



SAP Report Submission for Building Regulations Compliance

Client: Foreman Homes

Project: 10 Oram Way
West End, Southampton, SO30 3JW

Contact: Tobias Whiting
Abacus Energy (UK) Ltd
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Report Issue Date: 09/05/2022

EXCELLENCE
IN ENERGY
ASSESSMENT

BUILDING REGULATION COMPLIANCE

Calculation Type: New Build (As Built)

Property Reference	SAP 0647 Plot 10	Issued on Date	09/05/2022
Assessment Reference	As Built	Prop Type Ref	Kh
Property	10 Oram Way, West End, Southampton, SO30 3JW		
SAP Rating	89 B	DER	12.13
Environmental	89 B	TER	15.41
CO ₂ Emissions (t/year)	1.18	% DER<TER	21.28
General Requirements Compliance	Pass	DfEE	42.99
		TfEE	51.75
		% DfEE<TfEE	16.92
Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com		Assessor ID
			E477-0001
Client	Foreman Homes, FORE		

SUMMARY FOR INPUT DATA FOR New Build (As Built)

Criterion 1 – Achieving the TER and TfEE rate

1a TER and DER

Fuel for main heating	Mains gas		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	15.41	kgCO ₂ /m ²	
Dwelling Carbon Dioxide Emission Rate (DER)	12.13	kgCO ₂ /m ²	Pass
	-3.28 (-21.3%)	kgCO ₂ /m ²	

1b TfEE and DfEE

Target Fabric Energy Efficiency (TfEE)	51.75	kWh/m ² /yr	
Dwelling Fabric Energy Efficiency (DfEE)	42.99	kWh/m ² /yr	
	-8.7 (-16.8%)	kWh/m ² /yr	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	Pass
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	Pass
Openings	1.19 (max. 2.00)	1.20 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	3.99 (measured in this dwelling)	m ³ /(h.m ²) @ 50 Pa	
Maximum	10.0	m ³ /(h.m ²) @ 50 Pa	Pass

Limiting System Efficiencies

4 Heating efficiency

This report has been produced by an accredited Elmhurst member whose work is subject to quality assurance audits. The data used to produce the report has been verified by the Elmhurst members' portal.

BUILDING REGULATION COMPLIANCE

Calculation Type: New Build (As Built)

Main heating system

Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 4000 GR4700iW 15 S NG

Efficiency: 89.8% SEDBUK2009
Minimum: 88.0%

Pass

Secondary heating system

None

5 Cylinder insulation

Hot water storage

Measured cylinder loss: 1.73 kWh/day
Permitted by DBSCG 2.33

Pass

Primary pipework insulated

Yes

Pass

6 Controls

Space heating controls

Programmer, room thermostat and TRVs

Pass

Hot water controls

Cylinderstat

Pass

Independent timer for DHW

Pass

Boiler interlock

Yes

Pass

7 Low energy lights

Percentage of fixed lights with low-energy fittings

100 %

Minimum

75 %

Pass

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Southern England)

Slight

Pass

Based on:

Overshading

Average

Windows facing North

6.58 m², Overhang twice as wide as window, ratio 0.46

Windows facing South

14.81 m², No overhang

Windows facing West

1.26 m², No overhang

Air change rate

4.00 ach

Blinds/curtains

None

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

Type

U-value

W/m²K

Pass

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals

3.99 (measured in this dwelling) m³/(h.m²) @ 50 Pa

Maximum

10.0 m³/(h.m²) @ 50 Pa

Pass

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BUILDING REGULATION COMPLIANCE

Calculation Type: New Build (As Built)

10 Key features

Party wall U-value	0.00	W/m ² K
Roof U-value	0.10	W/m ² K
Floor U-value	0.12	W/m ² K
Door U-value	1.10	W/m ² K
Thermal bridging ψ -value	0.032	W/m ² K
Air permeability	4.0	m ³ /m ² h
Photovoltaic array	1.11	kW

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THERMAL BRIDGING

Calculation Type: New Build (As Built)

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SAP Rating	89 B	DER	12.13	TER	15.41
Environmental	89 B	% DER<TER	21.28		
CO ₂ Emissions (t/year)	1.18	DFEE	42.99	TFEE	51.75
General Requirements Compliance	Pass	% DFEE<TFEE	16.92		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	Assessor ID	E477-0001
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Client	Foreman Homes, FORE
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	Junction detail	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.093	0.63	0.06	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.070	2.75	0.19	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.067	7.20	0.48	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.070	2.92	0.20	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.059	2.77	0.16	Birtley Supatherm
External wall	E3 Sill	Independently assessed	0.021	10.58	0.22	Knauf P5
External wall	E4 Jamb	Independently assessed	0.016	36.60	0.59	Knauf P6
External wall	E5 Ground floor (normal)	Table K1 - Approved	0.160	35.55	5.69	
External wall	E6 Intermediate floor within a dwelling	Independently assessed	0.000	32.97	0.00	CD0029
External wall	E10 Eaves (insulation at ceiling level)	Table K1 - Approved	0.060	20.52	1.23	
External wall	E12 Gable (insulation at ceiling level)	Independently assessed	0.044	18.06	0.79	Knauf P21
External wall	E16 Corner (normal)	Independently assessed	0.039	29.74	1.16	Knauf P23
External wall	E17 Corner (inverted – internal area greater than external area)	Independently assessed	-0.091	9.54	-0.87	Knauf P24

Total: **9.91** W/mK:
Y-Value: **0.032** W/m²K:

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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FULL SAP CALCULATION PRINTOUT

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

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

DWELLING AS BUILT

Detached House, total floor area 137 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) 15.41 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 12.13 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)51.7 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)43.0 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.19 (max. 2.00)	1.20 (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: 3.99 (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

Worcester Greenstar 4000 GR4700iW 15 S NG

Efficiency: 89.8% SEDBUK2009

Minimum: 88.0% OK

Secondary heating system:

None

5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.73 kWh/day

Permitted by DBSCG 2.33 OK

Primary pipework insulated: Yes OK

6 Controls

Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls:

Cylinderstat OK

Independent timer for DHW OK

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: 6.58 m², Overhang twice as wide as window, ratio 0.46

Windows facing South: 14.81 m², No overhang

Windows facing West: 1.26 m², No overhang

Air change rate: 4.00 ach

Blinds/curtains: None

10 Key features

Party wall U-value 0.00 W/m²K

Roof U-value 0.10 W/m²K

Floor U-value 0.12 W/m²K

Door U-value 1.10 W/m²K

Thermal bridging y-value 0.032 W/m²K

Air permeability 4.0 m³/m²h

Photovoltaic array 1.11 kW

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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	69.3900 (1b)	x 2.3900 (2b)	= 165.8421 (1b) - (3b)
First floor	67.8400 (1c)	x 2.6700 (2c)	= 181.1328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	137.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 346.9749 (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					5 * 10 = 50.0000 (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) =					50.0000 / (5) = 0.1441 (8)
Pressure test					Yes
Measured/design AP50					3.9900
Infiltration rate					0.3436 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2921 (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	0.3724	0.3651	0.3578	0.3213	0.3140	0.2775	0.2775	0.2702	0.2921	0.3140	0.3286	0.3432 (22b)
Effective ac	0.5693	0.5666	0.5640	0.5516	0.5493	0.5385	0.5385	0.5365	0.5427	0.5493	0.5540	0.5589 (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
Front Door			2.1200	1.1000	2.3320		(26)
Windows (Uw = 1.20)			22.6500	1.1450	25.9351		(27)
Ground Floor			69.3900	0.1200	8.3268	84.0000	5828.7600 (28a)
Brick and Block	172.9900	24.7700	148.2200	0.2400	35.5728	42.2200	6257.8484 (29a)
Pitched Roof	69.3900		69.3900	0.1000	6.9390	9.1000	631.4490 (30)
Total net area of external elements Aum(A, m ²)			311.7700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	79.1057		(33)
GF Block			61.5800			75.0000	4618.5000 (32c)
GF Stud			44.6900			9.0000	402.2100 (32c)
FF Stud			160.2000			9.0000	1441.8000 (32c)
Internal Floor 1			67.8400			18.0000	1221.1200 (32d)
Internal Ceiling 1			67.8400			18.0000	1221.1200 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21622.8074 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							157.5662 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.9147 (36)
Total fabric heat loss						(33) + (36) =	89.0204 (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	65.1896	64.8814	64.5792	63.1599	62.8944	61.6582	61.6582	61.4293	62.1344	62.8944	63.4316	63.9932 (38)
Heat transfer coeff	154.2100	153.9017	153.5996	152.1803	151.9147	150.6786	150.6786	150.4497	151.1548	151.9147	152.4519	153.0135 (39)
Average = Sum(39)m / 12 =												152.1790 (39)
HLP	1.1237	1.1215	1.1193	1.1089	1.1070	1.0980	1.0980	1.0963	1.1015	1.1070	1.1109	1.1150 (40)
HLP (average)												1.1089 (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												2.9116 (42)
Average daily hot water use (litres/day)												103.3509 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6860	109.5520	105.4179	101.2839	97.1499	93.0158	93.0158	97.1499	101.2839	105.4179	109.5520	113.6860 (44)
Energy conte	168.5931	147.4526	152.1578	132.6549	127.2855	109.8377	101.7808	116.7950	118.1899	137.7389	150.3528	163.2734 (45)
Energy content (annual)										Total = Sum(45)m =		1626.1122 (45)

FULL SAP CALCULATION PRINTOUT

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	25.2890	22.1179	22.8237	19.8982	19.0928	16.4757	15.2671	17.5192	17.7285	20.6608	22.5529	24.4910	(46)
Water storage loss:													
Store volume													215.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.7300 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.9342 (55)
Total storage loss													
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 28.0260													(56)
If cylinder contains dedicated solar storage													
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 28.0260													(57)
Primary loss													(59)
23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 22.5120													
Total heat required for water heating calculated for each month													
220.8157 194.6214 204.3804 183.1929 179.5081 160.3757 154.0034 169.0176 168.7279 189.9615 200.8908 215.4960 (62)													
Solar input													(63)
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 =													
Output from w/h													
220.8157 194.6214 204.3804 183.1929 179.5081 160.3757 154.0034 169.0176 168.7279 189.9615 200.8908 215.4960 (64)													
Total per year (kWh/year) = Sum(64)m =													(64)
2240.9912 (64)													
Heat gains from water heating, kWh/month													
97.8353 86.7630 92.3706 84.5382 84.1005 76.9514 75.6202 80.6124 79.7285 87.5763 90.4227 96.0665 (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	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
28.3123 25.1468 20.4507 15.4825 11.5734 9.7707 10.5576 13.7232 18.4192 23.3874 27.2966 29.0992 (67)													
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
306.2400 309.4178 301.4098 284.3617 262.8416 242.6158 229.1036 225.9258 233.9338 250.9819 272.5020 292.7278 (68)													
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
37.5581 37.5581 37.5581 37.5581 37.5581 37.5581 37.5581 37.5581 37.5581 37.5581 37.5581 37.5581 (69)													
Pumps, fans													(70)
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)													
-116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 (71)													
Water heating gains (Table 5)													
131.4990 129.1116 124.1540 117.4141 113.0383 106.8770 101.6400 108.3500 110.7341 117.7100 125.5871 129.1216 (72)													
Total internal gains													(73)
535.7256 533.3504 515.6887 486.9326 457.1276 428.9377 410.9756 417.6733 432.7614 461.7536 495.0599 520.6229 (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				6.5800	10.6334		0.6300	0.7000	0.7700		21.3830 (74)	
South				14.8100	46.7521		0.6300	0.7000	0.7700		211.6059 (78)	
West				1.2600	19.6403		0.6300	0.7000	0.7700		7.5629 (80)	

