35.6727	31.8089	28.5248	32.7326	34.2277	38.6023	43.5420	45.7585	(72)
Total internal gains	413.6981	412.1889	397.6236	373.5661	347.9303	324.2477	309.5282	313.7482	326.6996	350.9051	378.7366	400.7719	(73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	Specific data or Table 6b	g	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	0.8400	10.6334	0.6300	0.6300	0.7000	0.7700	2.7298	(74)
East	7.2400	19.6403	0.6300	0.6300	0.7000	0.7700	43.4568	(76)
South	1.4400	46.7521	0.6300	0.6300	0.7000	0.7700	20.5748	(78)
West	8.3200	19.6403	0.6300	0.6300	0.7000	0.7700	49.9393	(80)

Solar gains	116.7006	221.6155	352.6725	501.5738	607.5275	619.7116	590.8298	511.5874	405.4379	259.3463	144.2096	96.8586	(83)
Total gains	530.3988	633.8044	750.2961	875.1399	955.4578	943.9593	900.3581	825.3355	732.1374	610.2514	522.9461	497.6304	(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	59.0893	59.2340	59.3765	60.0550	60.1837	60.7901	60.7901	60.9037	60.5551	60.1837	59.9239	59.6548	
alpha	4.9393	4.9489	4.9584	5.0037	5.0122	5.0527	5.0527	5.0602	5.0370	5.0122	4.9949	4.9770	
util living area	0.9993	0.9982	0.9941	0.9759	0.9149	0.7732	0.6051	0.6728	0.9047	0.9897	0.9986	0.9995	(86)
MIT	19.6050	19.7597	20.0325	20.3985	20.7210	20.9217	20.9821	20.9702	20.8088	20.3769	19.9242	19.5815	(87)
Th 2	19.9399	19.9422	19.9444	19.9551	19.9571	19.9664	19.9664	19.9681	19.9628	19.9571	19.9530	19.9488	(88)
util rest of house	0.9991	0.9976	0.9918	0.9658	0.8782	0.6840	0.4750	0.5424	0.8482	0.9840	0.9980	0.9994	(89)
MIT 2	18.6612	18.8176	19.0910	19.4596	19.7618	19.9288	19.9617	19.9592	19.8490	19.4440	18.9907	18.6449	(90)
Living area fraction									fLA = Living area / (4) =			0.1278	(91)
MIT	18.7818	18.9380	19.2113	19.5796	19.8844	20.0557	20.0921	20.0884	19.9716	19.5632	19.1100	18.7646	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7818	18.9380	19.2113	19.5796	19.8844	20.0557	20.0921	20.0884	19.9716	19.5632	19.1100	18.7646	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	529.7269	631.7450	742.5083	841.1316	836.1450	653.7930	442.6371	461.2373	621.4704	598.6550	521.4986	497.1749	(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	1917.6114	1854.3003	1675.0307	1391.4029	1064.0338	702.2031	449.4668	473.8484	758.6725	1165.2828	1568.1563	1910.2929	(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	1032.5861	821.5572	693.7967	396.1953	169.5493	0.0000	0.0000	0.0000	0.0000	421.5710	753.5935	1051.3597	(98)
Space heating												5340.2089	(98)
Space heating per m ²										(98) / (4) =		47.3969	(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	1209.8764	952.4559	976.3728	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8366	0.9056	0.8729	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1012.2238	862.5738	852.2493	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1215.2683	1161.8771	1076.3726	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

