

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



Property Reference	4907-0015-3817-176				Issued on Date	15/03/2018
Assessment Reference	As Built		Prop Type Ref	P306i - Det (Op)		
Property	62, St Andrews Road, Botley, SOUTHAMPTON, SO32 2ST					
SAP Rating	87 B	DER	14.31	TER	18.56	
Environmental	89 B	% DER<TER	22.89			
CO ₂ Emissions (t/year)	1.01	DFEE	51.20	TFEE	56.35	
General Requirements Compliance	Pass	% DFEE<TFEE	9.15			
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) 14.31 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)56.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)51.2 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: 4.83 (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 m², No overhang
Windows facing North East: 0.68 m², No overhang
Windows facing South: 7.97 m², No overhang
Windows facing North West: 0.68 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features

Door U-value 0.90 W/m²K
Thermal bridging y-value 0.036 W/m²K
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					4.8300
Infiltration rate					0.4220 (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) =		0.4220 (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	0.5381	0.5276	0.5170	0.4643	0.4537	0.4009	0.4009	0.3904	0.4220	0.4537	0.4748	0.4959 (22b)
Effective ac	0.6448	0.6392	0.6336	0.6078	0.6029	0.5804	0.5804	0.5762	0.5891	0.6029	0.6127	0.6230 (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	47.1406	46.7295	46.3267	44.4343	44.0802	42.4320	42.4320	42.1268	43.0669	44.0802	44.7965	45.5453 (38)
Heat transfer coeff	121.6659	121.2549	120.8520	118.9596	118.6056	116.9574	116.9574	116.6522	117.5922	118.6056	119.3218	120.0706 (39)
Average = Sum(39)m / 12 =												118.9579 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.3147	1.3103	1.3059	1.2855	1.2817	1.2639	1.2639	1.2606	1.2707	1.2817	1.2894	1.2975 (40)
HLP (average)												1.2855 (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												
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	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	34.3371	34.4535	34.5683	35.1182	35.2231	35.7194	35.7194	35.8129	35.5266	35.2231	35.0116	34.7933
alpha	3.2891	3.2969	3.3046	3.3412	3.3482	3.3813	3.3813	3.3875	3.3684	3.3482	3.3341	3.3196
util living area	0.9903	0.9831	0.9701	0.9409	0.8798	0.7634	0.6224	0.6631	0.8425	0.9518	0.9840	0.9920 (86)
MIT	18.9904	19.2107	19.5559	20.0140	20.4424	20.7754	20.9195	20.8980	20.6545	20.1012	19.4699	18.9607 (87)
Th 2	19.8293	19.8328	19.8362	19.8522	19.8552	19.8693	19.8693	19.8719	19.8638	19.8552	19.8491	19.8428 (88)
util rest of house	0.9880	0.9792	0.9625	0.9245	0.8422	0.6825	0.4929	0.5387	0.7801	0.9352	0.9795	0.9901 (89)
MIT 2	17.1645	17.4866	17.9886	18.6546	19.2497	19.6810	19.8261	19.8124	19.5420	18.7890	17.8760	17.1294 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	17.5226	17.8247	18.2960	18.9212	19.4836	19.8956	20.0406	20.0253	19.7602	19.0464	18.1886	17.4886 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.3726	17.6747	18.1460	18.7712	19.3336	19.7456	19.8906	19.8753	19.6102	18.8964	18.0386	17.3386 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9804	0.9680	0.9467	0.9036	0.8208	0.6721	0.4956	0.5391	0.7628	0.9155	0.9687	0.9836 (94)
Useful gains	534.5798	615.6915	666.1656	684.3608	645.9276	514.1018	362.7755	375.5339	504.9018	549.8637	521.4406	505.3443 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	1590.4882	1548.9987	1407.4449	1174.2744	905.3923	601.8182	384.8582	405.4000	647.9528	984.0003	1305.2135	1577.5558 (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	785.5959	627.1825	551.5118	352.7378	193.0417	0.0000	0.0000	0.0000	0.0000	322.9976	564.3165	797.7254 (98)
Space heating												4195.1091 (98)