Solar gains	240.5518	402.2146	535.2535	646.0050	713.7185	705.7788	681.4874	630.3636	572.9716	439.9915	286.6339	206.8923 (83)
Total gains	776.2774	935.5651	1050.9423	1132.9376	1170.8461	1134.7166	1092.4630	1048.0369	1005.7330	901.7451	781.6938	727.5152 (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	38.9491	39.0271	39.1039	39.4685	39.5375	39.8619	39.8619	39.9225	39.7363	39.5375	39.3982	39.2536	
alpha	3.5966	3.6018	3.6069	3.6312	3.6358	3.6575	3.6575	3.6615	3.6491	3.6358	3.6265	3.6169	
util living area	0.9906	0.9811	0.9637	0.9263	0.8512	0.7174	0.5643	0.6030	0.7989	0.9396	0.9829	0.9925 (86)	
MIT	19.2414	19.4804	19.8163	20.2260	20.5931	20.8527	20.9544	20.9410	20.7655	20.2836	19.6805	19.1962 (87)	
Th 2	19.9815	19.9833	19.9851	19.9935	19.9951	20.0025	20.0025	20.0038	19.9996	19.9951	19.9919	19.9886 (88)	
util rest of house	0.9885	0.9770	0.9554	0.9083	0.8121	0.6409	0.4532	0.4939	0.7354	0.9213	0.9784	0.9909 (89)	
MIT 2	18.3742	18.6124	18.9449	19.3492	19.6927	19.9174	19.9852	19.9797	19.8507	19.4118	18.8192	18.3346 (90)	
Living area fraction									fLA = Living area / (4) =			0.1323 (91)	
MIT	18.4890	18.7273	19.0602	19.4653	19.8119	20.0412	20.1135	20.1069	19.9717	19.5272	18.9331	18.4486 (92)	
Temperature adjustment												0.0000	
adjusted MIT	18.4890	18.7273	19.0602	19.4653	19.8119	20.0412	20.1135	20.1069	19.9717	19.5272	18.9331	18.4486 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.9843 0.9703 0.9458 0.8967 0.8039 0.6442 0.4663 0.5061 0.7334 0.9105 0.9721 0.9873 (94)													
Useful gains	764.1208	907.7650	993.9793	1015.9533	941.2274	731.0136	509.4339	530.3597	737.5910	821.0522	759.8970	718.3059 (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	2188.0803	2128.0404	1929.2388	1607.8252	1232.3100	819.8734	529.4030	557.7095	887.5402	1356.1748	1803.9855	2180.2306 (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	1059.4259	820.0251	695.8331	426.1478	216.5654	0.0000	0.0000	0.0000	0.0000	398.1312	751.7437	1087.6720 (98)	
Space heating												5455.5442 (98)	
Space heating per m2												(98) / (4) = 39.7547 (99)	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	69.3900 (1b)	x 2.3900 (2b)	= 165.8421 (1b) - (3b)
First floor	67.8400 (1c)	x 2.6700 (2c)	= 181.1328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	137.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 346.9749 (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) =	0.1153 (8)	
Pressure test															Yes		
Measured/design AP50															5.0000		
Infiltration rate															0.3653 (18)		
Number of sides sheltered															2 (19)		
Shelter factor										(20) = 1 - [0.075 x (19)] =					0.8500 (20)		
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =					0.3105 (21)		
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
Wind factor	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)					
Adj infilt rate	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)					
	0.3959	0.3881	0.3804	0.3415	0.3338	0.2950	0.2950	0.2872	0.3105	0.3338	0.3493	0.3648 (22b)					
Effective ac	0.5784	0.5753	0.5723	0.5583	0.5557	0.5435	0.5435	0.5412	0.5482	0.5557	0.5610	0.5665 (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					
TER Opaque door			2.1200	1.0000	2.1200		(26)					
TER Opening Type (Uw = 1.40)			22.6500	1.3258	30.0284		(27)					
Ground Floor			69.3900	0.1300	9.0207		(28a)					
Brick and Block	172.9900	24.7700	148.2200	0.1800	26.6796		(29a)					
Pitched Roof	69.3900		69.3900	0.1300	9.0207		(30)					
Total net area of external elements Aum(A, m2)			311.7700				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		76.8694		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.9933 (36)					
Total fabric heat loss						(33) + (36) =	89.8627 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 66.2230	Feb 65.8746	Mar 65.5331	Apr 63.9291	May 63.6290	Jun 62.2319	Jul 62.2319	Aug 61.9732	Sep 62.7701	Oct 63.6290	Nov 64.2361	Dec 64.8708 (38)
Heat transfer coeff	156.0857	155.7373	155.3958	153.7918	153.4917	152.0947	152.0947	151.8359	152.6328	153.4917	154.0988	154.7335 (39)
Average = Sum(39)m / 12 =												153.7904 (39)
HLP	Jan 1.1374	Feb 1.1349	Mar 1.1324	Apr 1.1207	May 1.1185	Jun 1.1083	Jul 1.1083	Aug 1.1064	Sep 1.1122	Oct 1.1185	Nov 1.1229	Dec 1.1275 (40)
HLP (average)												1.1207 (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												2.9116 (42)
Average daily hot water use (litres/day)												103.3509 (43)
Daily hot water use	Jan 113.6860	Feb 109.5520	Mar 105.4179	Apr 101.2839	May 97.1499	Jun 93.0158	Jul 93.0158	Aug 97.1499	Sep 101.2839	Oct 105.4179	Nov 109.5520	Dec 113.6860 (44)
Energy conte	168.5931	147.4526	152.1578	132.6549	127.2855	109.8377	101.7808	116.7950	118.1899	137.7389	150.3528	163.2734 (45)
Energy content (annual)												Total = Sum(45)m = 1626.1122 (45)
Distribution loss (46)m = 0.15 x (45)m												
	25.2890	22.1179	22.8237	19.8982	19.0928	16.4757	15.2671	17.5192	17.7285	20.6608	22.5529	24.4910 (46)
Water storage loss:												
Store volume												215.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7258 (48)
Temperature factor from Table 2b												0.5400 (49)

Enter (49) or (54) in (55)												0.9319 (55)
Total storage loss	28.8896	26.0938	28.8896	27.9576	28.8896	27.9576	28.8896	28.8896	27.9576	28.8896	27.9576	28.8896 (56)
If cylinder contains dedicated solar storage	28.8896	26.0938	28.8896	27.9576	28.8896	27.9576	28.8896	28.8896	27.9576	28.8896	27.9576	28.8896 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	220.7450	194.5575	204.3098	183.1245	179.4375	160.3074	153.9328	168.9469	168.6595	189.8908	200.8224	215.4253 (52)
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	220.7450	194.5575	204.3098	183.1245	179.4375	160.3074	153.9328	168.9469	168.6595	189.8908	200.8224	215.4253 (64)
								Total per year (kWh/year) =	Sum(64)m =			2240.1594 (64)
Heat gains from water heating, kWh/month	97.7788	86.7120	92.3140	84.4835	84.0440	76.8967	75.5637	80.5559	79.6738	87.5197	90.3680	96.0100 (65)

FULL SAP CALCULATION PRINTOUT

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 %)												93.5000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												5774.9955 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1071.4532	823.8539	687.8605	401.5786	179.6392	0.0000	0.0000	0.0000	0.0000	380.3997	754.8158	1100.0199 (98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000 (210)
Space heating fuel (main heating system)	1145.9393	881.1272	735.6797	429.4959	192.1275	0.0000	0.0000	0.0000	0.0000	406.8446	807.2896	1176.4919 (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	220.7450	194.5575	204.3098	183.1245	179.4375	160.3074	153.9328	168.9469	168.6595	189.8908	200.8224	215.4253 (64)
Efficiency of water heater (217)m	88.4735	88.2397	87.8039	86.8527	84.8169	79.8000	79.8000	79.8000	79.8000	86.6322	88.0198	79.8000 (216)
Fuel for water heating, kWh/month	249.5042	220.4876	232.6887	210.8450	211.5588	200.8864	192.8982	211.7129	211.3527	219.1921	228.1558	243.2660 (219)
Water heating fuel used												2632.5485 (219)
Annual totals kWh/year												
Space heating fuel - main system												5774.9955 (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)												500.0046 (232)
Total delivered energy for all uses												8982.5485 (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	5774.9955	0.2160	1247.3990 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2632.5485	0.2160	568.6305 (264)
Space and water heating			1816.0295 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	500.0046	0.5190	259.5024 (268)
Total CO2, kg/m2/year			2114.4569 (272)
Emissions per m2 for space and water heating			13.2335 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			1.8910 (272b)
Emissions per m2 for pumps and fans			0.2836 (272c)
Target Carbon Dioxide Emission Rate (TER) = (13.2335 * 1.00) + 1.8910 + 0.2836, rounded to 2 d.p.			15.4100 (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	69.3900 (1b)	x 2.3900 (2b)	= 165.8421 (1b) - (3b)
First floor	67.8400 (1c)	x 2.6700 (2c)	= 181.1328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	137.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 346.9749 (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) = 0.1153 (8)
Pressure test					Yes
Measured/design AP50					3.9900
Infiltration rate					0.3148 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2676 (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	0.3411	0.3345	0.3278	0.2943	0.2876	0.2542	0.2542	0.2475	0.2676	0.2876	0.3010	0.3144 (22b)
Effective ac	0.5582	0.5559	0.5537	0.5433	0.5414	0.5323	0.5323	0.5306	0.5358	0.5414	0.5453	0.5494 (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
Front Door			2.1200	1.1000	2.3320		(26)
Windows (Uw = 1.20)			22.6500	1.1450	25.9351		(27)
Ground Floor			69.3900	0.1200	8.3268	84.0000	5828.7600 (28a)
Brick and Block	172.9900	24.7700	148.2200	0.2400	35.5728	42.2200	6257.8484 (29a)
Pitched Roof	69.3900		69.3900	0.1000	6.9390	9.1000	631.4490 (30)
Total net area of external elements Aum(A, m ²)			311.7700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	79.1057		(33)
GF Block			61.5800			75.0000	4618.5000 (32c)
GF Stud			44.6900			9.0000	402.2100 (32c)
FF Stud			160.2000			9.0000	1441.8000 (32c)
Internal Floor 1			67.8400			18.0000	1221.1200 (32d)
Internal Ceiling 1			67.8400			9.0000	610.5600 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 21012.2474 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 153.1170 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.9147 (36)
Total fabric heat loss (33) + (36) = 89.0204 (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	63.9137	63.6550	63.4014	62.2102	61.9874	60.9499	60.9499	60.7578	61.3495	61.9874	62.4382	62.9095 (38)
Heat transfer coeff	152.9341	152.6754	152.4218	151.2306	151.0077	149.9703	149.9703	149.7781	150.3699	151.0077	151.4586	151.9299 (39)
Average = Sum(39)m / 12 =												151.2295 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1144	1.1126	1.1107	1.1020	1.1004	1.0928	1.0928	1.0914	1.0958	1.1004	1.1037	1.1071 (40)
HLP (average)												1.1020 (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												2.9116 (42)
Average daily hot water use (litres/day)												103.3509 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	113.6860	109.5520	105.4179	101.2839	97.1499	93.0158	93.0158	97.1499	101.2839	105.4179	109.5520	113.6860 (44)
Energy conte	168.5931	147.4526	152.1578	132.6549	127.2855	109.8377	101.7808	116.7950	118.1899	137.7389	150.3528	163.2734 (45)
Energy content (annual)										Total = Sum(45)m =		1626.1122 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	35.8260	31.3337	32.3335	28.1892	27.0482	23.3405	21.6284	24.8189	25.1153	29.2695	31.9500	34.6956 (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	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.3123	25.1468	20.4507	15.4825	11.5734	9.7707	10.5576	13.7232	18.4192	23.3874	27.2966	29.0992	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	306.2400	309.4178	301.4098	284.3617	262.8416	242.6158	229.1036	225.9258	233.9338	250.9819	272.5020	292.7278	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5581	37.5581	37.5581	37.5581	37.5581	37.5581	37.5581	37.5581	37.5581	37.5581	37.5581	37.5581	(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)	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	(71)
Water heating gains (Table 5)	48.1533	46.6275	43.4591	39.1516	36.3551	32.4174	29.0705	33.3588	34.8824	39.3407	44.3749	46.6339	(72)
Total internal gains	449.3798	447.8663	431.9938	405.6701	377.4443	351.4781	335.4060	339.6820	353.9097	380.3843	410.8478	435.1352	(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					6.5800	10.6334		0.6300	0.7000	0.7700		21.3830 (74)
South					14.8100	46.7521		0.6300	0.7000	0.7700		211.6059 (78)
West					1.2600	19.6403		0.6300	0.7000	0.7700		7.5629 (80)