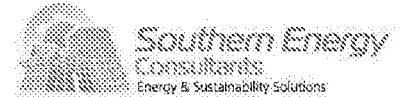


CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	146.1920	222.6817	166.7477	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												535.6214 (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	36.5480	55.6704	41.6869	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												133.9053 (107)
Space cooling per m2												1.1885 (108)
Energy for space heating												47.3969 (99)
Energy for space cooling												1.1885 (108)
Total												48.5854 (109)
Target Fabric Energy Efficiency (TFEE)												55.9 (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	56.8600 (1b)	x 2.3500 (2b)	= 133.6210 (1b) - (3b)
First floor	55.8100 (1c)	x 2.5200 (2c)	= 140.6412 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.6700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 274.2622 (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) = 0.1458 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3958 (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)	=	0.3365 (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	0.3533	0.3365	0.3365	0.3112	0.3112	0.2776	0.2860	0.2692	0.2776	0.2944	0.2944	0.3196 (22b)
Effective ac	0.5624	0.5566	0.5566	0.5484	0.5484	0.5385	0.5409	0.5362	0.5385	0.5433	0.5433	0.5511 (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)			17.8400	1.2357	22.0456		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			56.8600	0.1900	10.8034	75.0000	4264.5000 (28a)
Brick Cavity	149.5100	22.1400	127.3700	0.2500	31.8425	60.0000	7642.2000 (29a)
Main Plane	55.8100		55.8100	0.1100	6.1391	9.0000	502.2900 (30)
Bay Roof	1.5000		1.5000	0.1100	0.1650	9.0000	13.5000 (30)
Total net area of external elements Aum(A, m ²)			263.6800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	77.4456		(33)
Internal Wall 1			73.8800			75.0000	5541.0000 (32c)
Internal Wall 2			199.2400			9.0000	1793.1600 (32c)
Internal Floor 1			55.8100			18.0000	1004.5800 (32d)
Internal Ceiling 1			55.8100			18.0000	1004.5800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21765.8100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1819 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.3899 (36)
Total fabric heat loss						(33) + (36) =	87.8355 (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	50.9016	50.3764	50.3764	49.6368	49.6368	48.7402	48.9548	48.5321	48.7402	49.1757	49.1757	49.8769 (38)
Heat transfer coeff	138.7371	138.2119	138.2119	137.4723	137.4723	136.5757	136.7903	136.3676	136.5757	137.0112	137.0112	137.7124 (39)
Average = Sum(39)m / 12 =												137.3458 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2314	1.2267	1.2267	1.2201	1.2201	1.2122	1.2141	1.2103	1.2122	1.2160	1.2160	1.2223 (40)
HLP (average)												1.2190 (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												2.8299 (42)
Average daily hot water use (litres/day)												101.4110 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.5521	107.4957	103.4392	99.3828	95.3264	91.2699	91.2699	95.3264	99.3828	103.4392	107.4957	111.5521 (44)
Energy conte	165.4286	144.6849	149.3019	130.1650	124.8964	107.7761	99.8704	114.6027	115.9715	135.1535	147.5307	160.2088 (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 = 1595.5903 (45)
Distribution loss (46)m = 0.15 x (45)m												
	24.8143	21.7027	22.3953	19.5247	18.7345	16.1664	14.9806	17.1904	17.3957	20.2730	22.1296	24.0313 (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	14.1536	12.7725	14.1149	13.6233	14.0423	13.5489	13.9753	14.0188	13.5894	14.0809	13.6669	14.1411 (61)
Total heat required for water heating calculated for each month	179.5822	157.4574	163.4167	143.7882	138.9387	121.3250	113.8457	128.6215	129.5609	149.2345	161.1975	174.3498 (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	179.5822	157.4574	163.4167	143.7882	138.9387	121.3250	113.8457	128.6215	129.5609	149.2345	161.1975	174.3498 (64)
RHI water heating demand												
Heat gains from water heating, kWh/month	58.5434	51.3009	53.1716	46.6857	45.0386	39.2228	36.7007	41.6101	41.9579	48.4588	52.4707	56.8047 (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	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	64.1551	56.9820	46.3409	35.0830	26.2250	22.1402	23.9233	31.0964	41.7375	52.9954	61.8534	65.9382	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.9517	415.2160	404.4699	381.5927	352.7143	325.5726	307.4404	303.1760	313.9221	336.7993	365.6777	392.8194	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	(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)	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	(71)
Water heating gains (Table 5)	78.6874	76.3406	71.4672	64.8412	60.5358	54.4761	49.3289	55.9275	58.2748	65.1328	72.8759	76.3504	(72)
Total internal gains	668.2024	662.9469	636.6863	595.9252	553.8833	516.5973	495.1009	504.6082	528.3427	569.3358	614.8154	649.5162	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b		FF Specific data or Table 6c		Access factor Table 6d		Gains W
North					0.8400	11.9814	0.4400		0.0000		0.7700		3.4098 (74)
East					7.2400	22.3313	0.4400		0.0000		0.7700		54.7768 (76)
South					1.4400	50.9848	0.4400		0.0000		0.7700		24.8741 (78)
West					8.3200	22.3313	0.4400		0.0000		0.7700		62.9479 (80)
Solar gains	146.0085	249.6286	392.3405	574.4958	677.4312	739.3193	697.3121	617.7791	488.7413	311.9229	184.8797	119.9844	(83)
Total gains	814.2109	912.5755	1029.0268	1170.4210	1231.3146	1255.9165	1192.4130	1122.3873	1017.0840	881.2587	799.6951	769.5006	(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	43.5793	43.7448	43.7448	43.9802	43.9802	44.2689	44.1995	44.3365	44.2689	44.1282	44.1282	43.9035
alpha	3.9053	3.9163	3.9163	3.9320	3.9320	3.9513	3.9466	3.9558	3.9513	3.9419	3.9419	3.9269
util living area	0.9870	0.9790	0.9549	0.8875	0.7499	0.5202	0.3517	0.3831	0.6885	0.9164	0.9761	0.9893 (86)
MIT	19.6004	19.7660	20.1038	20.5125	20.8235	20.9704	20.9953	20.9936	20.9079	20.5190	19.9980	19.5715 (87)
Th 2	19.8950	19.8987	19.8987	19.9039	19.9039	19.9103	19.9088	19.9117	19.9103	19.9072	19.9072	19.9022 (88)
util rest of house	0.9835	0.9733	0.9423	0.8560	0.6830	0.4168	0.2299	0.2557	0.5901	0.8852	0.9684	0.9863 (89)
MIT 2	18.0650	18.3065	18.7898	19.3568	19.7455	19.8947	19.9078	19.9103	19.8469	19.3820	18.6502	18.0281 (90)
Living area fraction	18.2613	18.4931	18.9577	19.5045	19.8833	20.0322	20.0468	20.0487	19.9825	19.5273	18.6225	18.2254 (92)
MIT	18.2613	18.4931	18.9577	19.5045	19.8833	20.0322	20.0468	20.0487	19.9825	19.5273	18.6225	18.2254 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1113	18.3431	18.8077	19.3545	19.7333	19.8822	19.8968	19.8987	19.8325	19.3773	18.6725	18.0754 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9750	0.9618	0.9256	0.8367	0.6713	0.4140	0.2285	0.2541	0.5822	0.8656	0.9558	0.9788	(94)
Ext temp.	793.8522	877.7127	952.4164	979.3394	826.5621	519.9172	272.5153	285.2424	592.1845	762.8274	764.3316	753.2189	(95)
Heat loss rate W	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)
Month fracti	1805.1450	1761.2441	1576.6845	1299.7294	925.6418	530.2109	273.1430	286.2012	632.6888	1065.5834	1462.2451	1786.8703	(97)
Space heating kWh	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating	752.4019	593.7331	464.4555	230.6808	73.7152	0.0000	0.0000	0.0000	0.0000	225.2505	502.4977	769.0366	(98)
RHI space heating demand												3611.7714	(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	56.8600 (1b)	x 2.3500 (2b)	= 133.6210 (1b) - (3b)
First floor	55.8100 (1c)	x 2.5200 (2c)	= 140.6412 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.6700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 274.2622 (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) = 0.1458 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3958 (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)	=	0.3365 (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	0.4290	0.4206	0.4122	0.3701	0.3617	0.3196	0.3196	0.3112	0.3365	0.3617	0.3785	0.3954 (22b)
Effective ac	0.5920	0.5884	0.5849	0.5685	0.5654	0.5511	0.5511	0.5484	0.5566	0.5654	0.5716	0.5782 (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)			17.8400	1.2357	22.0456		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			56.8600	0.1900	10.8034	75.0000	4264.5000 (28a)
Brick Cavity	149.5100	22.1400	127.3700	0.2500	31.8425	60.0000	7642.2000 (29a)
Main Plane	55.8100		55.8100	0.1100	6.1391	9.0000	502.2900 (30)
Bay Roof	1.5000		1.5000	0.1100	0.1650	9.0000	13.5000 (30)
Total net area of external elements Aum(A, m ²)			263.6800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	77.4456		(33)
Internal Wall 1			73.8800			75.0000	5541.0000 (32c)
Internal Wall 2			199.2400			9.0000	1793.1600 (32c)
Internal Floor 1			55.8100			18.0000	1004.5800 (32d)
Internal Ceiling 1			55.8100			18.0000	1004.5800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21765.8100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1819 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.3899 (36)
Total fabric heat loss						(33) + (36) =	87.8355 (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	53.5816	53.2582	52.9412	51.4523	51.1737	49.8769	49.8769	49.6368	50.3764	51.1737	51.7373	52.3265 (38)
Heat transfer coeff	141.4171	141.0937	140.7767	139.2878	139.0092	137.7124	137.7124	137.4723	138.2119	139.0092	139.5728	140.1619 (39)
Average = Sum(39)m / 12 =												139.2865 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2551	1.2523	1.2495	1.2362	1.2338	1.2223	1.2223	1.2201	1.2267	1.2338	1.2388	1.2440 (40)
HLP (average)												1.2362 (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												2.8299 (42)
Average daily hot water use (litres/day)												101.4110 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.5521	107.4957	103.4392	99.3828	95.3264	91.2699	91.2699	95.3264	99.3828	103.4392	107.4957	111.5521 (44)
Energy conte	165.4286	144.6849	149.3019	130.1650	124.8964	107.7761	99.8704	114.6027	115.9715	135.1535	147.5307	160.2088 (45)

