

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-143			Issued on Date	27/06/2019
Assessment Reference	As Built	Prop Type Ref	P306i - Det (As)		
Property	35, Appleby Drive, Botley, SOUTHAMPTON, SO32 2GE				
SAP Rating	87 B	DER	14.23	TER	18.56
Environmental	89 B	% DER<TER	23.32		
CO ₂ Emissions (t/year)	1.00	DFEE	50.87	TFEE	56.35
General Requirements Compliance	Pass	% DFEE<TFEE	9.73		
Assessor Details	Mr. Fraser Browning, Fraser Browning, Tel: 01884 242050, Fraser.browning@aessc.co.uk			Assessor ID	T511-0001
Client					

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

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DWELLING AS BUILT

Detached House, total floor area 93 m²

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

1a TER and DER

Fuel for main heating:Mains gas

Fuel factor:1.00 (mains gas)

Target Carbon Dioxide Emission Rate (TER) 18.56 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 14.23 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)56.4 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)50.9 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Floor	0.15 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.20 (max. 0.35)	OK
Openings	1.34 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals:	4.52 (measured in this dwelling)	
Maximum	10.0	OK

4 Heating efficiency

Main heating system: Boiler system with radiators or underfloor - Mains gas

Data from database

Potterton Promax Ultra Combi 40 ErP

Combi boiler

Efficiency: 89.1% 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 (Southern England): Slight OK

Based on:

Overshading:	Average
Windows facing North:	5.76 m ² , No overhang
Windows facing North East:	0.68 m ² , No overhang
Windows facing South:	7.97 m ² , No overhang
Windows facing North West:	0.68 m ² , No overhang
Air change rate:	4.00 ach
Blinds/curtains:	None

10 Key features

Door U-value	0.90 W/m ² K
Thermal bridging y-value	0.036 W/m ² K
Photovoltaic array	0.81 kW

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (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) = 0.1805 (8)
Pressure test					Yes
Measured/design AP50					4.5200
Infiltration rate					0.4065 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.4065 (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	0.5183	0.5082	0.4980	0.4472	0.4370	0.3862	0.3862	0.3761	0.4065	0.4370	0.4574	0.4777 (22b)
Effective ac	0.6343	0.6291	0.6240	0.6000	0.5955	0.5746	0.5746	0.5707	0.5826	0.5955	0.6046	0.6141 (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
Solid Door			1.9600	0.9000	1.7640		(26)
Window (Uw = 1.40)			11.9400	1.3258	15.8295		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Half Glazed Door			1.8900	1.3000	2.4570		(26a)
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500 (28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120 (29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300 (30)
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900 (30)
Total net area of external elements Aum(A, m ²)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.3418		(33)
GF Masonry			41.2600			39.0000	1609.1400 (32c)
GF Timber			34.3700			9.0000	309.3300 (32c)
1F Timber			81.4300			9.0000	732.8700 (32c)
1F Metal			34.9000			20.0000	698.0000 (32c)
Internal Floor			45.7700			18.0000	823.8600 (32d)
Internal Floor 1			45.7700			18.0000	823.8600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15039.5420 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							162.5194 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1836 (36)
Total fabric heat loss						(33) + (36) =	74.5254 (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	46.3774	45.9960	45.6221	43.8662	43.5377	42.0083	42.0083	41.7251	42.5974	43.5377	44.2023	44.8971 (38)
Heat transfer coeff	120.9027	120.5213	120.1475	118.3916	118.0630	116.5337	116.5337	116.2504	117.1228	118.0630	118.7276	119.4225 (39)
Average = Sum(39)m / 12 =												118.3900 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3065	1.3024	1.2983	1.2794	1.2758	1.2593	1.2593	1.2562	1.2656	1.2758	1.2830	1.2905 (40)
HLP (average)												1.2793 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum (45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (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 =								130.8090	131.4899	150.6578	161.9373	174.8168 (64)
Output from w/h	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (64)
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920 (65)
Total per year (kWh/year) = Sum (64)m =												1777.7885 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.5802	20.0555	16.3102	12.3479	9.2302	7.7925	8.4201	10.9448	14.6900	18.6524	21.7701	23.2078 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	243.6738	246.2024	239.8305	226.2654	209.1420	193.0483	182.2968	179.7682	186.1401	199.7052	216.8287	232.9223 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946 (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)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958 (72)
Total internal gains	410.1801	407.9280	393.1245	369.2209	344.8387	321.4806	306.4099	312.7503	325.1263	349.2521	376.9382	397.8095 (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				5.7600	10.6334	0.6200	0.7000		0.7700	18.4212 (74)		
Northeast				0.6800	11.2829	0.6200	0.7000		0.7700	2.3076 (75)		
South				4.8200	46.7521	0.6200	0.7000		0.7700	67.7752 (78)		
Northwest				0.6800	11.2829	0.6200	0.7000		0.7700	2.3076 (81)		
South				3.1500	46.7521	0.6200	0.7000		0.7700	44.2929 (78)		
Solar gains	135.1044	228.1367	310.5410	388.1224	442.1549	443.3907	425.5451	383.7846	336.7740	251.3497	161.3709	115.9629 (83)
Total gains	545.2845	636.0647	703.6655	757.3433	786.9936	764.8714	731.9549	696.5350	661.9003	600.6018	538.3090	513.7725 (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	34.5538	34.6632	34.7710	35.2867	35.3849	35.8493	35.8493	35.9366	35.6690	35.3849	35.1868	34.9821
alpha	3.3036	3.3109	3.3181	3.3524	3.3590	3.3900	3.3900	3.3958	3.3779	3.3590	3.3458	3.3321
util living area	0.9903	0.9831	0.9700	0.9407	0.8792	0.7624	0.6211	0.6620	0.8418	0.9516	0.9840	0.9920 (86)
MIT	19.0036	19.2232	19.5669	20.0215	20.4477	20.7778	20.9206	20.8993	20.6578	20.1075	19.4787	18.9720 (87)
Th 2	19.8358	19.8390	19.8421	19.8570	19.8598	19.8729	19.8729	19.8753	19.8678	19.8598	19.8542	19.8483 (88)
util rest of house	0.9880	0.9791	0.9624	0.9242	0.8416	0.6816	0.4920	0.5379	0.7794	0.9350	0.9795	0.9902 (89)
MIT 2	17.1875	17.5084	18.0082	18.6684	19.2602	19.6866	19.8304	19.8165	19.5490	18.8008	17.8918	17.1491 (90)
Living area fraction	17.5437	17.8448	18.3139	18.9338	19.4931	19.9006	20.0442	20.0289	19.7665	19.0571	18.2030	0.1961 (91)
MIT	17.5437	17.8448	18.3139	18.9338	19.4931	19.9006	20.0442	20.0289	19.7665	19.0571	18.2030	17.5066 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.3937	17.6948	18.1639	18.7838	19.3431	19.7506	19.8942	19.8789	19.6165	18.9071	18.0530	17.3566 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9804	0.9680	0.9466	0.9034	0.8202	0.6713	0.4947	0.5383	0.7622	0.9154	0.9687	0.9836 (94)
Useful gains	534.6056	615.7023	666.1243	684.1962	645.5033	513.4916	362.1293	374.9497	504.4860	549.7740	521.4493	505.3661 (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	1583.0616	1542.0408	1401.3924	1170.1611	902.3656	600.2220	383.8846	404.4224	646.1084	980.7595	1300.4279	1571.1957 (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	780.0513	622.4995	547.0394	349.8947	191.1056	0.0000	0.0000	0.0000	0.0000	320.6533	560.8646	792.9772 (98)
Space heating												4165.0855 (98)

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Space heating per m2 (98) / (4) = 45.0085 (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 %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4627.8728 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	780.0513	622.4995	547.0394	349.8947	191.1056	0.0000	0.0000	0.0000	0.0000	320.6533	560.8646	792.9772	(98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)	866.7236	691.6661	607.8216	388.7719	212.3395	0.0000	0.0000	0.0000	0.0000	356.2814	623.1829	881.0858	(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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168	(64)
Efficiency of water heater (217)m	89.3627	89.3123	89.2157	89.0066	88.5703	86.7000	86.7000	86.7000	86.7000	88.9181	89.2390	86.7000	(216)
Fuel for water heating, kWh/month	201.2575	176.7731	184.1576	163.1012	158.8899	142.5096	134.4811	150.8755	151.6607	169.4343	181.4647	195.5764	(219)
Water heating fuel used												2010.1816	(219)
Annual totals kWh/year													
Space heating fuel - main system												4627.8728	(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)												398.7732	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1080 * 1.00) =										-699.5320		-699.5320	(233)
Total delivered energy for all uses												6412.2957	(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	4627.8728	0.2160	999.6205 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2010.1816	0.2160	434.1992 (264)
Space and water heating			1433.8198 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	398.7732	0.5190	206.9633 (268)
Energy saving/generation technologies			
PV Unit	-699.5320	0.5190	-363.0571 (269)
Total CO2, kg/year			1316.6510 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.2300 (273)