Solar gains	240.5518	402.2146	535.2535	646.0050	713.7185	705.7788	681.4874	630.3636	572.9716	439.9915	286.6339	206.8923 (83)
Total gains	689.9316	850.0809	967.2473	1051.6751	1091.1628	1057.2569	1016.8934	970.0457	926.8814	820.3758	697.4817	642.0274 (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	38.1650	38.2297	38.2933	38.5949	38.6519	38.9193	38.9193	38.9692	38.8159	38.6519	38.5368	38.4173	
alpha	3.5443	3.5486	3.5529	3.5730	3.5768	3.5946	3.5946	3.5979	3.5877	3.5768	3.5691	3.5612	
util living area	0.9929	0.9848	0.9694	0.9362	0.8680	0.7431	0.5931	0.6344	0.8238	0.9507	0.9869	0.9945	(86)
MIT	19.1387	19.3848	19.7315	20.1553	20.5429	20.8255	20.9432	20.9263	20.7258	20.2097	19.5848	19.0902	(87)
Th 2	19.9891	19.9906	19.9921	19.9992	20.0005	20.0067	20.0067	20.0078	20.0043	20.0005	19.9978	19.9950	(88)
util rest of house	0.9914	0.9815	0.9625	0.9203	0.8322	0.6692	0.4804	0.5248	0.7649	0.9354	0.9836	0.9933	(89)
MIT 2	18.2806	18.5262	18.8700	19.2891	19.6552	19.9032	19.9843	19.9765	19.8253	19.3485	18.7319	18.2368	(90)
Living area fraction	18.3942	18.6398	18.9840	19.4037	19.7727	20.0252	20.1112	20.1022	19.9444	19.4625	18.8448	18.3497	(91)
Temperature adjustment	18.3942	18.6398	18.9840	19.4037	19.7727	20.0252	20.1112	20.1022	19.9444	19.4625	18.8448	18.3497	(92)
adjusted MIT	18.3942	18.6398	18.9840	19.4037	19.7727	20.0252	20.1112	20.1022	19.9444	19.4625	18.8448	18.3497	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	681.6101	829.2408	922.2099	955.6825	897.5951	709.1374	501.5175	520.1206	705.1266	758.6594	682.2689	635.9149	(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	2155.4790	2097.7327	1902.8373	1588.4848	1219.0395	813.6232	526.5731	554.5048	878.8290	1338.3053	1778.8468	2149.7616	(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	1096.5585	852.4265	729.5868	455.6176	239.1546	0.0000	0.0000	0.0000	0.0000	431.2565	789.5361	1126.3019	(98)
Space heating												5720.4386	(98)
Space heating per m2												41.6850	(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	1409.7204	1109.7799	1138.3138	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7674	0.8415	0.8191	0.0000	0.0000	0.0000	0.0000	(101)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1081.7575	933.8947	932.3433	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1357.5072	1307.5676	1255.2718	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	198.5397	278.0127	240.2588	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												716.8112 (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	49.6349	69.5032	60.0647	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												179.2028 (107)
Space cooling per m2												1.3059 (108)
Energy for space heating												41.6850 (99)
Energy for space cooling												1.3059 (108)
Total												42.9909 (109)
Dwelling Fabric Energy Efficiency (DFEE)												43.0 (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	69.3900 (1b)	x 2.3900 (2b)	= 165.8421 (1b) - (3b)
First floor	67.8400 (1c)	x 2.6700 (2c)	= 181.1328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	137.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 346.9749 (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) =	0.1153 (8)	
Pressure test															Yes		
Measured/design AP50															5.0000		
Infiltration rate															0.3653 (18)		
Number of sides sheltered															2 (19)		
Shelter factor										(20) = 1 - [0.075 x (19)] =					0.8500 (20)		
Infiltration rate adjusted to include shelter factor										(21) = (18) x (20) =					0.3105 (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	0.3959	0.3881	0.3804	0.3415	0.3338	0.2950	0.2950	0.2872	0.3105	0.3338	0.3493	0.3648 (22b)					
Effective ac	0.5784	0.5753	0.5723	0.5583	0.5557	0.5435	0.5435	0.5412	0.5482	0.5557	0.5610	0.5665 (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					
TER Opaque door			2.1200	1.0000	2.1200		(26)					
TER Opening Type (Uw = 1.40)			22.6500	1.3258	30.0284		(27)					
Ground Floor			69.3900	0.1300	9.0207		(28a)					
Brick and Block	172.9900	24.7700	148.2200	0.1800	26.6796		(29a)					
Pitched Roof	69.3900		69.3900	0.1300	9.0207		(30)					
Total net area of external elements Aum(A, m2)			311.7700				(31)					
Fabric heat loss, W/K = Sum (A x U)			(26) ... (30) + (32) =		76.8694		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							12.9933 (36)					
Total fabric heat loss						(33) + (36) =	89.8627 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 66.2230	Feb 65.8746	Mar 65.5331	Apr 63.9291	May 63.6290	Jun 62.2319	Jul 62.2319	Aug 61.9732	Sep 62.7701	Oct 63.6290	Nov 64.2361	Dec 64.8708 (38)
Heat transfer coeff	156.0857	155.7373	155.3958	153.7918	153.4917	152.0947	152.0947	151.8359	152.6328	153.4917	154.0988	154.7335 (39)
Average = Sum(39)m / 12 =												153.7904 (39)
HLP	Jan 1.1374	Feb 1.1349	Mar 1.1324	Apr 1.1207	May 1.1185	Jun 1.1083	Jul 1.1083	Aug 1.1064	Sep 1.1122	Oct 1.1185	Nov 1.1229	Dec 1.1275 (40)
HLP (average)												1.1207 (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												2.9116 (42)
Average daily hot water use (litres/day)												103.3509 (43)
Daily hot water use	Jan 113.6860	Feb 109.5520	Mar 105.4179	Apr 101.2839	May 97.1499	Jun 93.0158	Jul 93.0158	Aug 97.1499	Sep 101.2839	Oct 105.4179	Nov 109.5520	Dec 113.6860 (44)
Energy conte	168.5931	147.4526	152.1578	132.6549	127.2855	109.8377	101.7808	116.7950	118.1899	137.7389	150.3528	163.2734 (45)
Energy content (annual)										Total = Sum(45)m =		1626.1122 (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												

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	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	0.0000 (59)
	35.8260	31.3337	32.3335	28.1892	27.0482	23.3405	21.6284	24.8189	25.1153	29.2695	31.9500	34.6956	(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	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	145.5809	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	28.3123	25.1468	20.4507	15.4825	11.5734	9.7707	10.5576	13.7232	18.4192	23.3874	27.2966	29.0992	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	306.2400	309.4178	301.4098	284.3617	262.8416	242.6158	229.1036	225.9258	233.9338	250.9819	272.5020	292.7278	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.5581	37.5581	37.5581	37.5581	37.5581	37.5581	37.5581	37.5581	37.5581	37.5581	37.5581	37.5581	(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)	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	(71)
Water heating gains (Table 5)	48.1533	46.6275	43.4591	39.1516	36.3551	32.4174	29.0705	33.3588	34.8824	39.3407	44.3749	46.6339	(72)
Total internal gains	449.3798	447.8663	431.9938	405.6701	377.4443	351.4781	335.4060	339.6820	353.9097	380.3843	410.8478	435.1352	(73)

6. Solar gains													

[Jan]			Area	Solar flux		g	FF		Access		Gains		
			m2	Table 6a		Specific data	Specific data		factor		W		
				W/m2		or Table 6b	or Table 6c		Table 6d				
North			6.5800	10.6334		0.6300	0.7000		0.7700		21.3830	(74)	
South			14.8100	46.7521		0.6300	0.7000		0.7700		211.6059	(78)	
West			1.2600	19.6403		0.6300	0.7000		0.7700		7.5629	(80)	

Solar gains	240.5518	402.2146	535.2535	646.0050	713.7185	705.7788	681.4874	630.3636	572.9716	439.9915	286.6339	206.8923	(83)
Total gains	689.9316	850.0809	967.2473	1051.6751	1091.1628	1057.2569	1016.8934	970.0457	926.8814	820.3758	697.4817	642.0274	(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	61.0553	61.1919	61.3264	61.9660	62.0871	62.6574	62.6574	62.7642	62.4365	62.0871	61.8425	61.5889	
alpha	5.0704	5.0795	5.0884	5.1311	5.1391	5.1772	5.1772	5.1843	5.1624	5.1391	5.1228	5.1059	
util living area	0.9991	0.9973	0.9922	0.9760	0.9267	0.8016	0.6302	0.6778	0.8862	0.9838	0.9978	0.9994	(86)
MIT	19.6848	19.8611	20.1119	20.4259	20.7134	20.9132	20.9804	20.9717	20.8403	20.4568	20.0055	19.6546	(87)
Th 2	19.9704	19.9725	19.9745	19.9840	19.9858	19.9940	19.9940	19.9956	19.9908	19.9858	19.9822	19.9784	(88)
util rest of house	0.9988	0.9963	0.9893	0.9661	0.8940	0.7169	0.5001	0.5499	0.8247	0.9754	0.9969	0.9992	(89)
MIT 2	18.7653	18.9428	19.1939	19.5102	19.7818	19.9510	19.9887	19.9870	19.8980	19.5449	19.0951	18.7415	(90)
Living area fraction									fLA = Living area / (4) =			0.1323	(91)
MIT	18.8870	19.0643	19.3154	19.6314	19.9051	20.0783	20.1200	20.1173	20.0227	19.6656	19.2156	18.8623	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8870	19.0643	19.3154	19.6314	19.9051	20.0783	20.1200	20.1173	20.0227	19.6656	19.2156	18.8623	(93)