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Energy content (annual)												Total = Sum(45)m =	1595.5903 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8143	21.7027	22.3953	19.5247	18.7345	16.1664	14.9806	17.1904	17.3957	20.2730	22.1296	24.0313	(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	14.1536	12.7725	14.1149	13.6233	14.0423	13.5489	13.9753	14.0188	13.5894	14.0809	13.6669	14.1411	(61)
Total heat required for water heating calculated for each month	179.5822	157.4574	163.4167	143.7882	138.9387	121.3250	113.8457	128.6215	129.5609	149.2345	161.1975	174.3498	(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	179.5822	157.4574	163.4167	143.7882	138.9387	121.3250	113.8457	128.6215	129.5609	149.2345	161.1975	174.3498	(64)
Heat gains from water heating, kWh/month	58.5434	51.3009	53.1716	46.6857	45.0386	39.2228	36.7007	41.6101	41.9579	48.4588	52.4707	56.8047	(65)
Total per year (kWh/year) = Sum(64)m =												1761.3181	(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	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	64.1551	56.9820	46.3409	35.0830	26.2250	22.1402	23.9233	31.0964	41.7375	52.9954	61.8534	65.9382	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.9517	415.2160	404.4699	381.5927	352.7143	325.5726	307.4404	303.1760	313.9221	336.7993	365.6777	392.8194	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	(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)	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	(71)
Water heating gains (Table 5)	78.6874	76.3406	71.4672	64.8412	60.5358	54.4761	49.3289	55.9275	58.2748	65.1328	72.8759	76.3504	(72)
Total internal gains	668.2024	662.9469	636.6863	595.9252	553.8833	516.5973	495.1009	504.6082	528.3427	569.3358	614.8154	649.5162	(73)

6. Solar gains

[Jan]				Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W			
North				0.8400	10.6334	0.4400	0.0000	0.7700	3.0262 (74)			
East				7.2400	19.6403	0.4400	0.0000	0.7700	48.1758 (76)			
South				1.4400	46.7521	0.4400	0.0000	0.7700	22.8090 (78)			
West				8.3200	19.6403	0.4400	0.0000	0.7700	55.3623 (80)			
Solar gains	129.3733	245.6810	390.9698	556.0405	673.4999	687.0070	654.9890	567.1414	449.4650	287.5091	159.8695	107.3766 (83)
Total gains	797.5758	908.6279	1027.6561	1151.9658	1227.3832	1203.6043	1150.0899	1071.7497	977.8078	856.8449	774.6849	756.8928 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.7534	42.8514	42.9479	43.4069	43.4939	43.9035	43.9035	43.9802	43.7448	43.4939	43.3183	43.1362	
alpha	3.8502	3.8568	3.8632	3.8938	3.8996	3.9269	3.9269	3.9320	3.9163	3.8996	3.8879	3.8757	
util living area	0.9898	0.9823	0.9637	0.9148	0.8160	0.6588	0.5058	0.5572	0.7865	0.9426	0.9829	0.9916	(86)
MIT	19.4389	19.6298	19.9552	20.3704	20.7095	20.9115	20.9758	20.9648	20.8156	20.3635	19.8255	19.4033	(87)
Th 2	19.8761	19.8784	19.8806	19.8911	19.8931	19.9022	19.9022	19.9039	19.8987	19.8931	19.8891	19.8850	(88)
util rest of house	0.9871	0.9776	0.9538	0.8911	0.7651	0.5700	0.3891	0.4386	0.7109	0.9216	0.9776	0.9894	(89)
MIT 2	17.8177	18.0957	18.5651	19.1546	19.6011	19.8376	19.8916	19.8869	19.7431	19.1594	18.3892	17.7718	(90)
Living area fraction	18.0249	18.2918	18.7428	19.3100	19.7428	19.9749	20.0302	20.0246	19.8802	19.3133	18.5728	17.9803	(91)
MIT	17.8749	18.1418	18.5928	19.1600	19.5928	19.8249	19.8802	19.8746	19.7302	19.1633	18.4228	17.8303	(92)
Temperature adjustment												-0.1500	
adjusted MIT												17.8303	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9799	0.9671	0.9383	0.8715	0.7491	0.5632	0.3866	0.4352	0.6973	0.9029	0.9671	0.9831	(94)
Useful gains	781.5054	878.7780	964.2584	1003.9155	919.3725	677.8484	444.6585	466.4182	681.8701	773.6069	749.2020	744.1203	(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	1919.7247	1868.3341	1702.3814	1429.0918	1097.1685	719.5299	451.7185	477.6643	778.1577	1190.3759	1580.3506	1910.4501	(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	846.8352	664.9817	549.1635	306.1269	132.2802	0.0000	0.0000	0.0000	0.0000	310.0761	598.4270	867.7494	(98)
Space heating												4275.6400	(98)
Space heating per m2												(98) / (4) =	37.9483 (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												4724.4641 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	846.8352	664.9817	549.1635	306.1269	132.2802	0.0000	0.0000	0.0000	0.0000	310.0761	598.4270	867.7494 (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)	935.7295	734.7864	606.8105	338.2618	146.1660	0.0000	0.0000	0.0000	0.0000	342.6256	661.2453	958.8391 (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	179.5822	157.4574	163.4167	143.7882	138.9387	121.3250	113.8457	128.6215	129.5609	149.2345	161.1975	174.3498 (64)
Efficiency of water heater	89.9233	89.8693	89.7456	89.4521	88.8320	87.3000	87.3000	87.3000	87.3000	89.4349	89.8015	87.3000 (216)
(217)m	89.9233	89.8693										89.9484 (217)
Fuel for water heating, kWh/month	199.7059	175.2071	182.0889	160.7433	156.4062	138.9748	130.4075	147.3327	148.4088	166.8639	179.5043	193.8332 (219)
Water heating fuel used												1979.4765 (219)
Annual totals kWh/year												
Space heating fuel - main system												4724.4641 (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)												453.1995 (232)