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

DER		14.2300	ZC1
Total Floor Area		92.5400	
Assumed number of occupants	TFA	2.6589	
CO2 emission factor in Table 12 for electricity displaced from grid	N	0.5190	
CO2 emissions from appliances, equation (L14)	EF	15.6036	ZC2
CO2 emissions from cooking, equation (L16)		1.9755	ZC3
Total CO2 emissions		31.8091	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		31.8091	ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1354 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3854 (18)
Number of sides sheltered					0 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3854 (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	0.4914	0.4818	0.4721	0.4240	0.4143	0.3661	0.3661	0.3565	0.3854	0.4143	0.4336	0.4529 (22b)
Effective ac	0.6207	0.6160	0.6115	0.5899	0.5858	0.5670	0.5670	0.5635	0.5743	0.5858	0.5940	0.6025 (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			1.9600	1.0000	1.9600		(26)
TER Semi-glazed door			1.8900	1.2000	2.2680		(26a)
TER Opening Type (Uw = 1.40)			15.0900	1.3258	20.0057		(27)
Heat Loss Floor			46.7700	0.1300	6.0801		(28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.1800	20.8422		(29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501		(30)
Bay	1.0100		1.0100	0.1300	0.1313		(30)
Total net area of external elements Aum(A, m ²)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.2374		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.3958 (36)
Total fabric heat loss						(33) + (36) =	68.6332 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	45.3826	45.0398	44.7039	43.1258	42.8305	41.4560	41.4560	41.2015	41.9855	42.8305	43.4278	44.0523 (38)
Heat transfer coeff	114.0158	113.6730	113.3370	111.7590	111.4637	110.0892	110.0892	109.8347	110.6187	111.4637	112.0610	112.6854 (39)
Average = Sum(39)m / 12 =												111.7575 (39)
HLP	1.2321	1.2284	1.2247	1.2077	1.2045	1.1896	1.1896	1.1869	1.1954	1.2045	1.2109	1.2177 (40)
HLP (average)												1.2077 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum(45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (46)
Water storage loss:												
Total storage loss												

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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	50.6003	47.0477	46.6316	43.2071	44.6473	46.6316	47.0477	50.6003	49.3151	50.9589 (61)
Solar input	209.7616	184.9173	193.9222	171.9992	166.5256	146.6664	140.5176	156.6442	158.3742	180.3405	190.9367	204.7508 (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	209.7616	184.9173	193.9222	171.9992	166.5256	146.6664	140.5176	156.6442	158.3742	180.3405	190.9367	204.7508 (64)
	65.5416	57.6877	60.3046	53.3083	51.5226	45.2020	43.0387	48.2371	48.7780	55.7887	59.4180	63.8755 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.5802	20.0555	16.3102	12.3479	9.2302	7.7925	8.4201	10.9448	14.6900	18.6524	21.7701	23.2078	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	243.6738	246.2024	239.8305	226.2654	209.1420	193.0483	182.2968	179.7682	186.1401	199.7052	216.8287	232.9223	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	(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)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	(71)
Water heating gains (Table 5)	88.0936	85.8448	81.0546	74.0393	69.2509	62.7806	57.8477	64.8348	67.7472	74.9848	82.5250	85.8542	(72)
Total internal gains	420.2313	417.9865	403.0790	378.5364	353.5068	329.5051	314.4483	321.4315	334.4611	359.2261	387.0074	407.8680	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g Specific data or Table 6c	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	5.7600	10.6334	0.6300	0.7000	0.7000	0.7700	18.7183	(74)
Northeast	0.6800	11.2829	0.6300	0.7000	0.7000	0.7700	2.3448	(75)
South	7.9700	46.7521	0.6300	0.7000	0.7000	0.7700	113.8757	(78)
Northwest	0.6800	11.2829	0.6300	0.7000	0.7000	0.7700	2.3448	(81)

Solar gains	137.2835	231.8164	315.5498	394.3824	449.2864	450.5422	432.4087	389.9747	342.2059	255.4038	163.9736	117.8333	(83)
Total gains	557.5149	649.8029	718.6288	772.9188	802.7932	780.0473	746.8570	711.4062	676.6670	614.6299	550.9810	525.7013	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.3640	56.5340	56.7016	57.5022	57.6545	58.3744	58.3744	58.5096	58.0950	57.6545	57.3472	57.0294	
alpha	4.7576	4.7689	4.7801	4.8335	4.8436	4.8916	4.8916	4.9006	4.8730	4.8436	4.8231	4.8020	
util living area	0.9979	0.9954	0.9891	0.9702	0.9157	0.7854	0.6188	0.6658	0.8756	0.9777	0.9957	0.9985	(86)
MIT	19.6524	19.8160	20.0663	20.3950	20.6970	20.9074	20.9776	20.9682	20.8281	20.4390	19.9872	19.6283	(87)
Th 2	19.8944	19.8974	19.9003	19.9139	19.9164	19.9283	19.9283	19.9305	19.9237	19.9164	19.9113	19.9059	(88)
util rest of house	0.9972	0.9938	0.9851	0.9580	0.8785	0.6951	0.4828	0.5320	0.8087	0.9662	0.9939	0.9979	(89)
MIT 2	18.1047	18.3453	18.7112	19.1924	19.6065	19.8628	19.9197	19.9168	19.7807	19.2621	18.6058	18.0775	(90)
Living area fraction	18.4083	18.6338	18.9770	19.4283	19.8204	20.0677	20.1272	20.1230	19.9862	19.4929	18.8767	18.3817	(92)
Temperature adjustment	18.4083	18.6338	18.9770	19.4283	19.8204	20.0677	20.1272	20.1230	19.9862	19.4929	18.8767	18.3817	(93)
adjusted MIT	18.4083	18.6338	18.9770	19.4283	19.8204	20.0677	20.1272	20.1230	19.9862	19.4929	18.8767	18.3817	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	555.1541	643.9626	704.4435	734.8505	702.0707	552.5287	380.5396	396.9332	550.3843	590.0598	546.2002	524.0049	(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	1608.5657	1561.1584	1414.1019	1176.6273	905.1308	601.9364	388.3069	408.9166	651.1183	991.2381	1319.7097	1598.0681	(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	783.7382	616.3556	527.9858	318.0793	151.0767	0.0000	0.0000	0.0000	0.0000	298.4767	556.9268	799.1030	(98)
Space heating												4051.7420	(98)
Space heating per m2												43.7837	(99)

8c. Space cooling requirement

Not applicable

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Calculation Type: New Build (As Built)