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating per m2 (98) / (4) = 45.3329 (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													4661.2324 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	785.5959	627.1825	551.5118	352.7378	193.0417	0.0000	0.0000	0.0000	0.0000	322.9976	564.3165	797.7254	(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)	872.8843	696.8694	612.7909	391.9309	214.4908	0.0000	0.0000	0.0000	0.0000	358.8862	627.0183	886.3615	(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	89.3663	89.3163	89.2205	89.0122	88.5785	86.7000	86.7000	86.7000	86.7000	88.9234	89.2426	86.7000	(216)
Fuel for water heating, kWh/month	201.2493	176.7650	184.1475	163.0909	158.8753	142.5096	134.4811	150.8755	151.6607	169.4242	181.4574	195.5699	(219)
Water heating fuel used												2010.1065	(219)
Annual totals kWh/year													
Space heating fuel - main system												4661.2324	(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												6445.5801	(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	4661.2324	0.2160	1006.8262 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2010.1065	0.2160	434.1830 (264)
Space and water heating			1441.0092 (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			1323.8404 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.3100 (273)

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

DER			14.3100 ZC1
Total Floor Area		TFA	92.5400
Assumed number of occupants		N	2.6589
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190
CO2 emissions from appliances, equation (L14)			15.6036 ZC2
CO2 emissions from cooking, equation (L16)			1.9755 ZC3
Total CO2 emissions			31.8891 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			31.8891 ZC8