Total delivered energy for all uses												7232.1402 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	4724.4641	3.4800	164.4114 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1979.4765	3.4800	68.8858 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	453.1995	13.1900	59.7770 (250)
Additional standing charges			120.0000 (251)
Total energy cost			422.9667 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1267 (257)
SAP value		84.2826
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	4724.4641	0.2160	1020.4842 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1979.4765	0.2160	427.5669 (264)
Space and water heating			1448.0512 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	453.1995	0.5190	235.2106 (268)
Total kg/year			1722.1867 (272)
CO2 emissions per m2			15.2900 (273)
EI value			85.3635
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	$3.48 / 0.8885 = 3.917$, stars = 4
Water heating environmental impact	$0.216 / 0.8885 = 0.2431$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	56.8600 (1b)	x 2.3500 (2b)	= 133.6210 (1b) - (3b)
First floor	55.8100 (1c)	x 2.5200 (2c)	= 140.6412 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.6700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 274.2622 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					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) = 0.1458 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3958 (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) =	0.3365 (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	0.3533	0.3365	0.3365	0.3112	0.3112	0.2776	0.2860	0.2692	0.2776	0.2944	0.2944	0.3196 (22b)
Effective ac	0.5624	0.5566	0.5566	0.5484	0.5484	0.5385	0.5409	0.5362	0.5385	0.5433	0.5433	0.5511 (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)			17.8400	1.2357	22.0456		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			56.8600	0.1900	10.8034	75.0000	4264.5000 (28a)
Brick Cavity	149.5100	22.1400	127.3700	0.2500	31.8425	60.0000	7642.2000 (29a)
Main Plane	55.8100		55.8100	0.1100	6.1391	9.0000	502.2900 (30)
Bay Roof	1.5000		1.5000	0.1100	0.1650	9.0000	13.5000 (30)
Total net area of external elements Aum(A, m ²)			263.6800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	77.4456		(33)
Internal Wall 1			73.8800			75.0000	5541.0000 (32c)
Internal Wall 2			199.2400			9.0000	1793.1600 (32c)
Internal Floor 1			55.8100			18.0000	1004.5800 (32d)
Internal Ceiling 1			55.8100			18.0000	1004.5800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21765.8100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1819 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.3899 (36)
Total fabric heat loss						(33) + (36) =	87.8355 (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	50.9016	50.3764	50.3764	49.6368	49.6368	48.7402	48.9548	48.5321	48.7402	49.1757	49.1757	49.8769 (38)
Heat transfer coeff	138.7371	138.2119	138.2119	137.4723	137.4723	136.5757	136.7903	136.3676	136.5757	137.0112	137.0112	137.7124 (39)
Average = Sum(39)m / 12 =												137.3458 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2314	1.2267	1.2267	1.2201	1.2201	1.2122	1.2141	1.2103	1.2122	1.2160	1.2160	1.2223 (40)
HLP (average)												1.2190 (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												2.8299 (42)
Average daily hot water use (litres/day)												101.4110 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.5521	107.4957	103.4392	99.3828	95.3264	91.2699	91.2699	95.3264	99.3828	103.4392	107.4957	111.5521 (44)
Energy conte	165.4286	144.6849	149.3019	130.1650	124.8964	107.7761	99.8704	114.6027	115.9715	135.1535	147.5307	160.2088 (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 =	1595.5903 (45)
Distribution loss (46)m = 0.15 x (45)m													
	24.8143	21.7027	22.3953	19.5247	18.7345	16.1664	14.9806	17.1904	17.3957	20.2730	22.1296	24.0313	(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	14.1536	12.7725	14.1149	13.6233	14.0423	13.5489	13.9753	14.0188	13.5894	14.0809	13.6669	14.1411	(61)
Total heat required for water heating calculated for each month	179.5822	157.4574	163.4167	143.7882	138.9387	121.3250	113.8457	128.6215	129.5609	149.2345	161.1975	174.3498	(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	179.5822	157.4574	163.4167	143.7882	138.9387	121.3250	113.8457	128.6215	129.5609	149.2345	161.1975	174.3498	(64)
Heat gains from water heating, kWh/month	58.5434	51.3009	53.1716	46.6857	45.0386	39.2228	36.7007	41.6101	41.9579	48.4588	52.4707	56.8047	(65)
Total per year (kWh/year) = Sum(64)m =												1761.3181	(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	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	64.1551	56.9820	46.3409	35.0830	26.2250	22.1402	23.9233	31.0964	41.7375	52.9954	61.8534	65.9382	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.9517	415.2160	404.4699	381.5927	352.7143	325.5726	307.4404	303.1760	313.9221	336.7993	365.6777	392.8194	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	(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)	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	(71)
Water heating gains (Table 5)	78.6874	76.3406	71.4672	64.8412	60.5358	54.4761	49.3289	55.9275	58.2748	65.1328	72.8759	76.3504	(72)
Total internal gains	668.2024	662.9469	636.6863	595.9252	553.8833	516.5973	495.1009	504.6082	528.3427	569.3358	614.8154	649.5162	(73)