8. Space heating requirement													

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	0.9984	0.9951	0.9868	0.9617	0.8908	0.7249	0.5173	0.5666	0.8271	0.9717	0.9960	0.9989	(94)
Ext temp.	688.8012	845.9519	954.4759	1011.3434	971.9857	766.4143	526.0378	549.6553	766.6031	797.1873	694.6577	641.2963	(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	2276.8251	2205.9138	1991.4547	1650.3964	1259.4095	833.2191	535.3672	564.4179	904.0002	1391.4925	1866.9955	2268.7567	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1181.4898	913.8944	771.5122	460.1181	213.8433	0.0000	0.0000	0.0000	0.0000	442.1630	844.0832	1210.8306	(98)
Space heating												6037.9347	(98)
Space heating per m2										(98) / (4) =		43.9986	(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	1429.6897	1125.5004	1153.9531	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8156	0.8939	0.8714	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1166.1222	1006.1058	1005.5665	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1357.5072	1307.5676	1255.2718	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	137.7972	224.2876	185.7807	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												547.8655	(104)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	34.4493	56.0719	46.4452	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												136.9664 (107)
Space cooling per m2												0.9981 (108)
Energy for space heating												43.9986 (99)
Energy for space cooling												0.9981 (108)
Total												44.9967 (109)
Target Fabric Energy Efficiency (TFEE)												51.7 (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	69.3900 (1b)	x 2.3900 (2b)	= 165.8421 (1b) - (3b)
First floor	67.8400 (1c)	x 2.6700 (2c)	= 181.1328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	137.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 346.9749 (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					5 * 10 = 50.0000 (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) =					50.0000 / (5) = 0.1441 (8)
Pressure test					Yes
Measured/design AP50					3.9900
Infiltration rate					0.3436 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2921 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.7000	4.4000	4.4000	4.0000	4.1000	3.9000	3.9000	3.8000	3.8000	4.1000	4.0000	4.1000 (22)
Wind factor	1.1750	1.1000	1.1000	1.0000	1.0250	0.9750	0.9750	0.9500	0.9500	1.0250	1.0000	1.0250 (22a)
Adj infilt rate	0.3432	0.3213	0.3213	0.2921	0.2994	0.2848	0.2848	0.2775	0.2775	0.2994	0.2921	0.2994 (22b)
Effective ac	0.5589	0.5516	0.5516	0.5427	0.5448	0.5405	0.5405	0.5385	0.5385	0.5448	0.5427	0.5448 (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
Front Door			2.1200	1.1000	2.3320		(26)
Windows (Uw = 1.20)			22.6500	1.1450	25.9351		(27)
Ground Floor			69.3900	0.1200	8.3268	84.0000	5828.7600 (28a)
Brick and Block	172.9900	24.7700	148.2200	0.2400	35.5728	42.2200	6257.8484 (29a)
Pitched Roof	69.3900		69.3900	0.1000	6.9390	9.1000	631.4490 (30)
Total net area of external elements Aum(A, m ²)			311.7700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	79.1057		(33)
GF Block			61.5800			75.0000	4618.5000 (32c)
GF Stud			44.6900			9.0000	402.2100 (32c)
FF Stud			160.2000			9.0000	1441.8000 (32c)
Internal Floor 1			67.8400			18.0000	1221.1200 (32d)
Internal Ceiling 1			67.8400			18.0000	1221.1200 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21622.8074 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							157.5662 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.9147 (36)
Total fabric heat loss						(33) + (36) =	89.0204 (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	63.9932	63.1599	63.1599	62.1344	62.3816	61.8933	61.8933	61.6582	61.6582	62.3816	62.1344	62.3816 (38)
Heat transfer coeff	153.0135	152.1803	152.1803	151.1548	151.4020	150.9136	150.9136	150.6786	150.6786	151.4020	151.1548	151.4020 (39)
Average = Sum(39)m / 12 =												151.4228 (39)
HLP	1.1150	1.1089	1.1089	1.1015	1.1033	1.0997	1.0997	1.0980	1.0980	1.1033	1.1015	1.1033 (40)
HLP (average)												1.1034 (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												2.9116 (42)
Average daily hot water use (litres/day)												103.3509 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6860	109.5520	105.4179	101.2839	97.1499	93.0158	93.0158	97.1499	101.2839	105.4179	109.5520	113.6860 (44)
Energy conte	168.5931	147.4526	152.1578	132.6549	127.2855	109.8377	101.7808	116.7950	118.1899	137.7389	150.3528	163.2734 (45)
Energy content (annual)										Total = Sum(45)m =		1626.1122 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	25.2890	22.1179	22.8237	19.8982	19.0928	16.4757	15.2671	17.5192	17.7285	20.6608	22.5529	24.4910	(46)
Water storage loss:													
Store volume													215.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.7300 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.9342 (55)
Total storage loss													
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 (56)													
If cylinder contains dedicated solar storage													
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 (57)													
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	23.2624	22.5120	(59)
Total heat required for water heating calculated for each month													
220.8157 194.6214 204.3804 183.1929 179.5081 160.3757 154.0034 169.0176 168.7279 189.9615 200.8908 215.4960 (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	220.8157	194.6214	204.3804	183.1929	179.5081	160.3757	154.0034	169.0176	168.7279	189.9615	200.8908	215.4960	(64)
RHI water heating demand													2241 (64)
Heat gains from water heating, kWh/month	97.8353	86.7630	92.3706	84.5382	84.1005	76.9514	75.6202	80.6124	79.7285	87.5763	90.4227	96.0665	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	70.7808	62.8669	51.1268	38.7063	28.9334	24.4268	26.3940	34.3079	46.0480	58.4686	68.2414	72.7480	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	457.0746	461.8176	449.8654	424.4205	392.3009	362.1131	341.9457	337.2027	349.1550	374.5998	406.7194	436.9072	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.3813	55.3813	55.3813	55.3813	55.3813	55.3813	55.3813	55.3813	55.3813	55.3813	55.3813	55.3813	(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)	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	(71)
Water heating gains (Table 5)	131.4990	129.1116	124.1540	117.4141	113.0383	106.8770	101.6400	108.3500	110.7341	117.7100	125.5871	129.1216	(72)
Total internal gains	775.9681	770.4098	741.7598	697.1545	650.8863	610.0305	586.5935	596.4743	622.5507	667.3921	717.1615	755.3905	(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				6.5800	13.4684	0.6300	0.7000	0.7700	27.0841 (74)			
South				14.8100	56.5862	0.6300	0.7000	0.7700	256.1165 (78)			
West				1.2600	25.1733	0.6300	0.7000	0.7700	9.6935 (80)			
Solar gains	292.8941	416.4402	565.1863	689.7526	723.0382	794.2975	735.6186	704.9663	634.7709	491.6344	347.7255	238.5820 (83)
Total gains	1068.8622	1186.8500	1306.9461	1386.9072	1373.9245	1404.3281	1322.2121	1301.4407	1257.3216	1159.0264	1064.8870	993.9725 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	39.2536	39.4685	39.4685	39.7363	39.6714	39.7998	39.7998	39.8619	39.8619	39.6714	39.7363	39.6714	
alpha	3.6169	3.6312	3.6312	3.6491	3.6448	3.6533	3.6533	3.6575	3.6575	3.6448	3.6491	3.6448	
util living area	0.9679	0.9531	0.9182	0.8468	0.7273	0.5187	0.3700	0.3643	0.6103	0.8395	0.9409	0.9733	(86)
MIT	19.7101	19.8745	20.1798	20.5367	20.8074	20.9597	20.9913	20.9920	20.9251	20.6335	20.1457	19.6796	(87)
Th 2	19.9886	19.9935	19.9935	19.9996	19.9982	20.0011	20.0011	20.0025	20.0025	19.9982	19.9996	19.9982	(88)
util rest of house	0.9609	0.9432	0.9008	0.8137	0.6670	0.4281	0.2612	0.2537	0.5216	0.7968	0.9261	0.9674	(89)
MIT 2	18.8424	19.0063	19.3008	19.6394	19.8729	19.9837	19.9992	20.0008	19.9656	19.7316	19.2781	18.8205	(90)
Living area fraction	18.9573	19.1212	19.4172	19.7581	19.9965	20.1128	20.1305	20.1320	20.0925	19.8510	19.3929	18.9342	(91)
MIT	18.9573	19.1212	19.4172	19.7581	19.9965	20.1128	20.1305	20.1320	20.0925	19.8510	19.3929	18.9342	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9573	19.1212	19.4172	19.7581	19.9965	20.1128	20.1305	20.1320	20.0925	19.8510	19.3929	18.9342	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	1017.3914	1106.8696	1161.7713	1115.8430	916.2371	616.0432	364.3352	349.2428	666.6004	915.1102	974.4708	953.5015	(94)
Ext temp.	5.6000	6.0000	7.6000	10.1000	13.1000	15.9000	17.7000	17.8000	15.4000	12.1000	8.6000	5.7000	(96)
Heat loss rate W	2043.8411	1996.7939	1798.3385	1459.8710	1044.1493	635.7753	366.7897	351.3822	707.0654	1173.5141	1631.3936	2003.6836	(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	763.6786	598.0291	473.6059	247.7002	95.1667	0.0000	0.0000	0.0000	0.0000	192.2525	472.9844	781.3355	(98)
Space heating												3624.7529	(98)
RHI space heating demand												3625	(98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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	69.3900 (1b)	x 2.3900 (2b)	= 165.8421 (1b) - (3b)
First floor	67.8400 (1c)	x 2.6700 (2c)	= 181.1328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	137.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 346.9749 (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					5 * 10 = 50.0000 (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)					50.0000 / (5) = 0.1441 (8)
Pressure test					Yes
Measured/design AP50					3.9900
Infiltration rate					0.3436 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2921 (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	0.3724	0.3651	0.3578	0.3213	0.3140	0.2775	0.2775	0.2702	0.2921	0.3140	0.3286	0.3432 (22b)
Effective ac	0.5693	0.5666	0.5640	0.5516	0.5493	0.5385	0.5385	0.5365	0.5427	0.5493	0.5540	0.5589 (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
Front Door			2.1200	1.1000	2.3320		(26)
Windows (Uw = 1.20)			22.6500	1.1450	25.9351		(27)
Ground Floor			69.3900	0.1200	8.3268	84.0000	5828.7600 (28a)
Brick and Block	172.9900	24.7700	148.2200	0.2400	35.5728	42.2200	6257.8484 (29a)
Pitched Roof	69.3900		69.3900	0.1000	6.9390	9.1000	631.4490 (30)
Total net area of external elements Aum(A, m ²)			311.7700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	79.1057		(33)
GF Block			61.5800			75.0000	4618.5000 (32c)
GF Stud			44.6900			9.0000	402.2100 (32c)
FF Stud			160.2000			9.0000	1441.8000 (32c)
Internal Floor 1			67.8400			18.0000	1221.1200 (32d)
Internal Ceiling 1			67.8400			18.0000	1221.1200 (32e)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (Sum(L x Psi) calculated using Appendix K)
Total fabric heat loss
(28)...(30) + (32) + (32a)...(32e) = 21622.8074 (34)
157.5662 (35)
9.9147 (36)
(33) + (36) = 89.0204 (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	65.1896	64.8814	64.5792	63.1599	62.8944	61.6582	61.6582	61.4293	62.1344	62.8944	63.4316	63.9932 (38)
Heat transfer coeff	154.2100	153.9017	153.5996	152.1803	151.9147	150.6786	150.6786	150.4497	151.1548	151.9147	152.4519	153.0135 (39)
Average = Sum(39)m / 12 =												152.1790 (39)
HLP	1.1237	1.1215	1.1193	1.1089	1.1070	1.0980	1.0980	1.0963	1.1015	1.1070	1.1109	1.1150 (40)
HLP (average)												1.1089 (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												2.9116 (42)
Average daily hot water use (litres/day)												103.3509 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6860	109.5520	105.4179	101.2839	97.1499	93.0158	93.0158	97.1499	101.2839	105.4179	109.5520	113.6860 (44)
Energy conte	168.5931	147.4526	152.1578	132.6549	127.2855	109.8377	101.7808	116.7950	118.1899	137.7389	150.3528	163.2734 (45)
Energy content (annual)										Total = Sum(45)m =		1626.1122 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	25.2890	22.1179	22.8237	19.8982	19.0928	16.4757	15.2671	17.5192	17.7285	20.6608	22.5529	24.4910	(46)
Water storage loss:													
Store volume													215.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.7300 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.9342 (55)
Total storage loss													
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 28.0260													(56)
If cylinder contains dedicated solar storage													
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 28.0260													(57)
Primary loss													(59)
23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 22.5120													
Total heat required for water heating calculated for each month													
220.8157 194.6214 204.3804 183.1929 179.5081 160.3757 154.0034 169.0176 168.7279 189.9615 200.8908 215.4960 (62)													
Solar input													(63)
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													
220.8157 194.6214 204.3804 183.1929 179.5081 160.3757 154.0034 169.0176 168.7279 189.9615 200.8908 215.4960 (64)													
Heat gains from water heating, kWh/month													
97.8353 86.7630 92.3706 84.5382 84.1005 76.9514 75.6202 80.6124 79.7285 87.5763 90.4227 96.0665 (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	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
70.7808 62.8669 51.1268 38.7063 28.9334 24.4268 26.3940 34.3079 46.0480 58.4686 68.2414 72.7480 (67)													
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
457.0746 461.8176 449.8654 424.4205 392.3009 362.1131 341.9457 337.2027 349.1550 374.5998 406.7194 436.9072 (68)													
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 (69)													
Pumps, fans													(70)
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)													
-116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 (71)													
Water heating gains (Table 5)													
131.4990 129.1116 124.1540 117.4141 113.0383 106.8770 101.6400 108.3500 110.7341 117.7100 125.5871 129.1216 (72)													
Total internal gains													
775.9681 770.4098 741.7598 697.1545 650.8863 610.0305 586.5935 596.4743 622.5507 667.3921 717.1615 755.3905 (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				6.5800	10.6334		0.6300	0.7000	0.7700		21.3830 (74)	
South				14.8100	46.7521		0.6300	0.7000	0.7700		211.6059 (78)	
West				1.2600	19.6403		0.6300	0.7000	0.7700		7.5629 (80)	