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													4338.0535 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	783.7382	616.3556	527.9858	318.0793	151.0767	0.0000	0.0000	0.0000	0.0000	298.4767	556.9268	799.1030	(98)
Space heating efficiency (main heating system 1)	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)	839.1201	659.9096	565.2953	340.5560	161.7523	0.0000	0.0000	0.0000	0.0000	319.5682	596.2814	855.5706	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	209.7616	184.9173	193.9222	171.9992	166.5256	146.6664	140.5176	156.6442	158.3742	180.3405	190.9367	204.7508	(64)
Efficiency of water heater (217)m	88.0614	87.8500	87.4455	86.5781	84.8071	80.3000	80.3000	80.3000	80.3000	86.3112	87.5874	88.1389	(216)
Fuel for water heating, kWh/month	238.1992	210.4921	221.7635	198.6635	196.3580	182.6481	174.9908	195.0737	197.2281	208.9422	217.9958	232.3049	(219)
Water heating fuel used												2474.6599	(219)
Annual totals kWh/year													
Space heating fuel - main system												4338.0535	(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)												398.7732	(232)
Total delivered energy for all uses												7286.4866	(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	4338.0535	0.2160	937.0196 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2474.6599	0.2160	534.5265 (264)
Space and water heating			1471.5461 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	398.7732	0.5190	206.9633 (268)
Total CO2, kg/m2/year			1717.4344 (272)
Emissions per m2 for space and water heating			15.9017 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			2.2365 (272b)
Emissions per m2 for pumps and fans			0.4206 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.9017 * 1.00) + 2.2365 + 0.4206, rounded to 2 d.p.			18.5600 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1354 (8)
Pressure test					Yes
Measured/design AP50					4.5200
Infiltration rate					0.3614 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3614 (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												
Effective ac	0.4608	0.4518	0.4427	0.3976	0.3885	0.3433	0.3433	0.3343	0.3614	0.3885	0.4066	0.4247 (22b)
	0.6062	0.6020	0.5980	0.5790	0.5755	0.5589	0.5589	0.5559	0.5653	0.5755	0.5827	0.5902 (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
Solid Door			1.9600	0.9000	1.7640		(26)
Window (Uw = 1.40)			11.9400	1.3258	15.8295		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Half Glazed Door			1.8900	1.3000	2.4570		(26a)
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500 (28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120 (29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300 (30)
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900 (30)
Total net area of external elements Aum(A, m ²)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.3418		(33)
GF Masonry			41.2600			39.0000	1609.1400 (32c)
GF Timber			34.3700			9.0000	309.3300 (32c)
1F Timber			81.4300			9.0000	732.8700 (32c)
1F Metal			34.9000			20.0000	698.0000 (32c)
Internal Floor			45.7700			18.0000	823.8600 (32d)
Internal Floor 1			45.7700			9.0000	411.9300 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	14627.6120 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							158.0680 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1836 (36)
Total fabric heat loss						(33) + (36) =	74.5254 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	44.3175	44.0161	43.7206	42.3330	42.0733	40.8647	40.8647	40.6409	41.3303	42.0733	42.5986	43.1477 (38)
Heat transfer coeff	118.8428	118.5414	118.2460	116.8583	116.5987	115.3901	115.3901	115.1663	115.8556	116.5987	117.1239	117.6730 (39)
Average = Sum(39)m / 12 =												116.8571 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2842	1.2810	1.2778	1.2628	1.2600	1.2469	1.2469	1.2445	1.2520	1.2600	1.2657	1.2716 (40)
HLP (average)												1.2628 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total =	Sum (45)m =	1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	33.7456	29.5141	30.4559	26.5522	25.4775	21.9851	20.3724	23.3777	23.6569	27.5698	30.0946	32.6808 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.5802	20.0555	16.3102	12.3479	9.2302	7.7925	8.4201	10.9448	14.6900	18.6524	21.7701	23.2078 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	243.6738	246.2024	239.8305	226.2654	209.1420	193.0483	182.2968	179.7682	186.1401	199.7052	216.8287	232.9223 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946 (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)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)	45.3570	43.9198	40.9354	36.8780	34.2439	30.5349	27.3823	31.4216	32.8568	37.0562	41.7981	43.9258 (72)
Total internal gains	374.4947	373.0614	359.9598	338.3751	315.4998	294.2595	280.9829	285.0183	296.5707	318.2975	343.2805	362.9396 (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				5.7600	10.6334	0.6200	0.7000		0.7700		18.4212 (74)	
Northeast				0.6800	11.2829	0.6200	0.7000		0.7700		2.3076 (75)	
South				4.8200	46.7521	0.6200	0.7000		0.7700		67.7752 (78)	
Northwest				0.6800	11.2829	0.6200	0.7000		0.7700		2.3076 (81)	
South				3.1500	46.7521	0.6200	0.7000		0.7700		44.2929 (78)	
Solar gains	135.1044	228.1367	310.5410	388.1224	442.1549	443.3907	425.5451	383.7846	336.7740	251.3497	161.3709	115.9629 (83)
Total gains	509.5991	601.1982	670.5008	726.4975	757.6547	737.6502	706.5280	668.8030	633.3447	569.6472	504.6514	478.9025 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	34.1899	34.2768	34.3625	34.7705	34.8479	35.2130	35.2130	35.2814	35.0715	34.8479	34.6917	34.5298
alpha	3.2793	3.2851	3.2908	3.3180	3.3232	3.3475	3.3475	3.3521	3.3381	3.3232	3.3128	3.3020
util living area	0.9914	0.9845	0.9718	0.9435	0.8838	0.7704	0.6308	0.6738	0.8498	0.9552	0.9857	0.9930 (86)
MIT	18.9537	19.1774	19.5274	19.9869	20.4229	20.7624	20.9134	20.8895	20.6358	20.0698	19.4290	18.9169 (87)
Th 2	19.8532	19.8558	19.8583	19.8701	19.8723	19.8826	19.8826	19.8846	19.8787	19.8723	19.8678	19.8632 (88)
util rest of house	0.9894	0.9809	0.9648	0.9280	0.8479	0.6919	0.5031	0.5515	0.7904	0.9400	0.9817	0.9913 (89)
MIT 2	17.9940	18.2180	18.5662	19.0250	19.4403	19.7442	19.8500	19.8392	19.6431	19.1130	18.4783	17.9645 (90)
Living area fraction									fLA =	Living area / (4) =		0.1961 (91)
MIT	18.1822	18.4061	18.7547	19.2136	19.6330	19.9439	20.0586	20.0452	19.8378	19.3007	18.6647	18.1513 (92)
Temperature adjustment												0.0000
adjusted MIT	18.1822	18.4061	18.7547	19.2136	19.6330	19.9439	20.0586	20.0452	19.8378	19.3007	18.6647	18.1513 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9852	0.9746	0.9558	0.9166	0.8387	0.6968	0.5252	0.5712	0.7877	0.9298	0.9758	0.9878 (94)
Ext temp.	502.0740	585.9334	640.8931	665.8781	635.4731	514.0250	371.0882	382.0156	498.9156	529.6500	492.4543	473.0691 (95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Month fracti	1649.8018	1601.0368	1449.0725	1205.2327	924.9810	616.6317	399.0888	419.8017	664.7608	1014.4847	1354.5088	1641.6943 (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	853.9095	682.1494	601.2855	388.3353	215.3938	0.0000	0.0000	0.0000	0.0000	360.7170	620.6793	869.4571 (98)
Space heating per m2												4591.9268 (98)
										(98) / (4) =		49.6210 (99)

8c. Space cooling requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	1084.6667	853.8866	875.2636	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7223	0.7996	0.7734	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	783.4799	682.8096	676.9032	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	963.1877	924.6984	882.4644	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	129.3896	179.9652	152.9376	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													
Cooled fraction									fC = cooled area / (4) =			462.2924	(104)
Intermittency factor (Table 10b)												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	32.3474	44.9913	38.2344	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling													
Space cooling per m2													115.5731 (107)
Energy for space heating													1.2489 (108)
Energy for space cooling													49.6210 (99)
Total													1.2489 (108)
Dwelling Fabric Energy Efficiency (DFEE)													50.8699 (109)
													50.9 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m ³ per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	0	+	0	=	0 * 20 = 0.0000 (6b)
Number of intermittent fans					3 * 10 = 30.0000 (7a)
Number of passive vents					0 * 10 = 0.0000 (7b)
Number of flueless gas fires					0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)					30.0000 / (5) = 0.1354 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3854 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3854 (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	0.4914	0.4818	0.4721	0.4240	0.4143	0.3661	0.3661	0.3565	0.3854	0.4143	0.4336	0.4529 (22b)
Effective ac	0.6207	0.6160	0.6115	0.5899	0.5858	0.5670	0.5670	0.5635	0.5743	0.5858	0.5940	0.6025 (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			1.9600	1.0000	1.9600		(26)
TER Semi-glazed door			1.8900	1.2000	2.2680		(26a)
TER Opening Type (Uw = 1.40)			15.0900	1.3258	20.0057		(27)
Heat Loss Floor			46.7700	0.1300	6.0801		(28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.1800	20.8422		(29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501		(30)
Bay	1.0100		1.0100	0.1300	0.1313		(30)
Total net area of external elements Aum(A, m ²)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.2374		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							11.3958 (36)
Total fabric heat loss						(33) + (36) =	68.6332 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	45.3826	45.0398	44.7039	43.1258	42.8305	41.4560	41.4560	41.2015	41.9855	42.8305	43.4278	44.0523 (38)
Heat transfer coeff	114.0158	113.6730	113.3370	111.7590	111.4637	110.0892	110.0892	109.8347	110.6187	111.4637	112.0610	112.6854 (39)
Average = Sum(39)m / 12 =												111.7575 (39)
HLP	1.2321	1.2284	1.2247	1.2077	1.2045	1.1896	1.1896	1.1869	1.1954	1.2045	1.2109	1.2177 (40)
HLP (average)												1.2077 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)												Total = Sum(45)m = 1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
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 (57)
Heat gains from water heating, kWh/month	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)
	33.7456	29.5141	30.4559	26.5522	25.4775	21.9851	20.3724	23.3777	23.6569	27.5698	30.0946	32.6808 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	132.9458	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.5802	20.0555	16.3102	12.3479	9.2302	7.7925	8.4201	10.9448	14.6900	18.6524	21.7701	23.2078	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	243.6738	246.2024	239.8305	226.2654	209.1420	193.0483	182.2968	179.7682	186.1401	199.7052	216.8287	232.9223	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	36.2946	(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)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	(71)
Water heating gains (Table 5)	45.3570	43.9198	40.9354	36.8780	34.2439	30.5349	27.3823	31.4216	32.8568	37.0562	41.7981	43.9258	(72)
Total internal gains	374.4947	373.0614	359.9598	338.3751	315.4998	294.2595	280.9829	285.0183	296.5707	318.2975	343.2805	362.9396	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W	
North	5.7600	10.6334	0.6300		0.7000	0.7700	18.7183	(74)
Northeast	0.6800	11.2829	0.6300		0.7000	0.7700	2.3448	(75)
South	7.9700	46.7521	0.6300		0.7000	0.7700	113.8757	(78)
Northwest	0.6800	11.2829	0.6300		0.7000	0.7700	2.3448	(81)

Solar gains	137.2835	231.8164	315.5498	394.3824	449.2864	450.5422	432.4087	389.9747	342.2059	255.4038	163.9736	117.8333	(83)
Total gains	511.7782	604.8778	675.5096	732.7575	764.7862	744.8017	713.3916	674.9930	638.7765	573.7013	507.2541	480.7729	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	56.3640	56.5340	56.7016	57.5022	57.6545	58.3744	58.3744	58.5096	58.0950	57.6545	57.3472	57.0294	
alpha	4.7576	4.7689	4.7801	4.8335	4.8436	4.8916	4.8916	4.9006	4.8730	4.8436	4.8231	4.8020	
util living area	0.9986	0.9966	0.9915	0.9756	0.9277	0.8064	0.6425	0.6929	0.8944	0.9830	0.9970	0.9990	(86)
MIT	19.6071	19.7720	20.0252	20.3599	20.6712	20.8953	20.9737	20.9622	20.8068	20.4018	19.9442	19.5836	(87)
Th 2	19.8944	19.8974	19.9003	19.9139	19.9164	19.9283	19.9283	19.9305	19.9237	19.9164	19.9113	19.9059	(88)
util rest of house	0.9981	0.9954	0.9883	0.9653	0.8942	0.7187	0.5038	0.5577	0.8332	0.9739	0.9957	0.9986	(89)
MIT 2	18.6273	18.7940	19.0481	19.3881	19.6833	19.8766	19.9213	19.9191	19.8110	19.4344	18.9772	18.6129	(90)
Living area fraction									fLA = Living area / (4) =			0.1961	(91)
MIT	18.8195	18.9858	19.2397	19.5787	19.8771	20.0764	20.1277	20.1237	20.0063	19.6241	19.1669	18.8033	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8195	18.9858	19.2397	19.5787	19.8771	20.0764	20.1277	20.1237	20.0063	19.6241	19.1669	18.8033	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9974	0.9940	0.9857	0.9612	0.8927	0.7325	0.5314	0.5843	0.8389	0.9706	0.9945	0.9981	(94)
Ext temp.	510.4497	601.2384	665.8685	704.3365	682.7443	545.5362	379.0653	394.3931	535.9009	556.8241	504.4445	479.8478	(95)
Heat loss rate W	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Month fracti	1655.4507	1601.1775	1443.8842	1193.4353	911.4479	602.8911	388.3599	408.9868	653.3487	1005.8596	1352.2251	1645.5793	(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	851.8808	671.9591	578.8437	352.1512	170.1555	0.0000	0.0000	0.0000	0.0000	334.0825	610.4020	867.3042	(98)
Space heating per m2												4436.7789	(98)
												(98) / (4) =	47.9444 (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	1034.8387	814.6603	834.7437	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8030	0.8812	0.8559	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	831.0181	717.8601	714.4289	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	971.5465	932.7208	889.6996	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)