6. Solar gains

[Jan]					Area m2	Solar flux Table 6a W/m2	g	Specific data or Table 6b	FF	Specific data or Table 6c	Access factor Table 6d	Gains W
North					0.8400	11.9814		0.4400		0.0000	0.7700	3.4098 (74)
East					7.2400	22.3313				0.0000	0.7700	54.7768 (76)
South					1.4400	50.9848		0.4400		0.0000	0.7700	24.8741 (78)
West					8.3200	22.3313		0.4400		0.0000	0.7700	62.9479 (80)
Solar gains	146.0085	249.6286	392.3405	574.4958	677.4312	739.3193	697.3121	617.7791	488.7413	311.9229	184.8797	119.9844 (83)
Total gains	814.2109	912.5755	1029.0268	1170.4210	1231.3146	1255.9165	1192.4130	1122.3873	1017.0840	881.2587	799.6951	769.5006 (84)

7. Mean internal temperature (heating season)

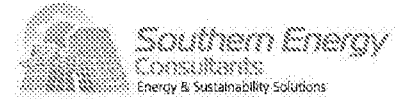
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	43.5793	43.7448	43.7448	43.9802	43.9802	44.2689	44.1995	44.3365	44.2689	44.1282	44.1282	43.9035	
alpha	3.9053	3.9163	3.9163	3.9320	3.9320	3.9513	3.9466	3.9558	3.9513	3.9419	3.9419	3.9269	
util living area	0.9870	0.9790	0.9549	0.8875	0.7499	0.5202	0.3517	0.3831	0.6885	0.9164	0.9761	0.9893	(86)
MIT	19.6004	19.7660	20.1038	20.5125	20.8235	20.9704	20.9953	20.9936	20.9079	20.5190	19.9980	19.5715	(87)
Th 2	19.8950	19.8987	19.8987	19.9039	19.9039	19.9103	19.9088	19.9117	19.9103	19.9072	19.9072	19.9022	(88)
util rest of house	0.9835	0.9733	0.9423	0.8560	0.6830	0.4168	0.2299	0.2557	0.5901	0.8852	0.9684	0.9863	(89)
MIT 2	18.0650	18.3065	18.7898	19.3568	19.7455	19.8947	19.9078	19.9103	19.8469	19.3820	18.6502	18.0281	(90)
Living area fraction	18.2613	18.4931	18.9577	19.5045	19.8833	20.0322	20.0468	20.0487	19.9825	19.5273	18.8225	18.2278	(91)
MIT	18.2613	18.4931	18.9577	19.5045	19.8833	20.0322	20.0468	20.0487	19.9825	19.5273	18.8225	18.2278	(92)
Temperature adjustment	18.1113	18.3431	18.8077	19.3545	19.7333	19.8822	19.8968	19.8987	19.8325	19.3773	18.6725	18.0754	(93)
adjusted MIT	18.1113	18.3431	18.8077	19.3545	19.7333	19.8822	19.8968	19.8987	19.8325	19.3773	18.6725	18.0754	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9750	0.9618	0.9256	0.8367	0.6713	0.4140	0.2285	0.2541	0.5822	0.8656	0.9558	0.9788	(94)
Useful gains	793.8522	877.7127	952.4164	979.3394	826.5621	519.9172	272.5153	285.2424	592.1845	762.8274	764.3316	753.2189	(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	1805.1450	1761.2441	1576.6845	1299.7294	925.6418	530.2109	273.1430	286.2012	632.6888	1065.5834	1462.2451	1786.8703	(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	752.4019	593.7331	464.4555	230.6808	73.7152	0.0000	0.0000	0.0000	0.0000	225.2505	502.4977	769.0366	(98)
Space heating												3611.7714	(98)
Space heating per m2												(98) / (4) =	32.0562 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.5000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3990.9076 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	752.4019	593.7331	464.4555	230.6808	73.7152	0.0000	0.0000	0.0000	0.0000	225.2505	502.4977	769.0366	(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)	831.3833	656.0587	513.2104	254.8959	81.4533	0.0000	0.0000	0.0000	0.0000	248.8956	555.2461	849.7642	(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	179.5822	157.4574	163.4167	143.7882	138.9387	121.3250	113.8457	128.6215	129.5609	149.2345	161.1975	174.3498	(64)
Efficiency of water heater (217)m	89.8653	89.8100	89.6448	89.2439	88.3833	87.3000	87.3000	87.3000	87.3000	89.1971	89.7014	87.3000	(216)
Fuel for water heating, kWh/month	199.8349	175.3229	182.2937	161.1183	157.2001	138.9748	130.4075	147.3327	148.4088	167.3087	179.7046	193.9568	(219)
Water heating fuel used												1981.8637	(219)
Annual totals kWh/year													
Space heating fuel - main system												3990.9076	(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)												453.1995	(232)
Total delivered energy for all uses												6500.9709	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3990.9076	3.8700	154.4481 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	1981.8637	3.8700	76.6981 (247)
Pumps and fans for heating	75.0000	18.9000	14.1750 (249)
Energy for lighting	453.1995	18.9000	85.6547 (250)
Additional standing charges			93.0000 (251)
Total energy cost			423.9760 (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	3990.9076	0.2160	862.0360 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1981.8637	0.2160	428.0826 (264)
Space and water heating			1290.1186 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	453.1995	0.5190	235.2106 (268)
Total kg/year			1564.2542 (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	3990.9076	1.2200	4868.9073 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1981.8637	1.2200	2417.8737 (264)
Space and water heating			7286.7810 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	453.1995	3.0700	1391.3225 (268)
Primary energy kWh/year			8908.3536 (272)
Primary energy kWh/m2/year			79.0659 (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	-192 kg (12.3%)
U Solar photovoltaic panels	+ 8.5	-£ 345	-947 kg (69.0%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£30	1.70 kg/m²	B 85 B 87
Solar photovoltaic panels	£345	8.40 kg/m²	A 94 A 95
Total Savings	£374	10.11 kg/m²	

Potential energy efficiency rating: A 94
 Potential environmental impact rating: A 95

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

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

	Current	Potential	Saving
Electricity	£100	£109	-£9
Mains gas	£324	£285	£39
Space heating	£262	£262	£0
Water heating	£77	£47	£30
Lighting	£86	£86	£0
Generated (PV)	-£0	-£345	£345
Total cost of fuels	£424	£49	£375
Total cost of uses	£425	£50	£375
Delivered energy	58 kWh/m²	33 kWh/m²	25 kWh/m²
Carbon dioxide emissions	1.6 tonnes	0.4 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	4 kg/m²	10 kg/m²
Primary energy	79 kWh/m²	20 kWh/m²	59 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	56.8600 (1b)	x 2.3500 (2b)	= 133.6210 (1b) - (3b)
First floor	55.8100 (1c)	x 2.5200 (2c)	= 140.6412 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.6700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 274.2622 (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) = 0.1458 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3958 (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) = 0.3365 (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	0.4290	0.4206	0.4122	0.3701	0.3617	0.3196	0.3196	0.3112	0.3365	0.3617	0.3785	0.3954 (22b)
Effective ac	0.5920	0.5884	0.5849	0.5685	0.5654	0.5511	0.5511	0.5484	0.5566	0.5654	0.5716	0.5782 (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)			17.8400	1.2357	22.0456		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			56.8600	0.1900	10.8034	75.0000	4264.5000 (28a)
Brick Cavity	149.5100	22.1400	127.3700	0.2500	31.8425	60.0000	7642.2000 (29a)
Main Plane	55.8100		55.8100	0.1100	6.1391	9.0000	502.2900 (30)
Bay Roof	1.5000		1.5000	0.1100	0.1650	9.0000	13.5000 (30)
Total net area of external elements Aum(A, m ²)			263.6800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	77.4456		(33)
Internal Wall 1			73.8800			75.0000	5541.0000 (32c)
Internal Wall 2			199.2400			9.0000	1793.1600 (32c)
Internal Floor 1			55.8100			18.0000	1004.5800 (32d)
Internal Ceiling 1			55.8100			18.0000	1004.5800 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 21765.8100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1819 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.3899 (36)
Total fabric heat loss							(33) + (36) = 87.8355 (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	53.5816	53.2582	52.9412	51.4523	51.1737	49.8769	49.8769	49.6368	50.3764	51.1737	51.7373	52.3265 (38)
Heat transfer coeff	141.4171	141.0937	140.7767	139.2878	139.0092	137.7124	137.7124	137.4723	138.2119	139.0092	139.5728	140.1619 (39)
Average = Sum(39)m / 12 =												139.2865 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2551	1.2523	1.2495	1.2362	1.2338	1.2223	1.2223	1.2201	1.2267	1.2338	1.2388	1.2440 (40)
HLP (average)												1.2362 (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	2.8299 (42)
Average daily hot water use (litres/day)	101.4110 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.5521	107.4957	103.4392	99.3828	95.3264	91.2699	91.2699	95.3264	99.3828	103.4392	107.4957	111.5521 (44)
Energy conte	165.4286	144.6849	149.3019	130.1650	124.8964	107.7761	99.8704	114.6027	115.9715	135.1535	147.5307	160.2088 (45)