Solar gains	240.5518	402.2146	535.2535	646.0050	713.7185	705.7788	681.4874	630.3636	572.9716	439.9915	286.6339	206.8923 (83)
Total gains	1016.5199	1172.6244	1277.0133	1343.1595	1364.6048	1315.8094	1268.0809	1226.8380	1195.5224	1107.3836	1003.7955	962.2828 (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	38.9491	39.0271	39.1039	39.4685	39.5375	39.8619	39.8619	39.9225	39.7363	39.5375	39.3982	39.2536	
alpha	3.5966	3.6018	3.6069	3.6312	3.6358	3.6575	3.6575	3.6615	3.6491	3.6358	3.6265	3.6169	
util living area													
0.9783 0.9632 0.9378 0.8880 0.7977 0.6507 0.4984 0.5316 0.7284 0.8982 0.9638 0.9819 (86)													
MIT	19.4609	19.6865	19.9964	20.3660	20.6829	20.8941	20.9696	20.9609	20.8315	20.4278	19.8751	19.4136 (87)	
Th 2	19.9815	19.9833	19.9851	19.9935	19.9951	20.0025	20.0025	20.0038	19.9996	19.9951	19.9919	19.9886 (88)	
util rest of house													
0.9738 0.9558 0.9249 0.8636 0.7520 0.5730 0.3954 0.4293 0.6585 0.8712 0.9552 0.9781 (89)													
MIT 2	18.5909	18.8138	19.1174	19.4772	19.7664	19.9436	19.9914	19.9886	19.8973	19.5429	19.0087	18.5496 (90)	
Living area fraction													
fLA = Living area / (4) =													
MIT	18.7060	18.9293	19.2337	19.5948	19.8877	20.0694	20.1208	20.1172	20.0209	19.6600	19.1233	18.6640 (92)	
Temperature adjustment													
adjusted MIT	18.7060	18.9293	19.2337	19.5948	19.8877	20.0694	20.1208	20.1172	20.0209	19.6600	19.1233	18.6640 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.9665 0.9461 0.9132 0.8523 0.7466 0.5787 0.4081 0.4415 0.6602 0.8604 0.9457 0.9716 (94)													
Useful gains	982.4498	1109.3747	1166.2316	1144.8038	1018.7727	761.4000	517.5512	541.6622	789.2412	952.8114	949.2953	934.9550 (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													
2221.5524 2159.1296 1955.8980 1627.5432 1243.8266 824.1238 530.5158 559.2582 894.9776 1376.3408 1832.9792 2213.1835 (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													
921.8923 705.4352 587.5118 347.5724 167.4401 0.0000 0.0000 0.0000 0.0000 315.1059 636.2524 951.0020 (98)													
Space heating													
Space heating per m2													
4632.2122 (98)													
(98) / (4) =													33.7551 (99)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.8000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													5101.5552 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	921.8923	705.4352	587.5118	347.5724	167.4401	0.0000	0.0000	0.0000	0.0000	315.1059	636.2524	951.0020	(98)
Space heating efficiency (main heating system 1)	90.8000	90.8000	90.8000	90.8000	90.8000	0.0000	0.0000	0.0000	0.0000	90.8000	90.8000	90.8000	(210)
Space heating fuel (main heating system)	1015.2999	776.9111	647.0394	382.7889	184.4054	0.0000	0.0000	0.0000	0.0000	347.0329	700.7185	1047.3591	(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	220.8157	194.6214	204.3804	183.1929	179.5081	160.3757	154.0034	169.0176	168.7279	189.9615	200.8908	215.4960	(64)
Efficiency of water heater (217)m	88.5151	88.2509	87.7739	86.7981	84.9301	80.1000	80.1000	80.1000	80.1000	86.4563	87.9797	80.1000	(216)
Fuel for water heating, kWh/month	249.4666	220.5319	232.8489	211.0564	211.3599	200.2194	192.2639	211.0082	210.6465	219.7198	228.3376	243.1872	(219)
Water heating fuel used												2630.6462	(219)
Annual totals kWh/year													
Space heating fuel - main system												5101.5552	(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)												500.0046	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.11 * 1080 * 1.00) =										-958.6179		-958.6179	(233)
Total delivered energy for all uses												7348.5881	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	5101.5552	3.4800	177.5341 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2630.6462	3.4800	91.5465 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	500.0046	13.1900	65.9506 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-958.6179	13.1900	-126.4417 (252)
Total energy cost			338.4820 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)		0.7801 (257)
SAP value	$[(255) \times (256)] / [(4) + 45.0] =$	89.1172
SAP rating (Section 12)		89 (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	5101.5552	0.2160	1101.9359 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2630.6462	0.2160	568.2196 (264)
Space and water heating			1670.1555 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	500.0046	0.5190	259.5024 (268)
Energy saving/generation technologies			
PV Unit	-958.6179	0.5190	-497.5227 (269)
Total kg/year			1471.0602 (272)
CO2 emissions per m2			10.7200 (273)
EI value			89.1828
EI rating			89 (274)
EI band			B

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CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.00) / 0.9080 = 3.833$, stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.00) / 0.9080 = 0.2379$, stars = 4
Water heating energy efficiency	$3.48 / 0.8498 = 4.095$, stars = 4
Water heating environmental impact	$0.216 / 0.8498 = 0.2542$, 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	69.3900 (1b)	x 2.3900 (2b)	= 165.8421 (1b) - (3b)
First floor	67.8400 (1c)	x 2.6700 (2c)	= 181.1328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	137.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 346.9749 (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					5 * 10 = 50.0000 (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) =					50.0000 / (5) = 0.1441 (8)
Pressure test					Yes
Measured/design AP50					3.9900
Infiltration rate					0.3436 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2921 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.7000	4.4000	4.4000	4.0000	4.1000	3.9000	3.9000	3.8000	3.8000	4.1000	4.0000	4.1000 (22)
Wind factor	1.1750	1.1000	1.1000	1.0000	1.0250	0.9750	0.9750	0.9500	0.9500	1.0250	1.0000	1.0250 (22a)
Adj infilt rate												
Effective ac	0.3432	0.3213	0.3213	0.2921	0.2994	0.2848	0.2848	0.2775	0.2775	0.2994	0.2921	0.2994 (22b)
	0.5589	0.5516	0.5516	0.5427	0.5448	0.5405	0.5405	0.5385	0.5385	0.5448	0.5427	0.5448 (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
Front Door			2.1200	1.1000	2.3320		(26)
Windows (Uw = 1.20)			22.6500	1.1450	25.9351		(27)
Ground Floor			69.3900	0.1200	8.3268	84.0000	5828.7600 (28a)
Brick and Block	172.9900	24.7700	148.2200	0.2400	35.5728	42.2200	6257.8484 (29a)
Pitched Roof	69.3900		69.3900	0.1000	6.9390	9.1000	631.4490 (30)
Total net area of external elements Aum(A, m ²)			311.7700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	79.1057		(33)
GF Block			61.5800			75.0000	4618.5000 (32c)
GF Stud			44.6900			9.0000	402.2100 (32c)
FF Stud			160.2000			9.0000	1441.8000 (32c)
Internal Floor 1			67.8400			18.0000	1221.1200 (32d)
Internal Ceiling 1			67.8400			18.0000	1221.1200 (32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 21622.8074 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 157.5662 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.9147 (36)
Total fabric heat loss (33) + (36) = 89.0204 (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	63.9932	63.1599	63.1599	62.1344	62.3816	61.8933	61.8933	61.6582	61.6582	62.3816	62.1344	62.3816 (38)
Heat transfer coeff	153.0135	152.1803	152.1803	151.1548	151.4020	150.9136	150.9136	150.6786	150.6786	151.4020	151.1548	151.4020 (39)
Average = Sum(39)m / 12 =												151.4228 (39)
HLP	1.1150	1.1089	1.1089	1.1015	1.1033	1.0997	1.0997	1.0980	1.0980	1.1033	1.1015	1.1033 (40)
HLP (average)												1.1034 (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												2.9116 (42)
Average daily hot water use (litres/day)												103.3509 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	113.6860	109.5520	105.4179	101.2839	97.1499	93.0158	93.0158	97.1499	101.2839	105.4179	109.5520	113.6860 (44)
Energy conte	168.5931	147.4526	152.1578	132.6549	127.2855	109.8377	101.7808	116.7950	118.1899	137.7389	150.3528	163.2734 (45)
Energy content (annual)										Total = Sum(45)m =		1626.1122 (45)

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Calculation Type: New Build (As Built)

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

Distribution loss (46)m = 0.15 x (45)m	25.2890	22.1179	22.8237	19.8982	19.0928	16.4757	15.2671	17.5192	17.7285	20.6608	22.5529	24.4910	(46)
Water storage loss:													
Store volume													215.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.7300 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													0.9342 (55)
Total storage loss													
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 28.0260													(56)
If cylinder contains dedicated solar storage													
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 28.0260													(57)
Primary loss													(59)
23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 22.5120													
Total heat required for water heating calculated for each month													
220.8157 194.6214 204.3804 183.1929 179.5081 160.3757 154.0034 169.0176 168.7279 189.9615 200.8908 215.4960 (62)													
Solar input													(63)
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 =													
Output from w/h													
220.8157 194.6214 204.3804 183.1929 179.5081 160.3757 154.0034 169.0176 168.7279 189.9615 200.8908 215.4960 (64)													
Total per year (kWh/year) = Sum(64)m =													(64)
2240.9912													
Heat gains from water heating, kWh/month													
97.8353 86.7630 92.3706 84.5382 84.1005 76.9514 75.6202 80.6124 79.7285 87.5763 90.4227 96.0665 (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	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
70.7808 62.8669 51.1268 38.7063 28.9334 24.4268 26.3940 34.3079 46.0480 58.4686 68.2414 72.7480 (67)													
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
457.0746 461.8176 449.8654 424.4205 392.3009 362.1131 341.9457 337.2027 349.1550 374.5998 406.7194 436.9072 (68)													
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 (69)													
Pumps, fans													(70)
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)													
-116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 (71)													
Water heating gains (Table 5)													
131.4990 129.1116 124.1540 117.4141 113.0383 106.8770 101.6400 108.3500 110.7341 117.7100 125.5871 129.1216 (72)													
Total internal gains													(73)
775.9681 770.4098 741.7598 697.1545 650.8863 610.0305 586.5935 596.4743 622.5507 667.3921 717.1615 755.3905 (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					6.5800	13.4684		0.6300	0.7000	0.7700	27.0841 (74)	
South					14.8100	56.5862		0.6300	0.7000	0.7700	256.1165 (78)	
West					1.2600	25.1733		0.6300	0.7000	0.7700	9.6935 (80)	

Solar gains	292.8941	416.4402	565.1863	689.7526	723.0382	794.2975	735.6186	704.9663	634.7709	491.6344	347.7255	238.5820 (83)
Total gains	1068.8622	1186.8500	1306.9461	1386.9072	1373.9245	1404.3281	1322.2121	1301.4407	1257.3216	1159.0264	1064.8870	993.9725 (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	39.2536	39.4685	39.4685	39.7363	39.6714	39.7998	39.7998	39.8619	39.8619	39.6714	39.7363	39.6714	
alpha	3.6169	3.6312	3.6312	3.6491	3.6448	3.6533	3.6533	3.6575	3.6575	3.6448	3.6491	3.6448	
util living area	0.9679	0.9531	0.9182	0.8468	0.7273	0.5187	0.3700	0.3643	0.6103	0.8395	0.9409	0.9733 (86)	
MIT	19.7101	19.8745	20.1798	20.5367	20.8074	20.9597	20.9913	20.9920	20.9251	20.6335	20.1457	19.6796 (87)	
Th 2	19.9886	19.9935	19.9935	19.9996	19.9982	20.0011	20.0011	20.0025	20.0025	19.9982	19.9996	19.9982 (88)	
util rest of house	0.9609	0.9432	0.9008	0.8137	0.6670	0.4281	0.2612	0.2537	0.5216	0.7968	0.9261	0.9674 (89)	
MIT 2	18.8424	19.0063	19.3008	19.6394	19.8729	19.9837	19.9992	20.0008	19.9656	19.7316	19.2781	18.8205 (90)	
Living area fraction									fLA = Living area / (4) =			0.1323 (91)	
MIT	18.9573	19.1212	19.4172	19.7581	19.9965	20.1128	20.1305	20.1320	20.0925	19.8510	19.3929	18.9342 (92)	
Temperature adjustment												0.0000	
adjusted MIT	18.9573	19.1212	19.4172	19.7581	19.9965	20.1128	20.1305	20.1320	20.0925	19.8510	19.3929	18.9342 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.9518 0.9326 0.8889 0.8046 0.6669 0.4387 0.2755 0.2684 0.5302 0.7896 0.9151 0.9593 (94)													
Useful gains	1017.3914	1106.8696	1161.7713	1115.8430	916.2371	616.0432	364.3352	349.2428	666.6004	915.1102	974.4708	953.5015 (95)	
Ext temp.	5.6000	6.0000	7.6000	10.1000	13.1000	15.9000	17.7000	17.8000	15.4000	12.1000	8.6000	5.7000 (96)	
Heat loss rate W	2043.8411	1996.7939	1798.3385	1459.8710	1044.1493	635.7753	366.7897	351.3822	707.0654	1173.5141	1631.3936	2003.6836 (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	763.6786	598.0291	473.6059	247.7002	95.1667	0.0000	0.0000	0.0000	0.0000	192.2525	472.9844	781.3355 (98)	
Space heating												3624.7529 (98)	
Space heating per m2												(98) / (4) =	26.4137 (99)

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Calculation Type: New Build (As Built)