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	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	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)
Total heat required for water heating calculated for each 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 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Output from w/h	209.7616	184.9173	193.9222	171.9992	166.5256	146.6664	140.5176	156.6442	158.3742	180.3405	190.9367	204.7508 (64)
Heat gains from water heating, kWh/month	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	g Specific data or Table 6b	FF Specific data or Table 6c			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	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					4.8300
Infiltration rate					0.3769 (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) =	0.3769 (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	0.4806	0.4711	0.4617	0.4146	0.4052	0.3581	0.3581	0.3486	0.3769	0.4052	0.4240	0.4429 (22b)
Effective ac	0.6155	0.6110	0.6066	0.5859	0.5821	0.5641	0.5641	0.5608	0.5710	0.5821	0.5899	0.5981 (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	44.9976	44.6697	44.3484	42.8392	42.5568	41.2423	41.2423	40.9988	41.7486	42.5568	43.1280	43.7252 (38)
Heat transfer coeff	119.5229	119.1951	118.8738	117.3645	117.0821	115.7676	115.7676	115.5242	116.2740	117.0821	117.6534	118.2506 (39)
Average = Sum(39)m / 12 =												117.3632 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2916	1.2880	1.2846	1.2683	1.2652	1.2510	1.2510	1.2484	1.2565	1.2652	1.2714	1.2778 (40)
HLP (average)												1.2682 (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 (76)			
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	33.9954	34.0889	34.1810	34.6206	34.7041	35.0981	35.0981	35.1721	34.9453	34.7041	34.5356	34.3611
alpha	3.2664	3.2726	3.2787	3.3080	3.3136	3.3399	3.3399	3.3448	3.3297	3.3136	3.3024	3.2907
util living area	0.9914	0.9845	0.9719	0.9437	0.8843	0.7713	0.6320	0.6748	0.8504	0.9554	0.9857	0.9930 (86)
MIT	18.9417	19.1661	19.5174	19.9800	20.4179	20.7601	20.9123	20.8883	20.6328	20.0641	19.4210	18.9066 (87)
Th 2	19.8474	19.8502	19.8529	19.8658	19.8682	19.8794	19.8794	19.8815	19.8751	19.8682	19.8633	19.8582 (88)
util rest of house	0.9894	0.9809	0.9649	0.9282	0.8485	0.6927	0.5039	0.5522	0.7910	0.9401	0.9817	0.9913 (89)
MIT 2	17.9779	18.2027	18.5524	19.0150	19.4325	19.7396	19.8464	19.8356	19.6376	19.1044	18.4671	17.9508 (90)
Living area fraction									fLA =	Living area / (4) =		0.1961 (91)
MIT	18.1670	18.3916	18.7417	19.2043	19.6258	19.9398	20.0555	20.0421	19.8328	19.2927	18.6542	18.1383 (92)
Temperature adjustment												0.0000
adjusted MIT	18.1670	18.3916	18.7417	19.2043	19.6258	19.9398	20.0555	20.0421	19.8328	19.2927	18.6542	18.1383 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	502.0574	585.9282	640.9299	666.0170	635.8356	514.5514	371.6685	382.5298	499.2624	529.7207	492.4488	473.0550 (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	1657.4205	1608.1374	1455.2126	1209.3570	927.9701	618.1758	400.0323	420.7487	666.5739	1017.7545	1359.3916	1648.2123 (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	859.5902	686.9246	605.8263	391.2048	217.3481	0.0000	0.0000	0.0000	0.0000	363.0972	624.1988	874.3171 (98)
Space heating												4622.5070 (98)
Space heating per m2										(98) / (4) =		49.9514 (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	1088.2157	856.6805	877.9839	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7206	0.7981	0.7718	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	784.1580	683.6793	677.6240	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	128.9013	179.3182	152.4013	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling													