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Calculation Type: New Build (As Built)



CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	101.1805	159.8563	130.4014	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												391.4382 (104)
Cooled fraction									fC = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	25.2951	39.9641	32.6004	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												97.8596 (107)
Space cooling per m2												1.0575 (108)
Energy for space heating												47.9444 (99)
Energy for space cooling												1.0575 (108)
Total												49.0019 (109)
Target Fabric Energy Efficiency (TFEE)												56.4 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

										main	secondary	other	total	m3 per hour										
										heating	heating													
Number of chimneys										0	+	0	+	0	=	0 * 40 =	0.0000 (6a)							
Number of open flues										0	+	0	+	0	=	0 * 20 =	0.0000 (6b)							
Number of intermittent fans																4 * 10 =	40.0000 (7a)							
Number of passive vents																0 * 10 =	0.0000 (7b)							
Number of flueless gas fires																0 * 40 =	0.0000 (7c)							
										Air changes per hour														
Infiltration due to chimneys, flues and fans										= (6a)+(6b)+(7a)+(7b)+(7c) =							40.0000 / (5) =	0.1805 (8)						
Pressure test																	Yes							
Measured/design AP50																	4.5200							
Infiltration rate																	0.4065 (18)							
Number of sides sheltered																	0 (19)							
Shelter factor										(20) = 1 - [0.075 x (19)] =							1.0000 (20)							
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =							0.4065 (21)							
													Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed													4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000 (22)
Wind factor													1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250 (22a)
Adj infilt rate													0.4269	0.3964	0.4065	0.3862	0.3862	0.3761	0.3659	0.3557	0.3456	0.3761	0.3557	0.3761 (22b)
Effective ac													0.5911	0.5786	0.5826	0.5746	0.5746	0.5707	0.5669	0.5633	0.5597	0.5707	0.5633	0.5707 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
Solid Door			1.9600	0.9000	1.7640			(26)					
Window (Uw = 1.40)			11.9400	1.3258	15.8295			(27)					
French (Uw = 1.40)			3.1500	1.3258	4.1761			(27)					
Half Glazed Door			1.8900	1.3000	2.4570			(26a)					
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500	(28a)					
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120	(29a)					
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300	(30)					
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900	(30)					
Total net area of external elements Aum(A, m2)			228.2800					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.3418			(33)					
GF Masonry			41.2600			39.0000	1609.1400	(32c)					
GF Timber			34.3700			9.0000	309.3300	(32c)					
1F Timber			81.4300			9.0000	732.8700	(32c)					
1F Metal			34.9000			20.0000	698.0000	(32c)					
Internal Floor			45.7700			18.0000	823.8600	(32d)					
Internal Floor 1			45.7700			18.0000	823.8600	(32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15039.5420	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							162.5194	(35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1836	(36)					
Total fabric heat loss						(33) + (36) =	74.5254	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	43.2167	42.2991	42.5974	42.0083	42.0083	41.7251	41.4494	41.1813	40.9208	41.7251	41.1813	41.7251	(38)
Heat transfer coeff	117.7420	116.8244	117.1228	116.5337	116.5337	116.2504	115.9748	115.7067	115.4461	116.2504	115.7067	116.2504	(39)
Average = Sum(39)m / 12 =												116.3618	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2723	1.2624	1.2656	1.2593	1.2593	1.2562	1.2532	1.2503	1.2475	1.2562	1.2503	1.2562	(40)
HLP (average)												1.2574	(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											
2.6589 (42)											
Average daily hot water use (litres/day)											
97.3492 (43)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum (45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (64)
RHI water heating demand												
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920 (65)
												1778 (64)

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

Metabolic gains (Table 5), Watts												
(66)m	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4505	50.1388	40.7756	30.8698	23.0755	19.4813	21.0503	27.3619	36.7251	46.6310	54.4252	58.0194 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	363.6923	367.4663	357.9559	337.7096	312.1522	288.1318	272.0848	268.3108	277.8211	298.0675	323.6249	347.6452 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124 (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)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958 (72)
Total internal gains	607.9758	603.1821	579.6223	543.0939	505.6012	472.1599	452.7350	461.6170	482.7493	519.4999	560.2965	591.2511 (73)

6. Solar gains

[Jan]				Area	Solar flux	g		FF	Access		Gains	
				m2	Table 6a	Specific data		Specific data	factor		W	
					W/m2	or Table 6b		or Table 6c	Table 6d			
North				5.7600	13.4839	0.6200		0.7000	0.7700		23.3593 (74)	
Northeast				0.6800	14.6176	0.6200		0.7000	0.7700		2.9896 (75)	
South				4.8200	56.7559	0.6200		0.7000	0.7700		82.2774 (78)	
Northwest				0.6800	14.6176	0.6200		0.7000	0.7700		2.9896 (81)	
South				3.1500	56.7559	0.6200		0.7000	0.7700		53.7705 (78)	

Solar gains	165.3865	237.8335	327.8314	416.1774	454.4217	496.7358	472.3078	433.5557	376.7660	283.0270	196.8981	139.5608 (83)
Total gains	773.3623	841.0157	907.4537	959.2714	960.0228	968.8957	925.0428	895.1727	859.5153	802.5269	757.1946	730.8119 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	35.4814	35.7601	35.6690	35.8493	35.8493	35.9366	36.0221	36.1055	36.1870	35.9366	36.1055	35.9366
alpha	3.3654	3.3840	3.3779	3.3900	3.3900	3.3958	3.4015	3.4070	3.4125	3.3958	3.4070	3.3958
util living area	0.9704	0.9600	0.9346	0.8811	0.7841	0.6106	0.4661	0.4786	0.7050	0.8802	0.9506	0.9741 (86)
MIT	19.4414	19.5991	19.9208	20.3243	20.6754	20.9030	20.9710	20.9688	20.8338	20.4403	19.9109	19.4312 (87)
Th 2	19.8626	19.8704	19.8678	19.8729	19.8729	19.8753	19.8776	19.8799	19.8822	19.8753	19.8799	19.8753 (88)
util rest of house	0.9639	0.9512	0.9196	0.8521	0.7276	0.5142	0.3419	0.3522	0.6190	0.8445	0.9378	0.9683 (89)
MIT 2	17.8366	18.0676	18.5248	19.0902	19.5516	19.8078	19.8659	19.8672	19.7494	19.2598	18.5250	17.8307 (90)
Living area fraction	18.1514	18.3680	18.7986	19.3323	19.7720	20.0226	20.0827	20.0832	19.9621	19.4913	18.7968	18.1446 (92)
MIT												
Temperature adjustment												-0.1500
adjusted MIT	18.0014	18.2180	18.6486	19.1823	19.6220	19.8726	19.9327	19.9332	19.8121	19.3413	18.6468	17.9946 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	733.6551	785.2362	815.3549	796.5905	684.5949	497.9213	322.1882	320.9618	526.8496	660.7310	695.6433	697.3924 (95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000 (96)
Heat loss rate W	1542.5834	1509.1344	1364.3115	1128.3101	829.9537	531.5676	328.5166	327.8234	590.1734	923.1807	1243.4812	1510.6280 (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	601.8426	486.4595	408.4237	238.8381	108.1469	0.0000	0.0000	0.0000	0.0000	195.2626	394.4433	605.0473 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Space heating	3038.4641 (98)
RHI space heating demand	3038 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (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) = 0.1805 (8)
Pressure test					Yes
Measured/design AP50					4.5200
Infiltration rate					0.4065 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.4065 (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												
Effective ac	0.5183	0.5082	0.4980	0.4472	0.4370	0.3862	0.3862	0.3761	0.4065	0.4370	0.4574	0.4777 (22b)
	0.6343	0.6291	0.6240	0.6000	0.5955	0.5746	0.5746	0.5707	0.5826	0.5955	0.6046	0.6141 (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
Solid Door			1.9600	0.9000	1.7640		(26)
Window (Uw = 1.40)			11.9400	1.3258	15.8295		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Half Glazed Door			1.8900	1.3000	2.4570		(26a)
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500 (28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120 (29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300 (30)
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900 (30)
Total net area of external elements Aum(A, m ²)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.3418		(33)
GF Masonry			41.2600			39.0000	1609.1400 (32c)
GF Timber			34.3700			9.0000	309.3300 (32c)
1F Timber			81.4300			9.0000	732.8700 (32c)
1F Metal			34.9000			20.0000	698.0000 (32c)
Internal Floor			45.7700			18.0000	823.8600 (32d)
Internal Floor 1			45.7700			18.0000	823.8600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15039.5420 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							162.5194 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1836 (36)
Total fabric heat loss						(33) + (36) =	74.5254 (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	46.3774	45.9960	45.6221	43.8662	43.5377	42.0083	42.0083	41.7251	42.5974	43.5377	44.2023	44.8971 (38)
Heat transfer coeff	120.9027	120.5213	120.1475	118.3916	118.0630	116.5337	116.5337	116.2504	117.1228	118.0630	118.7276	119.4225 (39)
Average = Sum(39)m / 12 =												118.3900 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3065	1.3024	1.2983	1.2794	1.2758	1.2593	1.2593	1.2562	1.2656	1.2758	1.2830	1.2905 (40)
HLP (average)												1.2793 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum (45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month												
Solar input	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (64)
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920 (65)
Total per year (kWh/year) = Sum (64)m =												1777.7885 (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	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4505	50.1388	40.7756	30.8698	23.0755	19.4813	21.0503	27.3619	36.7251	46.6310	54.4252	58.0194 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	363.6923	367.4663	357.9559	337.7096	312.1522	288.1318	272.0848	268.3108	277.8211	298.0675	323.6249	347.6452 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124 (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)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958 (72)
Total internal gains	607.9758	603.1821	579.6223	543.0939	505.6012	472.1599	452.7350	461.6170	482.7493	519.4999	560.2965	591.2511 (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				5.7600	10.6334	0.6200	0.7000	0.7700	18.4212 (74)			
Northeast				0.6800	11.2829	0.6200	0.7000	0.7700	2.3076 (75)			
South				4.8200	46.7521	0.6200	0.7000	0.7700	67.7752 (78)			
Northwest				0.6800	11.2829	0.6200	0.7000	0.7700	2.3076 (81)			
South				3.1500	46.7521	0.6200	0.7000	0.7700	44.2929 (78)			