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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 %)													90.8000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													3992.0186 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	763.6786	598.0291	473.6059	247.7002	95.1667	0.0000	0.0000	0.0000	0.0000	192.2525	472.9844	781.3355	(98)
Space heating efficiency (main heating system 1)	90.8000	90.8000	90.8000	90.8000	90.8000	0.0000	0.0000	0.0000	0.0000	90.8000	90.8000	90.8000	(210)
Space heating fuel (main heating system)	841.0557	658.6224	521.5924	272.7976	104.8091	0.0000	0.0000	0.0000	0.0000	211.7318	520.9079	860.5017	(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	220.8157	194.6214	204.3804	183.1929	179.5081	160.3757	154.0034	169.0176	168.7279	189.9615	200.8908	215.4960	(64)
Efficiency of water heater (217)m	88.1586	87.9164	87.2851	85.9204	83.5096	80.1000	80.1000	80.1000	80.1000	85.1470	87.3226	80.1000	(216)
Fuel for water heating, kWh/month	250.4754	221.3709	234.1527	213.2124	214.9551	200.2194	192.2639	211.0082	210.6465	223.0983	230.0559	244.1840	(219)
Water heating fuel used												2645.6427	(219)
Annual totals kWh/year													
Space heating fuel - main system												3992.0186	(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)												500.0046	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.11 * 1206 * 1.00) =										-1070.9371		-1070.9371	(233)
Total delivered energy for all uses												6141.7288	(238)

10a. Fuel costs - using BEDF prices (493)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	3992.0186	3.6300	144.9103 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	2645.6427	3.6300	96.0368 (247)
Pumps and fans for heating	75.0000	19.4400	14.5800 (249)
Energy for lighting	500.0046	19.4400	97.2009 (250)
Additional standing charges			95.0000 (251)
Energy saving/generation technologies			
PV Unit	-1070.9371	19.4400	-208.1902 (252)
Total energy cost			239.5378 (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	3992.0186	0.2160	862.2760 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2645.6427	0.2160	571.4588 (264)
Space and water heating			1433.7348 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	500.0046	0.5190	259.5024 (268)
Energy saving/generation technologies			
PV Unit	-1070.9371	0.5190	-555.8163 (269)
Total kg/year			1176.3459 (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	3992.0186	1.2200	4870.2627 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2645.6427	1.2200	3227.6841 (264)
Space and water heating			8097.9468 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	500.0046	3.0700	1535.0140 (268)
Energy saving/generation technologies			
PV Unit	-1070.9371	3.0700	-3287.7768 (269)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Primary energy kWh/year
Primary energy kWh/m²/year

6575.4340 (272)
47.9154 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 89
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	+ 1.3	-£ 40	-271 kg (23.0%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£40 1.97 kg/m ²	B 90	B 91
Total Savings	£40 1.97 kg/m ²		

Potential energy efficiency rating: B 90
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 493 TEST (31 Mar 2022)
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	£112	£122	-£10
Mains gas	£336	£286	£50
Space heating	£254	£256	-£2
Water heating	£96	£54	£42
Lighting	£97	£97	£0
Generated (PV)	-£208	-£208	£0
Total cost of fuels	£240	£200	£40
Total cost of uses	£239	£199	£40
Delivered energy	45 kWh/m ²	35 kWh/m ²	10 kWh/m ²
Carbon dioxide emissions	1.2 tonnes	0.9 tonnes	0.3 tonnes
CO2 emissions per m ²	9 kg/m ²	7 kg/m ²	2 kg/m ²
Primary energy	48 kWh/m ²	37 kWh/m ²	11 kWh/m ²

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	69.3900 (1b)	x 2.3900 (2b)	= 165.8421 (1b) - (3b)
First floor	67.8400 (1c)	x 2.6700 (2c)	= 181.1328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	137.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 346.9749 (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					5 * 10 = 50.0000 (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) =					50.0000 / (5) = 0.1441 (8)
Pressure test					Yes
Measured/design AP50					3.9900
Infiltration rate					0.3436 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2921 (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	0.3724	0.3651	0.3578	0.3213	0.3140	0.2775	0.2775	0.2702	0.2921	0.3140	0.3286	0.3432 (22b)
Effective ac	0.5693	0.5666	0.5640	0.5516	0.5493	0.5385	0.5385	0.5365	0.5427	0.5493	0.5540	0.5589 (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
Front Door			2.1200	1.1000	2.3320		(26)
Windows (Uw = 1.20)			22.6500	1.1450	25.9351		(27)
Ground Floor			69.3900	0.1200	8.3268	84.0000	5828.7600 (28a)
Brick and Block	172.9900	24.7700	148.2200	0.2400	35.5728	42.2200	6257.8484 (29a)
Pitched Roof	69.3900		69.3900	0.1000	6.9390	9.1000	631.4490 (30)
Total net area of external elements Aum(A, m ²)			311.7700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	79.1057		(33)
GF Block			61.5800			75.0000	4618.5000 (32c)
GF Stud			44.6900			9.0000	402.2100 (32c)
FF Stud			160.2000			9.0000	1441.8000 (32c)
Internal Floor 1			67.8400			18.0000	1221.1200 (32d)
Internal Ceiling 1			67.8400			18.0000	1221.1200 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21622.8074 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							157.5662 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.9147 (36)
Total fabric heat loss						(33) + (36) =	89.0204 (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	65.1896	64.8814	64.5792	63.1599	62.8944	61.6582	61.6582	61.4293	62.1344	62.8944	63.4316	63.9932 (38)
Heat transfer coeff	154.2100	153.9017	153.5996	152.1803	151.9147	150.6786	150.6786	150.4497	151.1548	151.9147	152.4519	153.0135 (39)
Average = Sum(39)m / 12 =												152.1790 (39)
HLP	1.1237	1.1215	1.1193	1.1089	1.1070	1.0980	1.0980	1.0963	1.1015	1.1070	1.1109	1.1150 (40)
HLP (average)												1.1089 (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												2.9116 (42)
Average daily hot water use (litres/day)												103.3509 (43)
Daily hot water use	113.6860	109.5520	105.4179	101.2839	97.1499	93.0158	93.0158	97.1499	101.2839	105.4179	109.5520	113.6860 (44)
Energy conte	168.5931	147.4526	152.1578	132.6549	127.2855	109.8377	101.7808	116.7950	118.1899	137.7389	150.3528	163.2734 (45)
Energy content (annual)										Total = Sum(45)m =		1626.1122 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Distribution loss (46)m = 0.15 x (45)m	25.2890	22.1179	22.8237	19.8982	19.0928	16.4757	15.2671	17.5192	17.7285	20.6608	22.5529	24.4910 (46)
Water storage loss:												
Store volume												215.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7300 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9342 (55)
Total storage loss												
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 (56)												
If cylinder contains dedicated solar storage												
18.8578 17.0329 18.8578 18.2495 18.8578 18.2495 18.8578 18.2495 18.8578 18.2495 18.8578 18.2495 18.8578 (57)												
Primary loss												
23.2624 21.0112 21.8667 15.7584 10.4681 9.9053 10.2355 11.1660 17.1091 21.8667 22.5120 23.2624 (59)												
Total heat required for water heating calculated for each month												
210.7133 185.4966 192.8823 166.6628 156.6114 137.9925 130.8741 146.8187 153.5485 178.4633 191.1143 205.3936 (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												1.1153 (H8)
Utilisation factor												0.5921 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												117.0000 (H13)
Daily hot water demand												103.3509 (H14)
Volume ratio Veff/V												1.1321 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-944.1413 (H17)
Solar input	-27.3782	-45.6864	-77.8091	-104.2796	-128.8286	-126.6590	-124.9852	-109.2002	-85.5257	-58.4040	-32.4745	-22.9109 (63)
Solar input (sum of months) = Sum (63)m =												-944.1413 (63)
Output from w/h												
183.3350 139.8102 115.0732 62.3832 27.7828 11.3335 5.8889 37.6185 68.0228 120.0594 158.6397 182.4827 (64)												
Total per year (kWh/year) = Sum (64)m =												1112.4299 (64)
Heat gains from water heating, kWh/month												
89.7534 79.4632 83.1720 71.3141 65.7831 59.0449 57.1167 62.8533 67.5850 78.3777 82.6015 87.9846 (65)												

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

Metabolic gains (Table 5), Watts												
(66)m	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
70.7808 62.8669 51.1268 38.7063 28.9334 24.4268 26.3940 34.3079 46.0480 58.4686 68.2414 72.7480 (67)												
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
457.0746 461.8176 449.8654 424.4205 392.3009 362.1131 341.9457 337.2027 349.1550 374.5998 406.7194 436.9072 (68)												
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 55.3813 (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)												
-116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 -116.4647 (71)												
Water heating gains (Table 5)												
120.6362 118.2488 111.7904 99.0473 88.4182 82.0067 76.7698 84.4803 93.8681 105.3464 114.7243 118.2588 (72)												
Total internal gains												
765.1053 759.5470 729.3962 678.7877 626.2662 585.1603 561.7232 572.6046 605.6847 655.0285 706.2988 744.5277 (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					6.5800	10.6334	0.6300		0.7000	0.7700		21.3830 (74)
South					14.8100	46.7521	0.6300		0.7000	0.7700		211.6059 (78)
West					1.2600	19.6403	0.6300		0.7000	0.7700		7.5629 (80)
Solar gains	240.5518	402.2146	535.2535	646.0050	713.7185	705.7788	681.4874	630.3636	572.9716	439.9915	286.6339	206.8923 (83)
Total gains	1005.6571	1161.7616	1264.6497	1324.7927	1339.9847	1290.9391	1243.2107	1202.9683	1178.6564	1095.0200	992.9327	951.4200 (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	38.9491	39.0271	39.1039	39.4685	39.5375	39.8619	39.8619	39.9225	39.7363	39.5375	39.3982	39.2536
alpha	3.5966	3.6018	3.6069	3.6312	3.6358	3.6575	3.6575	3.6615	3.6491	3.6358	3.6265	3.6169
util living area												
0.9790 0.9642 0.9394 0.8915 0.8045 0.6595 0.5069 0.5404 0.7346 0.9010 0.9649 0.9825 (86)												
MIT	19.4512	19.6774	19.9871	20.3547	20.6727	20.8892	20.9679	20.9588	20.8265	20.4198	19.8659	19.4037 (87)
Th 2	19.9815	19.9833	19.9851	19.9935	19.9951	20.0025	20.0025	20.0038	19.9996	19.9951	19.9919	19.9886 (88)
util rest of house												
0.9747 0.9569 0.9268 0.8677 0.7596 0.5817 0.4027 0.4370 0.6650 0.8744 0.9566 0.9789 (89)												
MIT 2	18.5814	18.8050	19.1086	19.4670	19.7582	19.9407	19.9907	19.9877	19.8939	19.5358	18.9998	18.5400 (90)
Living area fraction												
MIT	18.6965	18.9204	19.2248	19.5845	19.8792	20.0662	20.1200	20.1162	20.0173	19.6527	19.1145	18.6543 (92)
Temperature adjustment												0.0000
adjusted MIT	18.6965	18.9204	19.2248	19.5845	19.8792	20.0662	20.1200	20.1162	20.0173	19.6527	19.1145	18.6543 (93)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9674	0.9473	0.9152	0.8563	0.7538	0.5871	0.4156	0.4493	0.6664	0.8636	0.9472	0.9725	(94)
Useful gains	972.9183	1100.5555	1157.3731	1134.4572	1010.0181	757.9101	516.6429	540.4761	785.4086	945.6278	940.4924	925.2397	(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	2220.0844	2157.7650	1954.5261	1625.9667	1242.5382	823.6398	530.3915	559.0962	894.4322	1375.2461	1831.6267	2211.6989	(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	927.8915	710.4448	593.0818	353.8868	172.9949	0.0000	0.0000	0.0000	0.0000	319.6361	641.6166	957.1256	(98)
Space heating												4676.6782	(98)
Space heating per m2												34.0791	(99)
												(98) / (4) =	