Regs Region: England

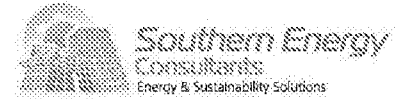
Elmhurst Energy Systems

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 =	1595.5903 (45)
Distribution loss (46)m = 0.15 x (45)m	24.8143	21.7027	22.3953	19.5247	18.7345	16.1664	14.9806	17.1904	17.3957	20.2730	22.1296	24.0313 (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	14.1536	12.7725	14.1149	13.6233	14.0423	13.5489	13.9753	14.0188	13.5894	14.0809	13.6669	14.1411 (61)	
Total heat required for water heating calculated for each month	179.5822	157.4574	163.4167	143.7882	138.9387	121.3250	113.8457	128.6215	129.5609	149.2345	161.1975	174.3498 (62)	
Aperture area of solar collector												3.0000 (H1)	
Zero-loss collector efficiency												0.7000 (H2)	
Collector heat loss coefficient												1.8000 (H3)	
Collector 2nd order heat loss coefficient												0.0050 (H3a)	
Collector effective heat loss coefficient												1.8063 (H3b)	
Collector performance ratio												2.5804 (H4)	
Annual solar radiation per m2												1079.5246 (H5)	
Overshading factor												0.8000 (H6)	
Solar energy available												1813.6014 (H7)	
Adjustment factor for showers												1.0000 (H7a)	
Solar-to-load ratio												1.1366 (H8)	
Utilisation factor												0.5851 (H9)	
Collector performance factor												0.8793 (H10)	
Dedicated solar storage volume												75.0000 (H11)	
Effective solar volume												75.0000 (H13)	
Daily hot water demand												101.4110 (H14)	
Volume ratio Veff/V												0.7396 (H15)	
Solar storage volume factor												0.9397 (H16)	
Solar input												-876.7982 (H17)	
Solar input	-25.4254	-42.4277	-72.2592	-96.8416	-119.6396	-117.6248	-116.0703	-101.4112	-79.4253	-54.2382	-30.1582	-21.2767 (63)	
	Solar input (sum of months) = Sum(63)m =											-876.7982 (63)	
Output from w/h	154.1568	115.0297	91.1575	46.9467	19.2991	3.7002	0.0000	27.2102	50.1355	94.9963	131.0394	153.0731 (64)	
	Total per year (kWh/year) = Sum(64)m =											886.7445 (64)	
Heat gains from water heating, kWh/month	58.5434	51.3009	53.1716	46.6857	45.0386	39.2228	36.7007	41.6101	41.9579	48.4588	52.4707	56.8047 (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	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	64.1551	56.9820	46.3409	35.0830	26.2250	22.1402	23.9233	31.0964	41.7375	52.9954	61.8534	65.9382	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.9517	415.2160	404.4699	381.5927	352.7143	325.5726	307.4404	303.1760	313.9221	336.7993	365.6777	392.8194	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	(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)	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	(71)
Water heating gains (Table 5)	78.6874	76.3406	71.4672	64.8412	60.5358	54.4761	49.3289	55.9275	58.2748	65.1328	72.8759	76.3504	(72)
Total internal gains	668.2024	662.9469	636.6863	595.9252	553.8833	516.5973	495.1009	504.6082	528.3427	569.3358	614.8154	649.5162	(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	
North	0.8400	10.6334	0.4400		0.0000	0.7700	3.0262	(74)
East	7.2400	19.6403	0.4400		0.0000	0.7700	48.1758	(76)
South	1.4400	46.7521	0.4400		0.0000	0.7700	22.8090	(78)
West	8.3200	19.6403	0.4400		0.0000	0.7700	55.3623	(80)

Solar gains	129.3733	245.6810	390.9698	556.0405	673.4999	687.0070	654.9890	567.1414	449.4650	287.5091	159.8695	107.3766	(83)
Total gains	797.5758	908.6279	1027.6561	1151.9658	1227.3832	1203.6043	1150.0899	1071.7497	977.8078	856.8449	774.6849	756.8928	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	42.7534	42.8514	42.9479	43.4069	43.4939	43.9035	43.9035	43.9802	43.7448	43.4939	43.3183	43.1362
alpha	3.8502	3.8568	3.8632	3.8938	3.8996	3.9269	3.9269	3.9320	3.9163	3.8996	3.8879	3.8757
util living area	0.9898	0.9823	0.9637	0.9148	0.8160	0.6588	0.5058	0.5572	0.7865	0.9426	0.9829	0.9916 (86)
MIT	19.4389	19.6298	19.9552	20.3704	20.7095	20.9115	20.9758	20.9648	20.8156	20.3635	19.8255	19.4033 (87)
Th 2	19.8761	19.8784	19.8806	19.8911	19.8931	19.9022	19.9022	19.9039	19.8987	19.8931	19.8891	19.8850 (88)
util rest of house	0.9871	0.9776	0.9538	0.8911	0.7651	0.5700	0.3891	0.4386	0.7109	0.9216	0.9776	0.9894 (89)
MIT 2	17.8177	18.0957	18.5651	19.1546	19.6011	19.8376	19.8916	19.8869	19.7431	19.1594	18.3892	17.7718 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	18.0249	18.2918	18.7428	19.3100	19.7428	19.9749	20.0302	20.0246	19.8802	19.3133	18.5728	17.9803 (91)
Temperature adjustment	-0.1500											
adjusted MIT	17.8749	18.1418	18.5928	19.1600	19.5928	19.8249	19.8802	19.8746	19.7302	19.1633	18.4228	17.8303 (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	0.9799	0.9671	0.9383	0.8715	0.7491	0.5632	0.3866	0.4352	0.6973	0.9029	0.9671	0.9831	(94)
Useful gains	781.5054	878.7780	964.2584	1003.9155	919.3725	677.8484	444.6585	466.4182	681.8701	773.6069	749.2020	744.1203	(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	1919.7247	1868.3341	1702.3814	1429.0918	1097.1685	719.5299	451.7185	477.6643	778.1577	1190.3759	1580.3506	1910.4501	(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	846.8352	664.9817	549.1635	306.1269	132.2802	0.0000	0.0000	0.0000	0.0000	310.0761	598.4270	867.7494	(98)
Space heating												4275.6400	(98)
Space heating per m2											(98) / (4) =	37.9483	(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													4724.4641 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	846.8352	664.9817	549.1635	306.1269	132.2802	0.0000	0.0000	0.0000	0.0000	310.0761	598.4270	867.7494	(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)	935.7295	734.7864	606.8105	338.2618	146.1660	0.0000	0.0000	0.0000	0.0000	342.6256	661.2453	958.8391	(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	154.1568	115.0297	91.1575	46.9467	19.2991	3.7002	0.0000	27.2102	50.1355	94.9963	131.0394	153.0731	(64)
Efficiency of water heater	89.9920	90.0134	90.0302	90.0611	90.0796	87.3000	87.3000	87.3000	87.3000	89.7287	89.9080	87.3000	(216)
(217)m												90.0053	(217)
Fuel for water heating, kWh/month	171.3005	127.7918	101.2522	52.1276	21.4245	4.2385	0.0000	31.1687	57.4290	105.8706	145.7483	170.0712	(219)
Water heating fuel used												988.4229	(219)
Annual totals kWh/year													
Space heating fuel - main system												4724.4641	(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)												453.1995	(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												4563.8471	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4724.4641	3.4800	164.4114	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	988.4229	3.4800	34.3971	(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	453.1995	13.1900	59.7770	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			167.2501	(255)