Solar gains	135.1044	228.1367	310.5410	388.1224	442.1549	443.3907	425.5451	383.7846	336.7740	251.3497	161.3709	115.9629 (83)
Total gains	743.0802	831.3189	890.1633	931.2163	947.7561	915.5507	878.2800	845.4017	819.5233	770.8497	721.6674	707.2140 (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	34.5538	34.6632	34.7710	35.2867	35.3849	35.8493	35.8493	35.9366	35.6690	35.3849	35.1868	34.9821
alpha	3.3036	3.3109	3.3181	3.3524	3.3590	3.3900	3.3900	3.3958	3.3779	3.3590	3.3458	3.3321
util living area	0.9764	0.9645	0.9442	0.9024	0.8237	0.6876	0.5405	0.5759	0.7662	0.9103	0.9637	0.9797 (86)
MIT	19.2540	19.4617	19.7806	20.1954	20.5685	20.8413	20.9481	20.9346	20.7543	20.2845	19.7037	19.2203 (87)
Th 2	19.8358	19.8390	19.8421	19.8570	19.8598	19.8729	19.8729	19.8753	19.8678	19.8598	19.8542	19.8483 (88)
util rest of house	0.9712	0.9568	0.9314	0.8784	0.7768	0.6020	0.4193	0.4567	0.6922	0.8834	0.9543	0.9752 (89)
MIT 2	17.5492	17.8500	18.3092	18.9034	19.4075	19.7463	19.8467	19.8395	19.6517	19.0387	18.2127	17.5083 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	17.8836	18.1661	18.5978	19.1568	19.6352	19.9611	20.0627	20.0543	19.8679	19.2830	18.5052	17.8441 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.7336	18.0161	18.4478	19.0068	19.4852	19.8111	19.9127	19.9043	19.7179	19.1330	18.3552	17.6941 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9576	0.9398	0.9109	0.8559	0.7586	0.5968	0.4239	0.4601	0.6808	0.8612	0.9371	0.9629 (94)
Useful gains	711.5430	781.2389	810.8184	797.0618	719.0043	546.3853	372.3355	388.9391	557.9413	668.8742	676.2987	680.9583 (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	1624.1534	1580.7709	1435.4933	1196.5556	919.1425	607.2654	386.0409	407.3738	657.9869	1007.4315	1336.2991	1611.4929 (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	678.9822	537.2855	464.7581	287.6356	148.9029	0.0000	0.0000	0.0000	0.0000	255.6067	475.2003	692.3177 (98)
Space heating												3540.6890 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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Space heating per m2 (98) / (4) = 38.2612 (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 %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3934.0988 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	678.9822	537.2855	464.7581	287.6356	148.9029	0.0000	0.0000	0.0000	0.0000	255.6067	475.2003	692.3177	(98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)	754.4247	596.9839	516.3979	319.5951	165.4476	0.0000	0.0000	0.0000	0.0000	284.0074	528.0003	769.2419	(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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168	(64)
Efficiency of water heater (217)m	89.2883	89.2287	89.1141	88.8655	88.3658	86.7000	86.7000	86.7000	86.7000	88.7473	89.1377	86.7000	(216)
Fuel for water heating, kWh/month	201.4252	176.9386	184.3675	163.3602	159.2577	142.5096	134.4811	150.8755	151.6607	169.7604	181.6710	195.7314	(219)
Water heating fuel used												2012.0390	(219)
Annual totals kWh/year													
Space heating fuel - main system												3934.0988	(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)												398.7732	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1080 * 1.00) =										-699.5320		-699.5320	(233)
Total delivered energy for all uses												5720.3791	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3934.0988	3.4800	136.9066 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2012.0390	3.4800	70.0190 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	398.7732	13.1900	52.5982 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-699.5320	13.1900	-92.2683 (252)
Total energy cost			297.1480 (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] =	0.9074 (257)
SAP value		87.3419
SAP rating (Section 12)		87 (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	3934.0988	0.2160	849.7653 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2012.0390	0.2160	434.6004 (264)
Space and water heating			1284.3658 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	398.7732	0.5190	206.9633 (268)
Energy saving/generation technologies			
PV Unit	-699.5320	0.5190	-363.0571 (269)
Total kg/year			1167.1970 (272)
CO2 emissions per m2			12.6100 (273)
EI value			88.6284
EI rating			89 (274)
EI band			B

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CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9000 = 3.867$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9000 = 0.2400$, stars = 4
Water heating energy efficiency	$3.48 / 0.8824 = 3.944$, stars = 4
Water heating environmental impact	$0.216 / 0.8824 = 0.2448$, stars = 4

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

SAP 2012 WORKSHEET FOR New Build (As Built) (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	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (5)

2. Ventilation rate

										main	secondary	other	total	m3 per hour			
										heating	heating						
Number of chimneys										0	+	0	+	0	=	0 * 40 =	0.0000 (6a)
Number of open flues										0	+	0	+	0	=	0 * 20 =	0.0000 (6b)
Number of intermittent fans																4 * 10 =	40.0000 (7a)
Number of passive vents																0 * 10 =	0.0000 (7b)
Number of flueless gas fires																0 * 40 =	0.0000 (7c)
										Air changes per hour							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =										40.0000 / (5) =							0.1805 (8)
Pressure test										Yes							
Measured/design AP50																	4.5200
Infiltration rate																	0.4065 (18)
Number of sides sheltered																	0 (19)
Shelter factor										(20) = 1 - [0.075 x (19)] =							1.0000 (20)
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =							0.4065 (21)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)				
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)				
Adj infilt rate	0.4269	0.3964	0.4065	0.3862	0.3862	0.3761	0.3659	0.3557	0.3456	0.3761	0.3557	0.3761	(22b)				
Effective ac	0.5911	0.5786	0.5826	0.5746	0.5746	0.5707	0.5669	0.5633	0.5597	0.5707	0.5633	0.5707	(25)				

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
Solid Door			1.9600	0.9000	1.7640			(26)					
Window (Uw = 1.40)			11.9400	1.3258	15.8295			(27)					
French (Uw = 1.40)			3.1500	1.3258	4.1761			(27)					
Half Glazed Door			1.8900	1.3000	2.4570			(26a)					
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500	(28a)					
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120	(29a)					
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300	(30)					
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900	(30)					
Total net area of external elements Aum(A, m2)			228.2800					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.3418			(33)					
GF Masonry			41.2600			39.0000	1609.1400	(32c)					
GF Timber			34.3700			9.0000	309.3300	(32c)					
1F Timber			81.4300			9.0000	732.8700	(32c)					
1F Metal			34.9000			20.0000	698.0000	(32c)					
Internal Floor			45.7700			18.0000	823.8600	(32d)					
Internal Floor 1			45.7700			18.0000	823.8600	(32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15039.5420	(34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							162.5194	(35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1836	(36)					
Total fabric heat loss						(33) + (36) =	74.5254	(37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 43.2167	Feb 42.2991	Mar 42.5974	Apr 42.0083	May 42.0083	Jun 41.7251	Jul 41.4494	Aug 41.1813	Sep 40.9208	Oct 41.7251	Nov 41.1813	Dec 41.7251	(38)
Heat transfer coeff	117.7420	116.8244	117.1228	116.5337	116.5337	116.2504	115.9748	115.7067	115.4461	116.2504	115.7067	116.2504	(39)
Average = Sum(39)m / 12 =												116.3618	(39)
HLP	Jan 1.2723	Feb 1.2624	Mar 1.2656	Apr 1.2593	May 1.2593	Jun 1.2562	Jul 1.2532	Aug 1.2503	Sep 1.2475	Oct 1.2562	Nov 1.2503	Dec 1.2562	(40)
HLP (average)												1.2574	(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											
2.6589 (42)											
Average daily hot water use (litres/day)											
97.3492 (43)											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