Cooled fraction									fC = cooled area / (4) =			460.6208	(104)
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	(105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	32.2253	44.8296	38.1003	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling													
Space cooling per m2												115.1552	(107)
Energy for space heating												1.2444	(108)
Energy for space cooling												49.9514	(99)
Total												1.2444	(108)
Dwelling Fabric Energy Efficiency (DFEE)												51.1958	(109)
												51.2	(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	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					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										4.8300							
Infiltration rate										0.4220 (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) =					0.4220	(21)	
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
Wind factor	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)				
Adj infilt rate	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)				
	0.4431	0.4115	0.4220	0.4009	0.4009	0.3904	0.3798	0.3693	0.3587	0.3904	0.3693	0.3904	(22b)				
Effective ac	0.5982	0.5847	0.5891	0.5804	0.5804	0.5762	0.5721	0.5682	0.5643	0.5762	0.5682	0.5762	(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	43.7343	42.7454	43.0669	42.4320	42.4320	42.1268	41.8297	41.5408	41.2600	42.1268	41.5408	42.1268	(38)
Heat transfer coeff	118.2597	117.2707	117.5922	116.9574	116.9574	116.6522	116.3551	116.0661	115.7853	116.6522	116.0661	116.6522	(39)
Average = Sum(39)m / 12 =												116.7722	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2779	1.2672	1.2707	1.2639	1.2639	1.2606	1.2573	1.2542	1.2512	1.2606	1.2542	1.2606	(40)
HLP (average)												1.2619	(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)
												1777.7885 (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 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	35.3261	35.6240	35.5266	35.7194	35.7194	35.8129	35.9043	35.9937	36.0810	35.8129	35.9937	35.8129
alpha	3.3551	3.3749	3.3684	3.3813	3.3813	3.3875	3.3936	3.3996	3.4054	3.3875	3.3996	3.3875
util living area	0.9705	0.9601	0.9348	0.8816	0.7850	0.6119	0.4672	0.4798	0.7059	0.8807	0.9508	0.9742 (86)
MIT	19.4323	19.5914	19.9135	20.3190	20.6720	20.9016	20.9705	20.9683	20.8322	20.4362	19.9056	19.4242 (87)
Th 2	19.8582	19.8666	19.8638	19.8693	19.8693	19.8719	19.8744	19.8769	19.8793	19.8719	19.8769	19.8719 (88)
util rest of house	0.9640	0.9514	0.9198	0.8527	0.7285	0.5151	0.3425	0.3528	0.6199	0.8450	0.9380	0.9683 (89)
MIT 2	17.8207	18.0540	18.5118	19.0806	19.5446	19.8034	19.8625	19.8639	19.7452	19.2518	18.5156	17.8184 (90)
Living area fraction	18.1368	18.3555	18.7867	19.3235	19.7658	20.0188	20.0798	20.0805	19.9584	19.4841	18.7882	18.1333 (92)
MIT												
Temperature adjustment												-0.1500
adjusted MIT	17.9868	18.2055	18.6367	19.1735	19.6158	19.8688	19.9298	19.9305	19.8084	19.3341	18.6382	17.9833 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9487	0.9338	0.8987	0.8308	0.7139	0.5148	0.3490	0.3592	0.6137	0.8237	0.9188	0.9543 (94)
Ext temp.	733.6917	785.3107	815.5496	796.9979	685.3221	498.8248	322.8245	321.5550	527.4864	661.0608	695.7266	697.4113 (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	1547.6423	1513.4430	1368.3881	1131.3831	832.2404	532.9640	329.2614	328.5264	591.4753	925.5282	1246.3409	1514.5306 (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)
	605.5793	489.3049	411.3118	240.7573	109.3073	0.0000	0.0000	0.0000	0.0000	196.7638	396.4423	607.9367 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF HEAT DEMAND 09 Jan 2014