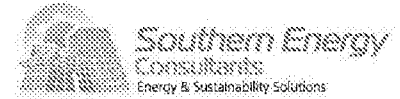
11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4455 (257)
SAP value		93.7850
SAP rating (Section 12)		94 (258)
SAP band		A

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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4724.4641	0.2160	1020.4842	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	988.4229	0.2160	213.4993	(264)
Space and water heating			1233.9836	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	453.1995	0.5190	235.2106	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			637.6319	(272)
CO2 emissions per m2			5.6600	(273)
EI value			94.5809	
EI rating			95	(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	56.8600 (1b)	x 2.3500 (2b)	= 133.6210 (1b) - (3b)
First floor	55.8100 (1c)	x 2.5200 (2c)	= 140.6412 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	112.6700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 274.2622 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					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) = 0.1458 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3958 (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)	=	0.3365 (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	0.3533	0.3365	0.3365	0.3112	0.3112	0.2776	0.2860	0.2692	0.2776	0.2944	0.2944	0.3196 (22b)
Effective ac	0.5624	0.5566	0.5566	0.5484	0.5484	0.5385	0.5409	0.5362	0.5385	0.5433	0.5433	0.5511 (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)			17.8400	1.2357	22.0456		(27)
Opening Type 3			2.1500	1.6000	3.4400		(26a)
Heat Loss Floor 1			56.8600	0.1900	10.8034	75.0000	4264.5000 (28a)
Brick Cavity	149.5100	22.1400	127.3700	0.2500	31.8425	60.0000	7642.2000 (29a)
Main Plane	55.8100		55.8100	0.1100	6.1391	9.0000	502.2900 (30)
Bay Roof	1.5000		1.5000	0.1100	0.1650	9.0000	13.5000 (30)
Total net area of external elements Aum(A, m ²)			263.6800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	77.4456		(33)
Internal Wall 1			73.8800			75.0000	5541.0000 (32c)
Internal Wall 2			199.2400			9.0000	1793.1600 (32c)
Internal Floor 1			55.8100			18.0000	1004.5800 (32d)
Internal Ceiling 1			55.8100			18.0000	1004.5800 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21765.8100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							193.1819 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.3899 (36)
Total fabric heat loss						(33) + (36) =	87.8355 (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	50.9016	50.3764	50.3764	49.6368	49.6368	48.7402	48.9548	48.5321	48.7402	49.1757	49.1757	49.8769 (38)
Heat transfer coeff	138.7371	138.2119	138.2119	137.4723	137.4723	136.5757	136.7903	136.3676	136.5757	137.0112	137.0112	137.7124 (39)
Average = Sum(39)m / 12 =												137.3458 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2314	1.2267	1.2267	1.2201	1.2201	1.2122	1.2141	1.2103	1.2122	1.2160	1.2160	1.2223 (40)
HLP (average)												1.2190 (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												2.8299 (42)
Average daily hot water use (litres/day)												101.4110 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.5521	107.4957	103.4392	99.3828	95.3264	91.2699	91.2699	95.3264	99.3828	103.4392	107.4957	111.5521 (44)
Energy conte	165.4286	144.6849	149.3019	130.1650	124.8964	107.7761	99.8704	114.6027	115.9715	135.1535	147.5307	160.2088 (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 =	1595.5903 (45)
Distribution loss (46)m = 0.15 x (45)m	24.8143	21.7027	22.3953	19.5247	18.7345	16.1664	14.9806	17.1904	17.3957	20.2730	22.1296	24.0313 (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	14.1536	12.7725	14.1149	13.6233	14.0423	13.5489	13.9753	14.0188	13.5894	14.0809	13.6669	14.1411 (61)	
Total heat required for water heating calculated for each month	179.5822	157.4574	163.4167	143.7882	138.9387	121.3250	113.8457	128.6215	129.5609	149.2345	161.1975	174.3498 (62)	
Aperture area of solar collector												3.0000 (H1)	
Zero-loss collector efficiency												0.7000 (H2)	
Collector heat loss coefficient												1.8000 (H3)	
Collector 2nd order heat loss coefficient												0.0050 (H3a)	
Collector effective heat loss coefficient												1.8063 (H3b)	
Collector performance ratio												2.5804 (H4)	
Annual solar radiation per m2												1140.0998 (H5)	
Overshading factor												0.8000 (H6)	
Solar energy available												1915.3676 (H7)	
Adjustment factor for showers												1.0000 (H7a)	
Solar-to-load ratio												1.2004 (H8)	
Utilisation factor												0.5653 (H9)	
Collector performance factor												0.8793 (H10)	
Dedicated solar storage volume												75.0000 (H11)	
Effective solar volume												75.0000 (H13)	
Daily hot water demand												101.4110 (H14)	
Volume ratio Veff/V												0.7396 (H15)	
Solar storage volume factor												0.9397 (H16)	
Solar input												-894.5790 (H17)	
Solar input	-27.5347	-41.3846	-69.6969	-96.3424	-116.0287	-122.1152	-119.1829	-106.4311	-83.0698	-56.5109	-33.4691	-22.8127 (63)	
	Solar input (sum of months) = Sum(63)m =											-894.5790 (63)	
Output from w/h	152.0475	116.0728	93.7198	47.4458	22.9100	0.0000	0.0000	22.1904	46.4910	92.7236	127.7284	151.5371 (64)	
	Total per year (kWh/year) = Sum(64)m =											872.8665 (64)	
Heat gains from water heating, kWh/month	58.5434	51.3009	53.1716	46.6857	45.0386	39.2228	36.7007	41.6101	41.9579	48.4588	52.4707	56.8047 (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	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	169.7963	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	64.1551	56.9820	46.3409	35.0830	26.2250	22.1402	23.9233	31.0964	41.7375	52.9954	61.8534	65.9382	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	410.9517	415.2160	404.4699	381.5927	352.7143	325.5726	307.4404	303.1760	313.9221	336.7993	365.6777	392.8194	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	54.8096	(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)	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	-113.1975	(71)
Water heating gains (Table 5)	78.6874	76.3406	71.4672	64.8412	60.5358	54.4761	49.3289	55.9275	58.2748	65.1328	72.8759	76.3504	(72)
Total internal gains	668.2024	662.9469	636.6863	595.9252	553.8833	516.5973	495.1009	504.6082	528.3427	569.3358	614.8154	649.5162	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	0.8400	11.9814	0.4400	0.0000	0.7700	3.4098 (74)
East	7.2400	22.3313	0.4400	0.0000	0.7700	54.7768 (76)
South	1.4400	50.9848	0.4400	0.0000	0.7700	24.8741 (78)
West	8.3200	22.3313	0.4400	0.0000	0.7700	62.9479 (80)