FULL SAP CALCULATION PRINTOUT

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

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum (45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month												
Solar input	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (64)
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920 (65)
Total per year (kWh/year) = Sum (64)m =												1777.7885 (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	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4505	50.1388	40.7756	30.8698	23.0755	19.4813	21.0503	27.3619	36.7251	46.6310	54.4252	58.0194 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	363.6923	367.4663	357.9559	337.7096	312.1522	288.1318	272.0848	268.3108	277.8211	298.0675	323.6249	347.6452 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124 (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)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958 (72)
Total internal gains	607.9758	603.1821	579.6223	543.0939	505.6012	472.1599	452.7350	461.6170	482.7493	519.4999	560.2965	591.2511 (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				5.7600	13.4839	0.6200	0.7000	0.7700	23.3593 (74)			
Northeast				0.6800	14.6176	0.6200	0.7000	0.7700	2.9896 (75)			
South				4.8200	56.7559	0.6200	0.7000	0.7700	82.2774 (78)			
Northwest				0.6800	14.6176	0.6200	0.7000	0.7700	2.9896 (81)			
South				3.1500	56.7559	0.6200	0.7000	0.7700	53.7705 (78)			
Solar gains	165.3865	237.8335	327.8314	416.1774	454.4217	496.7358	472.3078	433.5557	376.7660	283.0270	196.8981	139.5608 (83)
Total gains	773.3623	841.0157	907.4537	959.2714	960.0228	968.8957	925.0428	895.1727	859.5153	802.5269	757.1946	730.8119 (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	35.4814	35.7601	35.6690	35.8493	35.8493	35.9366	36.0221	36.1055	36.1870	35.9366	36.1055	35.9366
alpha	3.3654	3.3840	3.3779	3.3900	3.3900	3.3958	3.4015	3.4070	3.4125	3.3958	3.4070	3.3958
util living area	0.9704	0.9600	0.9346	0.8811	0.7841	0.6106	0.4661	0.4786	0.7050	0.8802	0.9506	0.9741 (86)
MIT	19.4414	19.5991	19.9208	20.3243	20.6754	20.9030	20.9710	20.9688	20.8338	20.4403	19.9109	19.4312 (87)
Th 2	19.8626	19.8704	19.8678	19.8729	19.8729	19.8753	19.8776	19.8799	19.8822	19.8753	19.8799	19.8753 (88)
util rest of house	0.9639	0.9512	0.9196	0.8521	0.7276	0.5142	0.3419	0.3522	0.6190	0.8445	0.9378	0.9683 (89)
MIT 2	17.8366	18.0676	18.5248	19.0902	19.5516	19.8078	19.8659	19.8672	19.7494	19.2598	18.5250	17.8307 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.1514	18.3680	18.7986	19.3323	19.7720	20.0226	20.0827	20.0832	19.9621	19.4913	18.7968	18.1446 (92)
Temperature adjustment												-0.1500
adjusted MIT	18.0014	18.2180	18.6486	19.1823	19.6220	19.8726	19.9327	19.9332	19.8121	19.3413	18.6468	17.9946 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9487	0.9337	0.8985	0.8304	0.7131	0.5139	0.3483	0.3585	0.6130	0.8233	0.9187	0.9543 (94)
Ext temp.	733.6551	785.2362	815.3549	796.5905	684.5949	497.9213	322.1882	320.9618	526.8496	660.7310	695.6433	697.3924 (95)
Heat loss rate W	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000 (96)
Month fracti	1542.5834	1509.1344	1364.3115	1128.3101	829.9537	531.5676	328.5166	327.8234	590.1734	923.1807	1243.4812	1510.6280 (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	601.8426	486.4595	408.4237	238.8381	108.1469	0.0000	0.0000	0.0000	0.0000	195.2626	394.4433	605.0473 (98)
												3038.4641 (98)

FULL SAP CALCULATION PRINTOUT

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Space heating per m2 (98) / (4) = 32.8341 (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 %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3376.0712 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	601.8426	486.4595	408.4237	238.8381	108.1469	0.0000	0.0000	0.0000	0.0000	195.2626	394.4433	605.0473	(98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)	668.7140	540.5106	453.8041	265.3757	120.1633	0.0000	0.0000	0.0000	0.0000	216.9584	438.2703	672.2748	(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	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168	(64)
Efficiency of water heater (217)m	89.2187	89.1684	89.0279	88.7234	88.1038	86.7000	86.7000	86.7000	86.7000	88.5324	89.0139	86.7000	(216)
Fuel for water heating, kWh/month	201.5824	177.0583	184.5460	163.6219	159.7313	142.5096	134.4811	150.8755	151.6607	170.1726	181.9237	195.8982	(219)
Water heating fuel used												2014.0611	(219)
Annual totals kWh/year													
Space heating fuel - main system												3376.0712	(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)												398.7732	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1208 * 1.00) =										-782.8819		-782.8819	(233)
Total delivered energy for all uses												5081.0237	(238)

10a. Fuel costs - using BEDF prices (443)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3376.0712	3.9200	132.3420	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2014.0611	3.9200	78.9512	(247)
Pumps and fans for heating	75.0000	16.9600	12.7200	(249)
Energy for lighting	398.7732	16.9600	67.6319	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-782.8819	16.9600	-132.7768	(252)
Total energy cost			246.8684	(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	3376.0712	0.2160	729.2314	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2014.0611	0.2160	435.0372	(264)
Space and water heating			1164.2686	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	398.7732	0.5190	206.9633	(268)
Energy saving/generation technologies				
PV Unit	-782.8819	0.5190	-406.3157	(269)
Total kg/year			1003.8412	(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	3376.0712	1.2200	4118.8069	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2014.0611	1.2200	2457.1546	(264)
Space and water heating			6575.9615	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	398.7732	3.0700	1224.2338	(268)

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Energy saving/generation technologies			
PV Unit	-782.8819	3.0700	-2403.4473 (269)
Primary energy kWh/year			5626.9980 (272)
Primary energy kWh/m2/year			60.8061 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 87
Current environmental impact rating:	B 89

(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	Already installed
A2	Not considered
A3	Not considered
T2	Not considered
W	Not considered
X	Not considered
Y	Not considered
J2	Not considered
Q2	Not considered
Z1	Not considered
Z2	Not considered
Z3	Not considered
Z4	Not considered
Z5	Not considered
V2 Wind turbine	Not applicable
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 32	-195 kg (19.4%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£32 2.10 kg/m²	B 89	B 90
Total Savings	£32 2.10 kg/m²		

Potential energy efficiency rating:	B 89
Potential environmental impact rating:	B 90

Fuel prices for cost data on this page from database revision number 443 TEST (28 May 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£80	£89	-£8
Mains gas	£299	£259	£40
Space heating	£233	£233	£0
Water heating	£79	£47	£32
Lighting	£68	£68	£0
Generated (PV)	-£133	-£133	£0
Total cost of fuels	£246	£215	£32
Total cost of uses	£247	£215	£32
Delivered energy	55 kWh/m²	44 kWh/m²	11 kWh/m²
Carbon dioxide emissions	1.0 tonnes	0.8 tonnes	0.2 tonnes
CO2 emissions per m²	11 kg/m²	9 kg/m²	2 kg/m²
Primary energy	61 kWh/m²	49 kWh/m²	12 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (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	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (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) =	0.1805 (8)
Pressure test					Yes
Measured/design AP50					4.5200
Infiltration rate					0.4065 (18)
Number of sides sheltered					0 (19)
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.4065 (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	0.5183	0.5082	0.4980	0.4472	0.4370	0.3862	0.3862	0.3761	0.4065	0.4370	0.4574	0.4777 (22b)
Effective ac	0.6343	0.6291	0.6240	0.6000	0.5955	0.5746	0.5746	0.5707	0.5826	0.5955	0.6046	0.6141 (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
Solid Door			1.9600	0.9000	1.7640		(26)
Window (Uw = 1.40)			11.9400	1.3258	15.8295		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Half Glazed Door			1.8900	1.3000	2.4570		(26a)
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500 (28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120 (29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300 (30)
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900 (30)
Total net area of external elements Aum(A, m ²)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.3418		(33)
GF Masonry			41.2600			39.0000	1609.1400 (32c)
GF Timber			34.3700			9.0000	309.3300 (32c)
1F Timber			81.4300			9.0000	732.8700 (32c)
1F Metal			34.9000			20.0000	698.0000 (32c)
Internal Floor			45.7700			18.0000	823.8600 (32d)
Internal Floor 1			45.7700			18.0000	823.8600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15039.5420 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							162.5194 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1836 (36)
Total fabric heat loss						(33) + (36) =	74.5254 (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	46.3774	45.9960	45.6221	43.8662	43.5377	42.0083	42.0083	41.7251	42.5974	43.5377	44.2023	44.8971 (38)
Heat transfer coeff	120.9027	120.5213	120.1475	118.3916	118.0630	116.5337	116.5337	116.2504	117.1228	118.0630	118.7276	119.4225 (39)
Average = Sum(39)m / 12 =												118.3900 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3065	1.3024	1.2983	1.2794	1.2758	1.2593	1.2593	1.2562	1.2656	1.2758	1.2830	1.2905 (40)
HLP (average)												1.2793 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