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.8000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													5150.5267 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	927.8915	710.4448	593.0818	353.8868	172.9949	0.0000	0.0000	0.0000	0.0000	319.6361	641.6166	957.1256	(98)
Space heating efficiency (main heating system 1)	90.8000	90.8000	90.8000	90.8000	90.8000	0.0000	0.0000	0.0000	0.0000	90.8000	90.8000	90.8000	(210)
Space heating fuel (main heating system)	1021.9070	782.4282	653.1738	389.7432	190.5231	0.0000	0.0000	0.0000	0.0000	352.0221	706.6263	1054.1031	(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	183.3350	139.8102	115.0732	62.3832	27.7828	11.3335	5.8889	37.6185	68.0228	120.0594	158.6397	182.4827	(64)
Efficiency of water heater (217)m	88.8420	88.8484	88.8709	89.0179	89.1521	80.1000	80.1000	80.1000	80.1000	87.6046	88.4576	88.8984	(216)
Fuel for water heating, kWh/month	206.3608	157.3582	129.4835	70.0794	31.1634	14.1491	7.3519	46.9644	84.9224	137.0469	179.3400	205.2710	(219)
Water heating fuel used												1269.4909	(219)
Annual totals kWh/year													
Space heating fuel - main system												5150.5267	(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)												500.0046	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.11 * 1080 * 1.00) =										-958.6179		-958.6179	(233)
Total delivered energy for all uses												6086.4043	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5150.5267	3.4800	179.2383	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1269.4909	3.4800	44.1783	(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	500.0046	13.1900	65.9506	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-958.6179	13.1900	-126.4417	(252)
Total energy cost			299.4130	(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] =	0.6901	(257)
SAP value			90.3734	
SAP rating (Section 12)			90	(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	5150.5267	0.2160	1112.5138 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1269.4909	0.2160	274.2100 (264)
Space and water heating			1386.7238 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	500.0046	0.5190	259.5024 (268)
Energy saving/generation technologies			
PV Unit	-958.6179	0.5190	-497.5227 (269)
Total kg/year			1213.5785 (272)
CO2 emissions per m2			8.8400 (273)
EI value			91.0761
EI rating			91 (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	69.3900 (1b)	x 2.3900 (2b)	= 165.8421 (1b) - (3b)
First floor	67.8400 (1c)	x 2.6700 (2c)	= 181.1328 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	137.2300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 346.9749 (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					5 * 10 = 50.0000 (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) =					50.0000 / (5) = 0.1441 (8)
Pressure test					Yes
Measured/design AP50					3.9900
Infiltration rate					0.3436 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.2921 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.7000	4.4000	4.4000	4.0000	4.1000	3.9000	3.9000	3.8000	3.8000	4.1000	4.0000	4.1000 (22)
Wind factor	1.1750	1.1000	1.1000	1.0000	1.0250	0.9750	0.9750	0.9500	0.9500	1.0250	1.0000	1.0250 (22a)
Adj infilt rate	0.3432	0.3213	0.3213	0.2921	0.2994	0.2848	0.2848	0.2775	0.2775	0.2994	0.2921	0.2994 (22b)
Effective ac	0.5589	0.5516	0.5516	0.5427	0.5448	0.5405	0.5405	0.5385	0.5385	0.5448	0.5427	0.5448 (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
Front Door			2.1200	1.1000	2.3320		(26)
Windows (Uw = 1.20)			22.6500	1.1450	25.9351		(27)
Ground Floor			69.3900	0.1200	8.3268	84.0000	5828.7600 (28a)
Brick and Block	172.9900	24.7700	148.2200	0.2400	35.5728	42.2200	6257.8484 (29a)
Pitched Roof	69.3900		69.3900	0.1000	6.9390	9.1000	631.4490 (30)
Total net area of external elements Aum(A, m ²)			311.7700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	79.1057		(33)
GF Block			61.5800			75.0000	4618.5000 (32c)
GF Stud			44.6900			9.0000	402.2100 (32c)
FF Stud			160.2000			9.0000	1441.8000 (32c)
Internal Floor 1			67.8400			18.0000	1221.1200 (32d)
Internal Ceiling 1			67.8400			18.0000	1221.1200 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	21622.8074 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							157.5662 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.9147 (36)
Total fabric heat loss						(33) + (36) =	89.0204 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	63.9932	63.1599	63.1599	62.1344	62.3816	61.8933	61.8933	61.6582	61.6582	62.3816	62.1344	62.3816 (38)
Average = Sum(39)m / 12 =	153.0135	152.1803	152.1803	151.1548	151.4020	150.9136	150.9136	150.6786	150.6786	151.4020	151.1548	151.4020 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1150	1.1089	1.1089	1.1015	1.1033	1.0997	1.0997	1.0980	1.0980	1.1033	1.1015	1.1033 (40)
HLP (average)												1.1034 (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												2.9116 (42)
Average daily hot water use (litres/day)												103.3509 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	113.6860	109.5520	105.4179	101.2839	97.1499	93.0158	93.0158	97.1499	101.2839	105.4179	109.5520	113.6860 (44)
Energy conte	168.5931	147.4526	152.1578	132.6549	127.2855	109.8377	101.7808	116.7950	118.1899	137.7389	150.3528	163.2734 (45)
Energy content (annual)										Total = Sum(45)m =		1626.1122 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

Distribution loss (46)m = 0.15 x (45)m	25.2890	22.1179	22.8237	19.8982	19.0928	16.4757	15.2671	17.5192	17.7285	20.6608	22.5529	24.4910 (46)
Water storage loss:												
Store volume												215.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7300 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9342 (55)
Total storage loss												
28.9602 26.1576 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 28.0260 28.9602 28.0260 28.9602 28.9602 (56)												
If cylinder contains dedicated solar storage												
18.8578 17.0329 18.8578 18.2495 18.8578 18.2495 18.8578 18.2495 18.8578 18.2495 18.8578 18.2495 18.8578 (57)												
Primary loss												
23.2624 21.0112 21.8667 15.7584 10.4681 9.9053 10.2355 11.1660 17.1091 21.8667 22.5120 23.2624 (59)												
Total heat required for water heating calculated for each month												
210.7133 185.4966 192.8823 166.6628 156.6114 137.9925 130.8741 146.8187 153.5485 178.4633 191.1143 205.3936 (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												1206.0102 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2026.0972 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.2460 (H8)
Utilisation factor												0.5518 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												117.0000 (H13)
Daily hot water demand												103.3509 (H14)
Volume ratio Veff/V												1.1321 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-983.1046 (H17)
Solar input	-32.0800	-45.6213	-79.1647	-106.4899	-123.7484	-134.6024	-127.6236	-116.3804	-91.0906	-62.9586	-37.9433	-25.4014 (63)
Solar input (sum of months) = Sum (63)m =												-983.1046 (63)
Output from w/h												
178.6333 139.8753 113.7176 60.1729 32.8630 3.3901 3.2505 30.4384 62.4578 115.5048 153.1710 179.9922 (64)												
Total per year (kWh/year) = Sum (64)m =												1073.4667 (64)
Heat gains from water heating, kWh/month												
89.7534 79.4632 83.1720 71.3141 65.7831 59.0449 57.1167 62.8533 67.5850 78.3777 82.6015 87.9846 (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	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970	174.6970 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	70.7808	62.8669	51.1268	38.7063	28.9334	24.4268	26.3940	34.3079	46.0480	58.4686	68.2414	72.7480 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	457.0746	461.8176	449.8654	424.4205	392.3009	362.1131	341.9457	337.2027	349.1550	374.5998	406.7194	436.9072 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.3813	55.3813	55.3813	55.3813	55.3813	55.3813	55.3813	55.3813	55.3813	55.3813	55.3813	55.3813 (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)	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647	-116.4647 (71)
Water heating gains (Table 5)	120.6362	118.2488	111.7904	99.0473	88.4182	82.0067	76.7698	84.4803	93.8681	105.3464	114.7243	118.2588 (72)
Total internal gains	765.1053	759.5470	729.3962	678.7877	626.2662	585.1603	561.7232	572.6046	605.6847	655.0285	706.2988	744.5277 (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					6.5800	13.4684	0.6300	0.7000	0.7700	27.0841 (74)		
South					14.8100	56.5862	0.6300	0.7000	0.7700	256.1165 (78)		
West					1.2600	25.1733	0.6300	0.7000	0.7700	9.6935 (80)		

Solar gains	292.8941	416.4402	565.1863	689.7526	723.0382	794.2975	735.6186	704.9663	634.7709	491.6344	347.7255	238.5820 (83)
Total gains	1057.9994	1175.9872	1294.5825	1368.5404	1349.3044	1379.4578	1297.3418	1277.5709	1240.4556	1146.6629	1054.0242	983.1097 (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	39.2536	39.4685	39.4685	39.7363	39.6714	39.7998	39.7998	39.8619	39.6714	39.7363	39.6714	39.6714	(86)
alpha	3.6169	3.6312	3.6312	3.6491	3.6448	3.6533	3.6533	3.6575	3.6448	3.6491	3.6448	3.6448	(87)
util living area	0.9688	0.9543	0.9201	0.8511	0.7351	0.5266	0.3766	0.3707	0.6165	0.8431	0.9425	0.9742	(88)
MIT	19.7008	19.8658	20.1712	20.5272	20.8002	20.9577	20.9908	20.9916	20.9225	20.6273	20.1374	19.6701	(89)
Th 2	19.9886	19.9935	19.9935	19.9996	19.9982	20.0011	20.0011	20.0025	20.0025	19.9982	19.9996	19.9982	(90)
util rest of house	0.9620	0.9446	0.9031	0.8185	0.6752	0.4351	0.2661	0.2584	0.5276	0.8009	0.9281	0.9685	(91)
MIT 2	18.8334	18.9979	19.2928	19.6312	19.8676	19.9827	19.9990	20.0007	19.9642	19.7266	19.2702	18.8112	(92)
Living area fraction	18.9482	19.1128	19.4090	19.7498	19.9910	20.1118	20.1303	20.1318	20.0910	19.8458	19.3850	18.9249	(93)
MIT	18.9482	19.1128	19.4090	19.7498	19.9910	20.1118	20.1303	20.1318	20.0910	19.8458	19.3850	18.9249	(94)
Temperature adjustment													
adjusted MIT	18.9482	19.1128	19.4090	19.7498	19.9910	20.1118	20.1303	20.1318	20.0910	19.8458	19.3850	18.9249	(95)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Built)

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

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9531	0.9341	0.8912	0.8092	0.6747	0.4457	0.2807	0.2732	0.5360	0.7934	0.9171	0.9605	(94)
Useful gains	1008.3797	1098.5001	1153.7260	1107.4026	910.3998	614.8371	364.1519	349.0860	664.9129	909.7994	966.6501	944.2379	(95)
Ext temp.	5.6000	6.0000	7.6000	10.1000	13.1000	15.9000	17.7000	17.8000	15.4000	12.1000	8.6000	5.7000	(96)
Heat loss rate W	2042.4545	1995.5073	1797.1039	1458.6091	1043.3158	635.6113	366.7631	351.3592	706.8335	1172.7234	1630.1970	2002.2721	(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	769.3516	602.7888	478.6731	252.8687	98.8895	0.0000	0.0000	0.0000	0.0000	195.6154	477.7538	787.1774	(98)
Space heating												3663.1184	(98)
Space heating per m2												26.6933	(99)
												(98) / (4) =	

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													90.8000 (206)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement													4034.2714 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	769.3516	602.7888	478.6731	252.8687	98.8895	0.0000	0.0000	0.0000	0.0000	195.6154	477.7538	787.1774	(98)
Space heating efficiency (main heating system 1)	90.8000	90.8000	90.8000	90.8000	90.8000	0.0000	0.0000	0.0000	0.0000	90.8000	90.8000	90.8000	(210)
Space heating fuel (main heating system)	847.3036	663.8643	527.1730	278.4898	108.9091	0.0000	0.0000	0.0000	0.0000	215.4355	526.1606	866.9355	(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	178.6333	139.8753	113.7176	60.1729	32.8630	3.3901	3.2505	30.4384	62.4578	115.5048	153.1710	179.9922	(64)
Efficiency of water heater (217)m	88.5705	88.5716	88.5298	88.5269	87.8721	80.1000	80.1000	80.1000	80.1000	86.5097	87.9478	88.5975	(216)
Fuel for water heating, kWh/month	201.6848	157.9234	128.4512	67.9713	37.3986	4.2323	4.0580	38.0004	77.9748	133.5165	174.1612	203.1573	(219)
Water heating fuel used												1228.5299	(219)
Annual totals kWh/year													
Space heating fuel - main system												4034.2714	(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)												500.0046	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.11 * 1206 * 1.00) =										-1070.9371		-1070.9371	(233)
Total delivered energy for all uses												4816.8688	(238)

10a. Fuel costs - using BEDF prices (493)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4034.2714	3.6300	146.4441	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1228.5299	3.6300	44.5956	(247)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Pump for solar water heating	50.0000	19.4400	9.7200	(249)
Energy for lighting	500.0046	19.4400	97.2009	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-1070.9371	19.4400	-208.1902	(252)
Total energy cost			199.3504	(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	4034.2714	0.2160	871.4026	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1228.5299	0.2160	265.3625	(264)
Space and water heating			1136.7651	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	500.0046	0.5190	259.5024	(268)

FULL SAP CALCULATION PRINTOUT

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

Energy saving/generation technologies			
PV Unit	-1070.9371	0.5190	-555.8163 (269)
Total kg/year			905.3261 (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	4034.2714	1.2200	4921.8111 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	1228.5299	1.2200	1498.8065 (264)
Space and water heating			6420.6176 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	500.0046	3.0700	1535.0140 (268)
Energy saving/generation technologies			
PV Unit	-1070.9371	3.0700	-3287.7768 (269)
Primary energy kWh/year			5051.6047 (272)
Primary energy kWh/m2/year			36.8112 (273)

U-VALUE CALCULATOR REPORT

Property Reference	SAP 0647 Plot 10	Issued on Date	09/05/2022
Assessment Reference	As Built	Prop Type Ref	Kh
Project	10 Oram Way, West End, Southampton, SO30 3JW		
Calculation Type	New Build (As Built)		

SAP Rating	89 B	DER	12.13	TER	15.41
Environmental	89 B	% DER<TER	21.28		
CO ₂ Emissions (t/year)	1.18	DFEE	42.99	TFEE	51.75
General Requirements Compliance	Pass	% DFEE<TFEE	16.92		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	Assessor ID	E477-0001
Client	Foreman Homes, FORE		

Building Elements

Roof 000002 - Mineral Wool between and above

Roof Type: Pitched Roof, insulated flat ceiling

Layer	Description	Thickness (mm)	Conductivity (W/m ² K)	Resistance (m ² K/W)	Fraction (%)	Density (kg/m ³)	Heat Cap. (J/kgK)
Ext surface				0.0400			
Layer 1	Earthwool Loft Roll 40						
	Main construction	150	0.0400	3.7500	100.00		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 2	Earthwool Loft Roll 40						
	Main construction	200	0.0400	5.0000	100.00		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 3	Earthwool Loft Roll 40						
	Main construction	100	0.0400	2.5000	87.50		
	Main construction	100	0.1300	0.7692	12.50		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 4	Plasterboard, standard						
	Main construction	12.5	0.2100	0.0595	100.00	700	1000
Int surface				0.1000			

Total resistance:	Upper limit = 11.200 m ² K/W	Lower limit = 10.901 m ² K/W	Average = 11.050 m ² K/W
	Total correction = 0.0065 m ² K/W	U-value (unrounded) = 0.1 W/m ² K	

Unheated space: None

Total thickness: 463 mm

U-value: 0.10 W/m² K

Kappa: 9.10 kJ/m² K

U-VALUE CALCULATOR REPORT

Property Reference	SAP 0647 Plot 10	Issued on Date	09/05/2022
Assessment Reference	As Built	Prop Type Ref	Kh
Project	10 Oram Way, West End, Southampton, SO30 3JW		
Calculation Type	New Build (As Built)		

SAP Rating	89 B	DER	12.13	TER	15.41
Environmental	89 B	% DER<TER	21.28		
CO ₂ Emissions (t/year)	1.18	DFEE	42.99	TFEE	51.75
General Requirements Compliance	Pass	% DFEE<TFEE	16.92		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	Assessor ID	E477-0001
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Client	Foreman Homes, FORE
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Building Elements

Wall 000001

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/m ² K)	Resistance (m ² K/W)	Fraction (%)	Density (kg/m ³)	Heat Cap. (J/kgK)
Ext surface				0.0400			
Layer 1	Brick, outer leaf						
	Main construction	102	0.7700	0.1325	82.81		
	Main construction	102	0.9407	0.1084	17.19		
Layer 2	Supafil 34						
	Main construction	100	0.0340	2.9412	100.00		
	Corrections - Air Gap: Level 0, Fasteners: None or plastic						
Layer 3	Supabloc						
	Main construction	100	0.1100	0.9091	94.04	460	1000
	Main construction	100	0.8803	0.1136	5.96	460	1000
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 4	airspace/plaster dabs						
	Main construction	15	0.0882	0.1700	80.00		
	Main construction	15	0.0882	0.1700	20.00		
	Corrections - Cavity Unventilated, Emissivity: Normal						
Layer 5	Plasterboard, standard						
	Main construction	12.5	0.2100	0.0595	100.00	700	1000
Int surface				0.1300			

Total resistance:	Upper limit = 4.321 m ² K/W	Lower limit = 4.110 m ² K/W	Average = 4.215 m ² K/W
	Total correction = 0.0002 m ² K/W	U-value (unrounded) = 0.24 W/m ² K	

Unheated space: None		
Total thickness: 330 mm	U-value: 0.24 W/m² K	Kappa: 42.22 kJ/m² K

U-VALUE CALCULATOR REPORT

Property Reference	SAP 0647 Plot 10	Issued on Date	09/05/2022
Assessment Reference	As Built	Prop Type Ref	Kh
Project	10 Oram Way, West End, Southampton, SO30 3JW		
Calculation Type	New Build (As Built)		

SAP Rating	89 B	DER	12.13	TER	15.41
Environmental	89 B	% DER<TER	21.28		
CO ₂ Emissions (t/year)	1.18	DFEE	42.99	TFEE	51.75
General Requirements Compliance	Pass	% DFEE<TFEE	16.92		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	Assessor ID	E477-0001
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Client	Foreman Homes, FORE
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Building Elements

Floor 000003 - Worst Case Slab

Floor Type: Slab On Ground Floor

Area = 69.39 m², Perimeter = 35.55 m, Wall thickness = 275.00 mm, Soil: Unknown

Horizontal edge insulation: none

Vertical edge insulation: none

Layer	Description	Thickness (mm)	Conductivity (W/m ² K)	Resistance (m ² K/W)	Fraction (%)	Density (kg/m ³)	Heat Cap. (J/kgK)
Ext surface				0.0400			
Layer 1	Concrete, medium density						
	Main construction	100	1.3500	0.0741	100.00		
Layer 2	Polythene, 1000 gauge						
	Main construction	0.5	0.0000	0.0000	100.00		
Layer 3	Celotex XR4000						
	Main construction	150	0.0220	6.8182	100.00		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 4	Polythene, 500 gauge						
	Main construction	0.5	0.0000	0.0000	100.00		
Layer 5	Screed						
	Main construction	70	1.1500	0.0609	100.00	1200	1000
Int surface				0.1700			

Total resistance: Upper limit = 6.953 m² K/W Lower limit = 6.953 m² K/W Average = 6.953 m² K/W

Total correction = 0.0096 m² K/W

U-value (unrounded) = 0.12 W/m² K

Unheated space: None

Total thickness: 321 mm

U-value: 0.12 W/m² K

Kappa: 84.00 kJ/m² K

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Built)

Property Reference	SAP 0647 Plot 10	Issued on Date	09/05/2022
Assessment Reference	As Built	Prop Type Ref	Kh
Property	10 Oram Way, West End, Southampton, SO30 3JW		
SAP Rating	89 B	DER	12.13
Environmental	89 B	TER	15.41
CO ₂ Emissions (t/year)	1.18	% DER<TER	21.28
General Requirements Compliance	Pass	DFEE	42.99
		TFEE	51.75
		% DFEE<TFEE	16.92
Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com		Assessor ID
			E477-0001
Client	Foreman Homes, FORE		

SUMMARY FOR INPUT DATA FOR: New Build (As Built)

Orientation	North
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Suburban
1.0 Property Type	House, Detached
2.0 Number of Storeys	2
3.0 Date Built	2020
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
	Ground Floor: 35.55 m	69.39 m ²	2.39 m
	1st Storey: 32.97 m	67.84 m ²	2.67 m

7.0 Living Area	18.16	m ²
8.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	157.57	kJ/m ² K

9.0 External Walls			U-Value (W/m ² K)	Kappa (kJ/m ² K)	Gross Area (m ²)	Nett Area (m ²)
Description	Type	Construction				
Brick and Block	Cavity Wall	Other	0.24	42.22	172.99	148.22

9.1 Party Walls			U-Value (W/m ² K)	Kappa (kJ/m ² K)	Area (m ²)
Description	Type	Construction			
		Single plasterboard on dabs on both sides, dense blocks, cavity or cavity fill		70.00	

9.2 Internal Walls			Kappa (kJ/m ² K)	Area (m ²)
Description	Construction			
GF Block	Dense block, plasterboard on dabs		75.00	61.58
GF Stud	Plasterboard on timber frame		9.00	44.69
FF Stud	Plasterboard on timber frame		9.00	160.20

10.0 External Roofs			U-Value (W/m ² K)	Kappa (kJ/m ² K)	Gross Area (m ²)	Nett Area (m ²)
Description	Type	Construction				
Pitched Roof	External Plane Roof	Other	0.10	9.10	69.39	69.39

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Built)

10.2 Internal Ceilings

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Ceiling 1	Plasterboard ceiling, carpeted chipboard floor	9.00	67.84

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Ground Floor	Ground Floor - Solid	Other	0.12	84.00	69.39

11.2 Internal Floors

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor 1	Plasterboard ceiling, carpeted chipboard floor	18.00	67.84

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Front Door	Manufacturer	Solid Door							1.10
Windows	Manufacturer	Window	Double Low-E Soft 0.1			0.63		0.70	1.20

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
Front Door	Solid Door	[1] Brick and Block	North							2.12	
Front Shaded	Window	[1] Brick and Block	North	None	0.46	Yes				0.84	
Front Elevation	Window	[1] Brick and Block	North	None	0.00					5.74	
Side Elevation	Window	[1] Brick and Block	West	None	0.00					1.26	
Rear Elevation	Window	[1] Brick and Block	South	None	0.00					14.81	

14.0 Conservatory

None

15.0 Draught Proofing

100 %

16.0 Draught Lobby

No

17.0 Thermal Bridging

Calculate Bridges

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported	Reference:
Independently assessed	E2 Other lintels (including other steel lintels)	0.63	0.093	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	2.75	0.070	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	7.20	0.067	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	2.92	0.070	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	2.77	0.059	No	Birtley Supatherm
Independently assessed	E3 Sill	10.58	0.021	No	Knauf P5
Independently assessed	E4 Jamb	36.60	0.016	No	Knauf P6
Table K1 - Approved	E5 Ground floor (normal)	35.55	0.160	No	
Independently assessed	E6 Intermediate floor within a dwelling	32.97	0.000	No	CD0029
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	20.52	0.060	No	
Independently assessed	E12 Gable (insulation at ceiling level)	18.06	0.044	No	Knauf P21
Independently assessed	E16 Corner (normal)	29.74	0.039	No	Knauf P23
Independently assessed	E17 Corner (inverted – internal area greater than external area)	9.54	-0.091	No	Knauf P24

Y-value 0.032 W/m²K

18.0 Pressure Testing

Designed AP ₅₀	Yes	
Property Tested ?	5.00	m³/(h.m²) @ 50 Pa
As Built AP ₅₀	Yes	
	3.99	m³/(h.m²) @ 50 Pa

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Built)

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows half open
Cross ventilation possible	Yes
Night Ventilation	Yes
Air change rate	4.00

Mechanical Ventilation

Mechanical Ventilation System Present	No
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20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0		0	0
Number of open flues	0		0	0
Number of intermittent fans				5
Number of passive vents				0
Number of flueless gas fires				0

21.0 Fixed Cooling System

No

22.0 Lighting

Internal

Total number of light fittings	28	
Total number of L.E.L. fittings	28	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	Yes
Light and motion sensor	Yes

23.0 Electricity Tariff

Standard

24.0 Main Heating 1

0 Main Heating 1	Database	
Description	Gas Combi	
Percentage of Heat	100	%
Database Ref. No.	18912	
Fuel Type	Mains gas	
Main Heating	BGB	
SAP Code	102	
In Winter	90.8	
In Summer	80.1	
Controls	CBE Programmer, room thermostat and TRVs	
PCDF Controls	0	
Delayed Start Stat	No	
Sap Code	2106	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
Flow Temperature	Normal (> 45°C)	

25.0 Main Heating 2

None

SUMMARY FOR INPUT DATA

Calculation Type: New Build (As Built)

Community Heating	None			
28.0 Water Heating	HWP From main heating 1			
Water Heating	Main Heating 1			
Flue Gas Heat Recovery System	No			
Waste Water Heat Recovery Instantaneous System 1	No			
Waste Water Heat Recovery Instantaneous System 2	No			
Waste Water Heat Recovery Storage System	No			
Solar Panel	No			
Water use <= 125 litres/person/day	Yes			
SAP Code	901			
29.0 Hot Water Cylinder	Hot Water Cylinder			
Cylinder Stat	Yes			
Cylinder In Heated Space	Yes			
Independent Time Control	Yes			
Insulation Type	Measured Loss			
Cylinder Volume	215.00	L		
Loss	1.73	kWh/day		
Pipes insulation	Fully insulated primary pipework			
31.0 Thermal Store	None			
32.0 Photovoltaic Unit	One Dwelling			
PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
1.11	South	30°	None Or Little	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental Impact
Solar water heating	£4,000 - £6,000	£40	B 90	