Solar gains	146.0085	249.6286	392.3405	574.4958	677.4312	739.3193	697.3121	617.7791	488.7413	311.9229	184.8797	119.9844 (83)
Total gains	814.2109	912.5755	1029.0268	1170.4210	1231.3146	1255.9165	1192.4130	1122.3873	1017.0840	881.2587	799.6951	769.5006 (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	43.5793	43.7448	43.7448	43.9802	43.9802	44.2689	44.1995	44.3365	44.2689	44.1282	44.1282	43.9035
alpha	3.9053	3.9163	3.9163	3.9320	3.9320	3.9513	3.9466	3.9558	3.9513	3.9419	3.9419	3.9269
util living area	0.9870	0.9790	0.9549	0.8875	0.7499	0.5202	0.3517	0.3831	0.6885	0.9164	0.9761	0.9893 (86)
MIT	19.6004	19.7660	20.1038	20.5125	20.8235	20.9704	20.9953	20.9936	20.9079	20.5190	19.9980	19.5715 (87)
Th 2	19.8950	19.8987	19.8987	19.9039	19.9039	19.9103	19.9088	19.9117	19.9103	19.9072	19.9072	19.9022 (88)
util rest of house	0.9835	0.9733	0.9423	0.8560	0.6830	0.4168	0.2299	0.2557	0.5901	0.8852	0.9684	0.9863 (89)
MIT 2	18.0650	18.3065	18.7898	19.3568	19.7455	19.8947	19.9078	19.9103	19.8469	19.3820	18.6502	18.0281 (90)
Living area fraction	fLA = Living area / (4) = 0.1278 (91)											
MIT	18.2613	18.4931	18.9577	19.5045	19.8833	20.0322	20.0468	20.0487	19.9825	19.5273	18.6225	18.2254 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.1113	18.3431	18.8077	19.3545	19.7333	19.8822	19.8968	19.8987	19.8325	19.3773	18.6725	18.0754 (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	0.9750	0.9618	0.9256	0.8367	0.6713	0.4140	0.2285	0.2541	0.5822	0.8656	0.9558	0.9788	(94)
Useful gains	793.8522	877.7127	952.4164	979.3394	826.5621	519.9172	272.5153	285.2424	592.1845	762.8274	764.3316	753.2189	(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	1805.1450	1761.2441	1576.6845	1299.7294	925.6418	530.2109	273.1430	286.2012	632.6888	1065.5834	1462.2451	1786.8703	(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	752.4019	593.7331	464.4555	230.6808	73.7152	0.0000	0.0000	0.0000	0.0000	225.2505	502.4977	769.0366	(98)
Space heating												3611.7714	(98)
Space heating per m2											(98) / (4) =	32.0562	(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													3990.9076 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	752.4019	593.7331	464.4555	230.6808	73.7152	0.0000	0.0000	0.0000	0.0000	225.2505	502.4977	769.0366	(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)	831.3833	656.0587	513.2104	254.8959	81.4533	0.0000	0.0000	0.0000	0.0000	248.8956	555.2461	849.7642	(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	152.0475	116.0728	93.7198	47.4458	22.9100	0.0000	0.0000	22.1904	46.4910	92.7236	127.7284	151.5371	(64)
Efficiency of water heater	89.9457	89.9608	89.9464	89.9376	89.7202	87.3000	87.3000	87.3000	87.3000	89.5429	89.8326	87.3000	(216)
(217)m	89.9457	89.9608	89.9464	89.9376	89.7202	87.3000	87.3000	87.3000	87.3000	89.5429	89.8326	89.9572	(217)
Fuel for water heating, kWh/month	169.0436	129.0261	104.1952	52.7541	25.5349	0.0000	0.0000	25.4186	53.2543	103.5522	142.1848	168.4547	(219)
Water heating fuel used												973.4185	(219)
Annual totals kWh/year													
Space heating fuel - main system												3990.9076	(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)												453.1995	(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												3718.3660	(238)

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

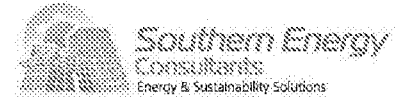
	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3990.9076	3.8700	154.4481	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	973.4185	3.8700	37.6713	(247)
Pumps and fans for heating	75.0000	18.9000	14.1750	(249)
Pump for solar water heating	50.0000	18.9000	9.4500	(249)
Energy for lighting	453.1995	18.9000	85.6547	(250)
Additional standing charges			93.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	18.9000	-344.7662	(252)
Total energy cost			49.6330	(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	3990.9076	0.2160	862.0360	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.4185	0.2160	210.2584	(264)
Space and water heating			1072.2944	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	453.1995	0.5190	235.2106	(268)
Energy saving/generation technologies				

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

PV Unit	-1824.1596	0.5190	-946.7389 (269)
Total kg/year			425.6411 (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	3990.9076	1.2200	4868.9073 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	973.4185	1.2200	1187.5705 (264)
Space and water heating			6056.4778 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	453.1995	3.0700	1391.3225 (268)
Energy saving/generation technologies			
PV Unit	-1824.1596	3.0700	-5600.1701 (269)
Primary energy kWh/year			2231.3803 (272)
Primary energy kWh/m2/year			19.8046 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	193.2 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	362.03 (P1)
Transmission heat loss coefficient	87.84 (37)
Summer heat loss coefficient	449.86 (P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	0.8400	81.1852	0.4400	0.0000	0.9000	27.0054
East	7.2400	117.5071	0.4400	0.0000	0.9000	336.8975
South	1.4400	112.2060	0.4400	0.0000	0.9000	63.9843
West	8.3200	117.5071	0.4400	0.0000	0.9000	387.1529

total: 815.0401

	Jun	Jul	Aug	
Solar gains	864	815	722	(P4)
Internal gains	514	492	502	
Total summer gains	1378	1307	1224	(P5)
Summer gain/loss ratio	3.06	2.91	2.72	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 193.2)	0.65	0.65	0.65	
Threshold temperature	19.71	21.45	21.17	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			