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Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum(45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m												
23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688	(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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month												
179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168	(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												1.1841 (H8)
Utilisation factor												0.5703 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												97.3492 (H14)
Volume ratio Veff/V												0.7704 (H15)
Solar storage volume factor												0.9478 (H16)
Solar input												-861.9358 (H17)
Solar input	-24.9944	-41.7085	-71.0344	-95.2000	-117.6116	-115.6310	-114.1028	-99.6922	-78.0790	-53.3188	-29.6470	-20.9161 (63)
Solar input (sum of months) = Sum(63)m =												-861.9358 (63)
Output from w/h	154.8547	116.1715	93.2631	49.9708	23.1177	7.9249	2.4922	31.1168	53.4109	97.3390	132.2903	153.9008 (64)
Total per year (kWh/year) = Sum(64)m =												915.8527 (64)
Heat gains from water heating, kWh/month												
58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920	(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	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	56.4505	50.1388	40.7756	30.8698	23.0755	19.4813	21.0503	27.3619	36.7251	46.6310	54.4252	58.0194 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	363.6923	367.4663	357.9559	337.7096	312.1522	288.1318	272.0848	268.3108	277.8211	298.0675	323.6249	347.6452 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124 (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)												
	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566 (71)
Water heating gains (Table 5)												
	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958 (72)
Total internal gains												
	607.9758	603.1821	579.6223	543.0939	505.6012	472.1599	452.7350	461.6170	482.7493	519.4999	560.2965	591.2511 (73)

6. Solar gains

[Jan]												
Area												
m2												
Solar flux												
Table 6a												
W/m2												
Specific data												
or Table 6b												
Specific data												
or Table 6c												
Access												
factor												
Table 6d												
Gains												
W												
North	5.7600	10.6334	0.6200	0.7000	18.4212 (74)							
Northeast	0.6800	11.2829	0.6200	0.7000	2.3076 (75)							
South	4.8200	46.7521	0.6200	0.7000	67.7752 (76)							
Northwest	0.6800	11.2829	0.6200	0.7000	2.3076 (81)							
South	3.1500	46.7521	0.6200	0.7000	44.2929 (78)							
Solar gains	135.1044	228.1367	310.5410	388.1224	442.1549	443.3907	425.5451	383.7846	336.7740	251.3497	161.3709	115.9629 (83)
Total gains	743.0802	831.3189	890.1633	931.2163	947.7561	915.5507	878.2800	845.4017	819.5233	770.8497	721.6674	707.2140 (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	34.5538	34.6632	34.7710	35.2867	35.3849	35.8493	35.8493	35.9366	35.6690	35.3849	35.1868	34.9821
alpha	3.3036	3.3109	3.3181	3.3524	3.3590	3.3900	3.3900	3.3958	3.3779	3.3590	3.3458	3.3321
util living area	0.9764	0.9645	0.9442	0.9024	0.8237	0.6876	0.5405	0.5759	0.7662	0.9103	0.9637	0.9797 (86)
MIT	19.2540	19.4617	19.7806	20.1954	20.5685	20.8413	20.9481	20.9346	20.7543	20.2845	19.7037	19.2203 (87)
Th 2	19.8358	19.8390	19.8421	19.8570	19.8598	19.8729	19.8729	19.8753	19.8678	19.8598	19.8542	19.8483 (88)
util rest of house	0.9712	0.9568	0.9314	0.8784	0.7768	0.6020	0.4193	0.4567	0.6922	0.8834	0.9543	0.9752 (89)
MIT 2	17.5492	17.8500	18.3092	18.9034	19.4075	19.7463	19.8467	19.8395	19.6517	19.0387	18.2127	17.5083 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	17.8836	18.1661	18.5978	19.1568	19.6352	19.9611	20.0627	20.0543	19.8679	19.2830	18.5052	17.8441 (92)

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CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature adjustment
adjusted MIT 17.7336 18.0161 18.4478 19.0068 19.4852 19.8111 19.9127 19.9043 19.7179 19.1330 18.3552 -0.1500
17.6941 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9576	0.9398	0.9109	0.8559	0.7586	0.5968	0.4239	0.4601	0.6808	0.8612	0.9371	0.9629	(94)
Useful gains	711.5430	781.2389	810.8184	797.0618	719.0043	546.3853	372.3355	388.9391	557.9413	663.8742	676.2987	680.9583	(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	1624.1534	1580.7709	1435.4933	1196.5556	919.1425	607.2654	386.0409	407.3738	657.9869	1007.4315	1336.2991	1611.4929	(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	678.9822	537.2855	464.7581	287.6356	148.9029	0.0000	0.0000	0.0000	0.0000	255.6067	475.2003	692.3177	(98)
Space heating												3540.6890	(98)
Space heating per m2												38.2612	(99)

(98) / (4) =

8c. Space cooling requirement

Not applicable

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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 %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3934.0988 (211)
Space heating requirement	678.9822	537.2855	464.7581	287.6356	148.9029	0.0000	0.0000	0.0000	0.0000	255.6067	475.2003	692.3177	(98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)	754.4247	596.9839	516.3979	319.5951	165.4476	0.0000	0.0000	0.0000	0.0000	284.0074	528.0003	769.2419	(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	154.8547	116.1715	93.2631	49.9708	23.1177	7.9249	2.4922	31.1168	53.4109	97.3390	132.2903	153.9008	(64)
Efficiency of water heater (217)m	89.3683	89.3951	89.4311	89.4958	89.5420	86.7000	86.7000	86.7000	86.7000	89.0651	89.2602	86.7000	(216)
Fuel for water heating, kWh/month	173.2771	129.9529	104.2849	55.8359	25.8177	9.1406	2.8745	35.8902	61.6042	109.2898	148.2076	172.1846	(219)
Water heating fuel used												1028.3600	(219)
Annual totals kWh/year													
Space heating fuel - main system													3934.0988 (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)													398.7732 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1080 * 1.00) =									-699.5320				-699.5320 (233)
Total delivered energy for all uses													4786.7001 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3934.0988	3.4800	136.9066	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1028.3600	3.4800	35.7869	(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	398.7732	13.1900	52.5982	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-699.5320	13.1900	-92.2683	(252)
Total energy cost			269.5110	(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] =	0.8230 (257)
SAP value			88.5192
SAP rating (Section 12)			89 (258)
SAP band			B

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	3934.0988	0.2160	849.7653 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1028.3600	0.2160	222.1258 (264)
Space and water heating			1071.8911 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	398.7732	0.5190	206.9633 (268)
Energy saving/generation technologies			
PV Unit	-699.5320	0.5190	-363.0571 (269)
Total kg/year			980.6723 (272)
CO2 emissions per m2			10.6000 (273)
EI value			90.4457
EI rating			90 (274)
EI band			B