Space heating
RHI space heating demand

3057.4035 (98)
3057 (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	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													4.8300	
Infiltration rate													0.4220 (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) =		0.4220 (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	0.5381	0.5276	0.5170	0.4643	0.4537	0.4009	0.4009	0.3904	0.4220	0.4537	0.4748	0.4959	(22b)	
Effective ac	0.6448	0.6392	0.6336	0.6078	0.6029	0.5804	0.5804	0.5762	0.5891	0.6029	0.6127	0.6230	(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	47.1406	46.7295	46.3267	44.4343	44.0802	42.4320	42.4320	42.1268	43.0669	44.0802	44.7965	45.5453	(38)
Heat transfer coeff	121.6659	121.2549	120.8520	118.9596	118.6056	116.9574	116.9574	116.6522	117.5922	118.6056	119.3218	120.0706	(39)
Average = Sum(39)m / 12 =												118.9579	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3147	1.3103	1.3059	1.2855	1.2817	1.2639	1.2639	1.2606	1.2707	1.2817	1.2894	1.2975	(40)
HLP (average)												1.2855	(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	34.3371	34.4535	34.5683	35.1182	35.2231	35.7194	35.7194	35.8129	35.5266	35.2231	35.0116	34.7933
alpha	3.2891	3.2969	3.3046	3.3412	3.3482	3.3813	3.3813	3.3875	3.3684	3.3482	3.3341	3.3196
util living area	0.9765	0.9647	0.9445	0.9030	0.8246	0.6888	0.5419	0.5772	0.7672	0.9107	0.9638	0.9798 (86)
MIT	19.2404	19.4489	19.7694	20.1879	20.5634	20.8392	20.9472	20.9336	20.7513	20.2783	19.6947	19.2086 (87)
Th 2	19.8293	19.8328	19.8362	19.8522	19.8552	19.8693	19.8693	19.8719	19.8638	19.8552	19.8491	19.8428 (88)
util rest of house	0.9713	0.9569	0.9317	0.8790	0.7778	0.6030	0.4202	0.4576	0.6932	0.8839	0.9545	0.9753 (89)
MIT 2	17.5255	17.8277	18.2894	18.8897	19.3976	19.7411	19.8426	19.8356	19.6451	19.0270	18.1966	17.4880 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	17.8619	18.1457	18.5797	19.1443	19.6262	19.9565	20.0593	20.0509	19.8621	19.2724	18.4904	17.8255 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.7119	17.9957	18.4297	18.9943	19.4762	19.8065	19.9093	19.9009	19.7121	19.1224	18.3404	17.6755 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9576	0.9399	0.9111	0.8564	0.7594	0.5977	0.4248	0.4609	0.6817	0.8616	0.9372	0.9629 (94)
Useful gains	711.5578	781.3186	811.0236	797.4646	719.7550	547.2423	373.1056	389.6694	558.6552	664.1649	676.3628	680.9607 (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	1631.7694	1587.9144	1441.7263	1200.8194	922.3064	608.9351	387.0458	408.3892	659.9365	1010.8098	1341.2273	1618.0107 (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	684.6374	542.0324	469.2428	290.4154	150.6982	0.0000	0.0000	0.0000	0.0000	257.9038	478.7024	697.1652 (98)
Space heating												3570.7977 (98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating per m2

(98) / (4) = 38.5865 (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													3967.5530 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	684.6374	542.0324	469.2428	290.4154	150.6982	0.0000	0.0000	0.0000	0.0000	257.9038	478.7024	697.1652	(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)	760.7082	602.2582	521.3809	322.6838	167.4424	0.0000	0.0000	0.0000	0.0000	286.5597	531.8916	774.6280	(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	89.2929	89.2339	89.1203	88.8726	88.3756	86.7000	86.7000	86.7000	86.7000	88.7543	89.1423	86.7000	(216)
Fuel for water heating, kWh/month	201.4148	176.9284	184.3546	163.3470	159.2399	142.5096	134.4811	150.8755	151.6607	169.7471	181.6615	195.7231	(219)
Water heating fuel used												2011.9434	(219)
Annual totals kWh/year													
Space heating fuel - main system												3967.5530	(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												5753.7376	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3967.5530	3.4800	138.0708 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2011.9434	3.4800	70.0156 (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			298.3089 (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] =	0.9109 (257)
SAP value		87.2925
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	3967.5530	0.2160	856.9914 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2011.9434	0.2160	434.5798 (264)
Space and water heating			1291.5712 (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			1174.4024 (272)
CO2 emissions per m2			12.6900 (273)
EI value			88.5582
EI rating			89 (274)
EI band			B

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency
Main heating environmental impact
Water heating energy efficiency
Water heating environmental impact

$3.48 \times (1 + 0.29 \times 0.00) / 0.9000 = 3.867$, stars = 4
 $0.216 \times (1 + 0.29 \times 0.00) / 0.9000 = 0.2400$, stars = 4
 $3.48 / 0.8824 = 3.944$, stars = 4
 $0.216 / 0.8824 = 0.2448$, 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																	4.8300
Infiltration rate																	0.4220 (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) =							0.4220 (21)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
Wind factor	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)				
Adj infilt rate	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)				
	0.4431	0.4115	0.4220	0.4009	0.4009	0.3904	0.3798	0.3693	0.3587	0.3904	0.3693	0.3904	(22b)				
Effective ac	0.5982	0.5847	0.5891	0.5804	0.5804	0.5762	0.5721	0.5682	0.5643	0.5762	0.5682	0.5762	(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	43.7343	42.7454	43.0669	42.4320	42.4320	42.1268	41.8297	41.5408	41.2600	42.1268	41.5408	42.1268	(38)
Heat transfer coeff	118.2597	117.2707	117.5922	116.9574	116.9574	116.6522	116.3551	116.0661	115.7853	116.6522	116.0661	116.6522	(39)
Average = Sum(39)m / 12 =												116.7722	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2779	1.2672	1.2707	1.2639	1.2639	1.2606	1.2573	1.2542	1.2512	1.2606	1.2542	1.2606	(40)
HLP (average)												1.2619	(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 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	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	35.3261	35.6240	35.5266	35.7194	35.7194	35.8129	35.9043	35.9937	36.0810	35.8129	35.9937	35.8129
alpha	3.3551	3.3749	3.3684	3.3813	3.3813	3.3875	3.3936	3.3996	3.4054	3.3875	3.3996	3.3875
util living area	0.9705	0.9601	0.9348	0.8816	0.7850	0.6119	0.4672	0.4798	0.7059	0.8807	0.9508	0.9742 (86)
MIT	19.4323	19.5914	19.9135	20.3190	20.6720	20.9016	20.9705	20.9683	20.8322	20.4362	19.9056	19.4242 (87)
Th 2	19.8582	19.8666	19.8638	19.8693	19.8693	19.8719	19.8744	19.8769	19.8793	19.8719	19.8769	19.8719 (88)
util rest of house	0.9640	0.9514	0.9198	0.8527	0.7285	0.5151	0.3425	0.3528	0.6199	0.8450	0.9380	0.9683 (89)
MIT 2	17.8207	18.0540	18.5118	19.0806	19.5446	19.8034	19.8625	19.8639	19.7452	19.2518	18.5156	17.8184 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.1368	18.3555	18.7867	19.3235	19.7658	20.0188	20.0798	20.0805	19.9584	19.4841	18.7882	18.1333 (92)
Temperature adjustment												-0.1500
adjusted MIT	17.9868	18.2055	18.6367	19.1735	19.6158	19.8688	19.9298	19.9305	19.8084	19.3341	18.6382	17.9833 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9487	0.9338	0.8987	0.8308	0.7139	0.5148	0.3490	0.3592	0.6137	0.8237	0.9188	0.9543 (94)
Useful gains	733.6917	785.3107	815.5496	796.9979	685.3221	498.8248	322.8245	321.5550	527.4864	661.0608	695.7266	697.4113 (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	1547.6423	1513.4430	1368.3881	1131.3831	832.2404	532.9640	329.2614	328.5264	591.4753	925.5282	1246.3409	1514.5306 (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	605.5793	489.3049	411.3118	240.7573	109.3073	0.0000	0.0000	0.0000	0.0000	196.7638	396.4423	607.9367 (98)
Space heating												3057.4035 (98)

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Space heating per m2 (98) / (4) = 33.0387 (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													3397.1150 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	605.5793	489.3049	411.3118	240.7573	109.3073	0.0000	0.0000	0.0000	0.0000	196.7638	396.4423	607.9367	(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)	672.8658	543.6722	457.0132	267.5081	121.4525	0.0000	0.0000	0.0000	0.0000	218.6264	440.4914	675.4853	(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	89.2224	89.1720	89.0327	88.7296	88.1124	86.7000	86.7000	86.7000	86.7000	88.5386	89.0174	86.7000	(216)
Fuel for water heating, kWh/month	201.5740	177.0511	184.5360	163.6103	159.7157	142.5096	134.4811	150.8755	151.6607	170.1606	181.9165	195.8921	(219)
Water heating fuel used												2013.9832	(219)
Annual totals kWh/year													
Space heating fuel - main system												3397.1150	(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												5101.9895	(238)

10a. Fuel costs - using BEDF prices (445)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3397.1150	3.9300	133.5066 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2013.9832	3.9300	79.1495 (247)
Pumps and fans for heating	75.0000	17.5600	13.1700 (249)
Energy for lighting	398.7732	17.5600	70.0246 (250)
Additional standing charges			88.0000 (251)
Energy saving/generation technologies			
PV Unit	-782.8819	17.5600	-137.4741 (252)
Total energy cost			246.3767 (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	3397.1150	0.2160	733.7768 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2013.9832	0.2160	435.0204 (264)
Space and water heating			1168.7972 (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			1008.3698 (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	3397.1150	1.2200	4144.4802 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2013.9832	1.2200	2457.0595 (264)
Space and water heating			6601.5398 (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			5652.5762 (272)
Primary energy kWh/m2/year			61.0825 (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	-£ 31	-195 kg (19.3%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£31 2.10 kg/m²	B 88	B 90
Total Savings	£31 2.10 kg/m²		
Potential energy efficiency rating:		B 88	
Potential environmental impact rating:			B 90

Fuel prices for cost data on this page from database revision number 445 TEST (30 Jul 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	£83	£92	-£9
Mains gas	£301	£260	£40
Space heating	£235	£235	£0
Water heating	£79	£48	£31
Lighting	£70	£70	£0
Generated (PV)	-£137	-£137	£0
Total cost of fuels	£247	£215	£31
Total cost of uses	£247	£216	£31
Delivered energy	55 kWh/m²	45 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	m ³ per hour
Number of chimneys	0	+	0	= 0 * 40 =	0.0000 (6a)
Number of open flues	0	+	0	= 0 * 20 =	0.0000 (6b)
Number of intermittent fans				4 * 10 =	40.0000 (7a)
Number of passive vents				0 * 10 =	0.0000 (7b)
Number of flueless gas fires				0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c)				40.0000 / (5) =	0.1805 (8)
Pressure test				Yes	
Measured/design AP50				4.8300	
Infiltration rate				0.4220 (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) =		0.4220 (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	0.5381	0.5276	0.5170	0.4643	0.4537	0.4009	0.4009	0.3904	0.4220	0.4537	0.4748	0.4959 (22b)
Effective ac	0.6448	0.6392	0.6336	0.6078	0.6029	0.5804	0.5804	0.5762	0.5891	0.6029	0.6127	0.6230 (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/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	47.1406	46.7295	46.3267	44.4343	44.0802	42.4320	42.4320	42.1268	43.0669	44.0802	44.7965	45.5453 (38)
Heat transfer coeff	121.6659	121.2549	120.8520	118.9596	118.6056	116.9574	116.9574	116.6522	117.5922	118.6056	119.3218	120.0706 (39)
Average = Sum(39)m / 12 =												118.9579 (39)
HLP	1.3147	1.3103	1.3059	1.2855	1.2817	1.2639	1.2639	1.2606	1.2707	1.2817	1.2894	1.2975 (40)
HLP (average)												1.2855 (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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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	158.027	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	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	34.3371	34.4535	34.5683	35.1182	35.2231	35.7194	35.7194	35.8129	35.5266	35.2231	35.0116	34.7933
alpha	3.2891	3.2969	3.3046	3.3412	3.3482	3.3813	3.3813	3.3875	3.3684	3.3482	3.3341	3.3196
util living area	0.9765	0.9647	0.9445	0.9030	0.8246	0.6888	0.5419	0.5772	0.7672	0.9107	0.9638	0.9798 (86)
MIT	19.2404	19.4489	19.7694	20.1879	20.5634	20.8392	20.9472	20.9336	20.7513	20.2783	19.6947	19.2086 (87)
Th 2	19.8293	19.8328	19.8362	19.8522	19.8552	19.8693	19.8693	19.8719	19.8638	19.8552	19.8491	19.8428 (88)
util rest of house	0.9713	0.9569	0.9317	0.8790	0.7778	0.6030	0.4202	0.4576	0.6932	0.8839	0.9545	0.9753 (89)
MIT 2	17.5255	17.8277	18.2894	18.8897	19.3976	19.7411	19.8426	19.8356	19.6451	19.0270	18.1966	17.4880 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	17.8619	18.1457	18.5797	19.1443	19.6262	19.9565	20.0593	20.0509	19.8621	19.2724	18.4904	17.8255 (92)

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Temperature adjustment
adjusted MIT 17.7119 17.9957 18.4297 18.9943 19.4762 19.8065 19.9093 19.9009 19.7121 19.1224 18.3404 -0.1500
17.6755 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9576	0.9399	0.9111	0.8564	0.7594	0.5977	0.4248	0.4609	0.6817	0.8616	0.9372	0.9629	(94)
Useful gains	711.5578	781.3186	811.0236	797.4646	719.7550	547.2423	373.1056	389.6694	558.6552	664.1649	676.3628	680.9607	(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	1631.7694	1587.9144	1441.7263	1200.8194	922.3064	608.9351	387.0458	408.3892	659.9365	1010.8098	1341.2273	1618.0107	(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	684.6374	542.0324	469.2428	290.4154	150.6982	0.0000	0.0000	0.0000	0.0000	257.9038	478.7024	697.1652	(98)
Space heating												3570.7977	(98)
Space heating per m2												38.5865	(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													3967.5530 (211)
Space heating requirement	684.6374	542.0324	469.2428	290.4154	150.6982	0.0000	0.0000	0.0000	0.0000	257.9038	478.7024	697.1652	(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)	760.7082	602.2582	521.3809	322.6838	167.4424	0.0000	0.0000	0.0000	0.0000	286.5597	531.8916	774.6280	(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	89.3725	89.3994	89.4356	89.4999	89.5467	86.7000	86.7000	86.7000	86.7000	89.0710	89.2644	86.7000	(216)
Fuel for water heating, kWh/month	173.2689	129.9466	104.2796	55.8333	25.8163	9.1406	2.8745	35.8902	61.6042	109.2825	148.2006	172.1778	(219)
Water heating fuel used												1028.3152	(219)
Annual totals kWh/year													
Space heating fuel - main system												3967.5530	(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												4820.1095	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3967.5530	3.4800	138.0708	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1028.3152	3.4800	35.7854	(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			270.6736	(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] =	0.8265 (257)
SAP value			88.4697
SAP rating (Section 12)			88 (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	3967.5530	0.2160	856.9914	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1028.3152	0.2160	222.1161	(264)
Space and water heating			1079.1075	(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			987.8887	(272)
CO2 emissions per m2			10.6800	(273)
EI value			90.3754	
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	=	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								4.8300				
Infiltration rate								0.4220 (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) =	0.4220 (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	0.4431	0.4115	0.4220	0.4009	0.4009	0.3904	0.3798	0.3693	0.3587	0.3904	0.3693	0.3904 (22b)
Effective ac	0.5982	0.5847	0.5891	0.5804	0.5804	0.5762	0.5721	0.5682	0.5643	0.5762	0.5682	0.5762 (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	43.7343	42.7454	43.0669	42.4320	42.4320	42.1268	41.8297	41.5408	41.2600	42.1268	41.5408	42.1268	(38)
Heat transfer coeff	118.2597	117.2707	117.5922	116.9574	116.9574	116.6522	116.3551	116.0661	115.7853	116.6522	116.0661	116.6522	(39)
Average = Sum(39)m / 12 =												116.7722	(39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2779	1.2672	1.2707	1.2639	1.2639	1.2606	1.2573	1.2542	1.2512	1.2606	1.2542	1.2606	(40)
HLP (average)												1.2619	(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	35.3261	35.6240	35.5266	35.7194	35.7194	35.8129	35.9043	35.9937	36.0810	35.8129	35.9937	35.8129
alpha	3.3551	3.3749	3.3684	3.3813	3.3813	3.3875	3.3936	3.3996	3.4054	3.3875	3.3996	3.3875
util living area	0.9705	0.9601	0.9348	0.8816	0.7850	0.6119	0.4672	0.4798	0.7059	0.8807	0.9508	0.9742 (86)
MIT	19.4323	19.5914	19.9135	20.3190	20.6720	20.9016	20.9705	20.9683	20.8322	20.4362	19.9056	19.4242 (87)
Th 2	19.8582	19.8666	19.8638	19.8693	19.8693	19.8719	19.8744	19.8769	19.8793	19.8719	19.8769	19.8719 (88)
util rest of house	0.9640	0.9514	0.9198	0.8527	0.7285	0.5151	0.3425	0.3528	0.6199	0.8450	0.9380	0.9683 (89)
MIT 2	17.8207	18.0540	18.5118	19.0806	19.5446	19.8034	19.8625	19.8639	19.7452	19.2518	18.5156	17.8184 (90)
Living area fraction									fLA = Living area / (4) =			0.1961 (91)
MIT	18.1368	18.3555	18.7867	19.3235	19.7658	20.0188	20.0798	20.0805	19.9584	19.4841	18.7882	18.1333 (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	17.9868	18.2055	18.6367	19.1735	19.6158	19.8688	19.9298	19.9305	19.8084	19.3341	18.6382		17.9833 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9487	0.9338	0.8987	0.8308	0.7139	0.5148	0.3490	0.3592	0.6137	0.8237	0.9188	0.9543	(94)
Useful gains	733.6917	785.3107	815.5496	796.9979	685.3221	498.8248	322.8245	321.5550	527.4864	661.0608	695.7266	697.4113	(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	1547.6423	1513.4430	1368.3881	1131.3831	832.2404	532.9640	329.2614	328.5264	591.4753	925.5282	1246.3409	1514.5306	(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	605.5793	489.3049	411.3118	240.7573	109.3073	0.0000	0.0000	0.0000	0.0000	196.7638	396.4423	607.9367	(98)
Space heating												3057.4035	(98)
Space heating per m2											(98) / (4) =	33.0387	(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													3397.1150 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	605.5793	489.3049	411.3118	240.7573	109.3073	0.0000	0.0000	0.0000	0.0000	196.7638	396.4423	607.9367	(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)	672.8658	543.6722	457.0132	267.5081	121.4525	0.0000	0.0000	0.0000	0.0000	218.6264	440.4914	675.4853	(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	89.3229	89.3469	89.3736	89.4267	89.3168	86.7000	86.7000	86.7000	86.7000	88.9116	89.1747	86.7000	(216)
Fuel for water heating, kWh/month	168.6148	130.1736	103.8806	54.5257	30.7777	2.9966	0.0000	28.6331	55.9534	104.9239	142.8173	168.7950	(219)
Water heating fuel used												992.0916	(219)
Annual totals kWh/year													
Space heating fuel - main system												3397.1150	(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												4130.0979	(238)

10a. Fuel costs - using BEDF prices (445)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3397.1150	3.9300	133.5066	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	992.0916	3.9300	38.9892	(247)
Pumps and fans for heating	75.0000	17.5600	13.1700	(249)
Pump for solar water heating	50.0000	17.5600	8.7800	(249)
Energy for lighting	398.7732	17.5600	70.0246	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-782.8819	17.5600	-137.4741	(252)
Total energy cost			214.9963	(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	3397.1150	0.2160	733.7768	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	992.0916	0.2160	214.2918	(264)
Space and water heating			948.0686	(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			813.5912 (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	3397.1150	1.2200	4144.4802 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	992.0916	1.2200	1210.3518 (264)
Space and water heating			5354.8320 (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			4559.3685 (272)
Primary energy kWh/m2/year			49.2692 (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

	Jun	Jul	Aug	
Solar gains	598	559	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