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

SAP 2012 WORKSHEET FOR New Build (As Built) (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	46.7700 (1b)	x 2.3100 (2b)	= 108.0387 (1b) - (3b)
First floor	45.7700 (1c)	x 2.4800 (2c)	= 113.5096 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	92.5400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 221.5483 (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) = 0.1805 (8)
Pressure test					Yes
Measured/design AP50					4.5200
Infiltration rate					0.4065 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.4065 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000 (22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250 (22a)
Adj infilt rate												
Effective ac	0.4269	0.3964	0.4065	0.3862	0.3862	0.3761	0.3659	0.3557	0.3456	0.3761	0.3557	0.3761 (22b)
	0.5911	0.5786	0.5826	0.5746	0.5746	0.5707	0.5669	0.5633	0.5597	0.5707	0.5633	0.5707 (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
Solid Door			1.9600	0.9000	1.7640		(26)
Window (Uw = 1.40)			11.9400	1.3258	15.8295		(27)
French (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
Half Glazed Door			1.8900	1.3000	2.4570		(26a)
Heat Loss Floor			46.7700	0.1500	7.0155	75.0000	3507.7500 (28a)
100mm Knauf Supafil	134.7300	18.9400	115.7900	0.2500	28.9475	52.8000	6113.7120 (29a)
External Plane Roof	45.7700		45.7700	0.1300	5.9501	9.0000	411.9300 (30)
Bay	1.0100		1.0100	0.2000	0.2020	9.0000	9.0900 (30)
Total net area of external elements Aum(A, m ²)			228.2800				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.3418		(33)
GF Masonry			41.2600			39.0000	1609.1400 (32c)
GF Timber			34.3700			9.0000	309.3300 (32c)
1F Timber			81.4300			9.0000	732.8700 (32c)
1F Metal			34.9000			20.0000	698.0000 (32c)
Internal Floor			45.7700			18.0000	823.8600 (32d)
Internal Floor 1			45.7700			18.0000	823.8600 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	15039.5420 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							162.5194 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1836 (36)
Total fabric heat loss						(33) + (36) =	74.5254 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	43.2167	42.2991	42.5974	42.0083	42.0083	41.7251	41.4494	41.1813	40.9208	41.7251	41.1813	41.7251 (38)
Heat transfer coeff	117.7420	116.8244	117.1228	116.5337	116.5337	116.2504	115.9748	115.7067	115.4461	116.2504	115.7067	116.2504 (39)
Average = Sum(39)m / 12 =												116.3618 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2723	1.2624	1.2656	1.2593	1.2593	1.2562	1.2532	1.2503	1.2475	1.2562	1.2503	1.2562 (40)
HLP (average)												1.2574 (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												2.6589 (42)
Average daily hot water use (litres/day)												97.3492 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Daily hot water use	107.0842	103.1902	99.2962	95.4022	91.5083	87.6143	87.6143	91.5083	95.4022	99.2962	103.1902	107.0842 (44)
Energy conte	158.8027	138.8899	143.3219	124.9515	119.8939	103.4594	95.8703	110.0126	111.3265	129.7403	141.6217	153.7919 (45)
Energy content (annual)										Total = Sum (45)m =		1531.6825 (45)
Distribution loss (46)m = 0.15 x (45)m	23.8204	20.8335	21.4983	18.7427	17.9841	15.5189	14.3805	16.5019	16.6990	19.4610	21.2432	23.0688 (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	21.0464	18.9901	20.9755	20.2193	20.8354	20.0965	20.7248	20.7965	20.1634	20.9175	20.3157	21.0249 (61)
Total heat required for water heating calculated for each month	179.8492	157.8800	164.2974	145.1708	140.7293	123.5558	116.5951	130.8090	131.4899	150.6578	161.9373	174.8168 (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												1208.1510 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2029.6937 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.3251 (H8)
Utilisation factor												0.5298 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												97.3492 (H14)
Volume ratio Veff/V												0.7704 (H15)
Solar storage volume factor												0.9478 (H16)
Solar input												-896.2419 (H17)
Solar input	-29.2376	-41.5740	-71.4557	-96.4103	-113.2396	-120.9578	-118.4140	-105.9842	-82.9783	-57.3683	-34.5804	-24.0418 (63)
Solar input (sum of months) = Sum (63)m =												-896.2419 (63)
Output from w/h	150.6116	116.3060	92.8418	48.7605	27.4897	2.5980	0.0000	24.8249	48.5116	93.2895	127.3570	150.7750 (64)
Total per year (kWh/year) = Sum (64)m =												883.3655 (64)
Heat gains from water heating, kWh/month	58.0635	50.9284	52.8984	46.6012	45.0736	39.4244	37.0581	41.7783	42.0569	48.3680	52.1681	56.3920 (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	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	159.5349	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.4505	50.1388	40.7756	30.8698	23.0755	19.4813	21.0503	27.3619	36.7251	46.6310	54.4252	58.0194	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	363.6923	367.4663	357.9559	337.7096	312.1522	288.1318	272.0848	268.3108	277.8211	298.0675	323.6249	347.6452	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	53.6124	(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)	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	-106.3566	(71)
Water heating gains (Table 5)	78.0424	75.7863	71.1000	64.7239	60.5828	54.7560	49.8092	56.1536	58.4124	65.0108	72.4557	75.7958	(72)
Total internal gains	607.9758	603.1821	579.6223	543.0939	505.6012	472.1599	452.7350	461.6170	482.7493	519.4999	560.2965	591.2511	(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				5.7600	13.4839	0.6200	0.7000			0.7700			23.3593 (74)
Northeast				0.6800	14.6176	0.6200	0.7000			0.7700			2.9896 (75)
South				4.8200	56.7559	0.6200	0.7000			0.7700			82.2774 (78)
Northwest				0.6800	14.6176	0.6200	0.7000			0.7700			2.9896 (81)
South				3.1500	56.7559	0.6200	0.7000			0.7700			53.7705 (78)

Solar gains	165.3865	237.8335	327.8314	416.1774	454.4217	496.7358	472.3078	433.5557	376.7660	283.0270	196.8981	139.5608	(83)
Total gains	773.3623	841.0157	907.4537	959.2714	960.0228	968.8957	925.0428	895.1727	859.5153	802.5269	757.1946	730.8119	(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	35.4814	35.7601	35.6690	35.8493	35.8493	35.9366	36.0221	36.1055	36.1870	35.9366	36.1055	35.9366
alpha	3.3654	3.3840	3.3779	3.3900	3.3900	3.3958	3.4015	3.4070	3.4125	3.3958	3.4070	3.3958
util living area	0.9704	0.9600	0.9346	0.8811	0.7841	0.6106	0.4661	0.4786	0.7050	0.8802	0.9506	0.9741 (86)
MIT	19.4414	19.5991	19.9208	20.3243	20.6754	20.9030	20.9710	20.9688	20.8338	20.4403	19.9109	19.4312 (87)
Th 2	19.8626	19.8704	19.8678	19.8729	19.8729	19.8753	19.8776	19.8799	19.8822	19.8753	19.8799	19.8753 (88)
util rest of house	0.9639	0.9512	0.9196	0.8521	0.7276	0.5142	0.3419	0.3522	0.6190	0.8445	0.9378	0.9683 (89)
MIT 2	17.8366	18.0676	18.5248	19.0902	19.5516	19.8078	19.8659	19.8672	19.7494	19.2598	18.5250	17.8307 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.1514	18.3680	18.7986	19.3323	19.7720	20.0226	20.0827	20.0832	19.9621	19.4913	18.7968	18.1446 (92)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Temperature adjustment													-0.1500
adjusted MIT	18.0014	18.2180	18.6486	19.1823	19.6220	19.8726	19.9327	19.9332	19.8121	19.3413	18.6468		17.9946 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9487	0.9337	0.8985	0.8304	0.7131	0.5139	0.3483	0.3585	0.6130	0.8233	0.9187	0.9543	(94)
Useful gains	733.6551	785.2362	815.3549	796.5905	684.5949	497.9213	322.1882	320.9618	526.8496	660.7310	695.6433	697.3924	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1542.5834	1509.1344	1364.3115	1128.3101	829.9537	531.5676	328.5166	327.8234	590.1734	923.1807	1243.4812	1510.6280	(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	601.8426	486.4595	408.4237	238.8381	108.1469	0.0000	0.0000	0.0000	0.0000	195.2626	394.4433	605.0473	(98)
Space heating												3038.4641	(98)
Space heating per m2										(98) / (4) =		32.8341	(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 %)													90.0000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3376.0712 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	601.8426	486.4595	408.4237	238.8381	108.1469	0.0000	0.0000	0.0000	0.0000	195.2626	394.4433	605.0473	(98)
Space heating efficiency (main heating system 1)	90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)
Space heating fuel (main heating system)	668.7140	540.5106	453.8041	265.3757	120.1633	0.0000	0.0000	0.0000	0.0000	216.9584	438.2703	672.2748	(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	150.6116	116.3060	92.8418	48.7605	27.4897	2.5980	0.0000	24.8249	48.5116	93.2895	127.3570	150.7750	(64)
Efficiency of water heater (217)m	89.3195	89.3438	89.3700	89.4229	89.3110	86.7000	86.7000	86.7000	86.7000	88.9060	89.1716	86.7000	(216)
Fuel for water heating, kWh/month	168.6211	130.1780	103.8847	54.5280	30.7797	2.9966	0.0000	28.6331	55.9534	104.9305	142.8223	168.7998	(219)
Water heating fuel used												992.1273	(219)
Annual totals kWh/year													
Space heating fuel - main system												3376.0712	(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)												398.7732	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.81 * 1208 * 1.00) =									-782.8819			-782.8819	(233)
Total delivered energy for all uses												4109.0899	(238)

10a. Fuel costs - using BEDF prices (443)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3376.0712	3.9200	132.3420 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	992.1273	3.9200	38.8914 (247)
Pumps and fans for heating	75.0000	16.9600	12.7200 (249)
Pump for solar water heating	50.0000	16.9600	8.4800 (249)
Energy for lighting	398.7732	16.9600	67.6319 (250)
Additional standing charges			88.0000 (251)
Energy saving/generation technologies			
PV Unit	-782.8819	16.9600	-132.7768 (252)
Total energy cost			215.2886 (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	3376.0712	0.2160	729.2314 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	992.1273	0.2160	214.2995 (264)
Space and water heating			943.5309 (265)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	398.7732	0.5190	206.9633 (268)
Energy saving/generation technologies			
PV Unit	-782.8819	0.5190	-406.3157 (269)
Total kg/year			809.0535 (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	3376.0712	1.2200	4118.8069 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	992.1273	1.2200	1210.3953 (264)
Space and water heating			5329.2022 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	398.7732	3.0700	1224.2338 (268)
Energy saving/generation technologies			
PV Unit	-782.8819	3.0700	-2403.4473 (269)
Primary energy kWh/year			4533.7387 (272)
Primary energy kWh/m2/year			48.9922 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	162.5 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	292.44 (P1)
Transmission heat loss coefficient	74.53 (37)
Summer heat loss coefficient	366.97 (P2)

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

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

[Jul]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	5.7600	87.1704	0.6200	0.7000	0.9000	176.5088
North East	0.6800	106.0502	0.6200	0.7000	0.9000	25.3510
South	4.8200	118.5567	0.6200	0.7000	0.9000	200.8851
North West	0.6800	106.0502	0.6200	0.7000	0.9000	25.3510
South	3.1500	118.5567	0.6200	0.7000	0.9000	131.2838

total: 559.3798

Solar gains	Jun 598	Jul 559	Aug 512	(P3)
Internal gains	469	450	459	
Total summer gains	1067	1009	970	(P5)

Summer gain/loss ratio	2.91	2.75	2.64	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 162.5)	0.86	0.86	0.86	
Threshold temperature	19.17	20.91	20.81	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight